BHUTAN NATIONAL HUMAN DEVELOPMENT REPORT **2011**

Sustaining progress: Rising to the climate challenge

Bhutanese traditional art depicting nature.

BHUTAN NATIONAL HUMAN DEVELOPMENT REPORT **2011**

Sustaining Progress: Rising to the Climate Challenge

Royal Government of Bhutan
ISBN : 978 - 99936 - 55 - 00 - 8

Contents

Foreword

Bhutan's Human Development Report 2011 "Sustaining Progress: Rising to the Climate Challenge" explores the linkages between climate change and human development in Bhutan.

In Bhutan, conservation of the environment and protection of tradition and culture are integral for enhancing the collective happiness of the Bhutanese people, and economic development only serves as a means of achieving that aspiration. The Constitution of the Kingdom of Bhutan mandates the maintenance of "60 per cent forest cover for all times to come" and already, 51.4 per cent of the total land area is placed under a protected area and biological corridor system. Of these conservation areas, the Northern Forest Complex, which covers 28 per cent of the forest cover, has been labelled the Green Jewel for its rich biodiversity. The complex provides essential ecosystem services to the region and is home to glacial lakes which are the source of the country's major rivers that feed the hydropower plants currently generating 40 per cent of the national revenue. These rivers also feed into the major river systems in India and the broader region, interconnecting Bhutan with its neighbours.

At the same time, during the past decade, as a result of massive investment in the hydropower sector and enormous expansion in the economic and social infrastructure, Bhutan enjoyed a sustained economic growth of over 8 per cent. Notably, this economic growth occurred in a highly sustainable manner with minimal impact on the natural and cultural environments. Bhutan's gross domestic product also more than tripled in less than a decade from Nu 20 billion in 2001 to Nu 61 billion in 2009. Inflation over the period on average remained below 6 per cent. The country also moved from a low to a medium human development ranked country due to a significant scaling up of its human development indicators. Bhutan's human development index value has been rising steadily with the 2008 human development index value assessed at 0.627 compared to 0.599 in 2005.

These human development index gains have come not only from growth in real income but accrued as a result of across-the-board improvements in social indicators such as poverty reduction, expanded educational enrolments, impressive declines in child and maternal mortality and securing high access levels in the provisioning of water and sanitation facilities. Most significantly, Bhutan witnessed momentous socio-political change during the implementation of the Tenth Five Year Plan, particularly the adoption of the Constitution and the introduction of parliamentary democracy in 2008.

Bhutan has always acted as a responsible member of the global society and given environmental stewardship utmost priority. During the 2009 United Nations Framework Convention on Climate Change's 15th Session of Conference of Parties (COP15) in Copenhagen, the Royal Government of Bhutan committed to ensuring that the country's emissions do not exceed the sequestration capacity of its forests. To this end, Bhutan has adopted a green economic development policy in addition to strengthening further the protection of its forests. In terms of the climate change policy framework, Bhutan is taking necessary steps to formulate national strategies on climate change including both adaptation and mitigation. We also recognize the need to be prepared to mitigate and/or prevent the risks of climate change through greater promotion and use of renewable energy and clean technology as the country sustains its robust growth. The country's efforts alone are not enough, however, and there is a need for both regional and global support to help it cope

with the adverse impacts of climate change. Support from the international community is required for not only maintaining the current levels of achievement in human development but also in building the resilience of the Bhutanese people to the adverse impacts of climate change. Therefore, new and additional resources to address the full incremental cost of tackling climate change will be crucial to alleviate its impact on the well-being of the Bhutanese people.

At the national level, it is envisaged that the Bhutan Human Development Report 2011 will facilitate the mainstreaming of climate change issues into development policies and programmes so that they are addressed in a more holistic manner. The Report is also intended to reaffirm Bhutan's commitment to remain carbon neutral and to encourage private sector participation in meeting this commitment.

Lastly, on behalf of the Royal Government of Bhutan, I would like to extend our appreciation to the United Nations Development Programme and its Country Office in Bhutan for the extensive assistance and cooperation provided in the preparation and publication of this report. We would also like to extend our deep appreciation to the National Technical Committee for their guidance and valuable inputs in the preparation of this report.

Karma Tshiteem
Secretary,
Gross National Happiness Commission.

Acknowledgements

This Report was prepared with the overall guidance and support of the Gross National Happiness Commission (GNHC) Secretariat, Royal Government of Bhutan under the leadership of Honourable Secretary, Mr. Karma Tshiteem. Mr. Sangay Dorji, Perspective Planning Division, GNHC; Mr. Lhaba Tshering, Sustainable Development Secretariat, GNHC; and Ms. Fumie Arimizu, Poverty Reduction and Millennium Development Goals Unit, UNDP Bhutan were the main focal persons at various stages of the National Human Development Report preparation process. The core authors of the Report, led by the principal national consultant, Mr. Tandi Dorji and an international consultant, Mr. Christopher Kuonqui, included Mr. Sangay Tempa, Statistician; and Mr. Chheki Wangchuk and Ms. Tshering Lhamtshok, Climate Change Adaptation Writers from the Institute for Management Studies. Christopher Kuonqui was earlier involved in producing the Concept Note for the Report, containing the research framework and annotated chapter outlines, which guided the Report preparation.

Valuable advice, comments and inputs were received from the staff of the UNDP Country Office in Bhutan, including Mr. Yeshey Penjor, Ms. Dorji Choden, Mr. Bakhodir Burkhanov, Mr. Karma L. Rapten and Ms. Claire Van der Vaeren. UNDP intern, Mr. Andres Valenciano, provided research support.

The report benefited from extensive support, comments and suggestions provided by the Human Development Report Unit in the UNDP Asia-Pacific Regional Centre (initially from Colombo, subsequently out of Bangkok), especially Mr. Bishwa Nath Tiwari, Mr. Niranjan Sarangi, Ms. Elena Borsatti, Ms. Rohini Kohli, Mr. Omar Siddique, Ms. Caroline Borchard, Ms. Susan Wong and Ms. Anuradha Rajivan. A comprehensive review of the report was also conducted and many useful insights provided by Ms. Paola Pagliani, Ms. Shital Beejadhur, Ms. Subhra Bhattacharjee of the UNDP Human Development Report Office in New York, facilitated by Ms. Mary Ann Mwangi. A peer reviewer, Mr. Arunabha Ghosh, provided additional comments for the chapter on mitigation and adaptation.

A Technical Committee was set up, led by the GNHC, consisting of representatives from GNHC, UNDP, National Environment Commission (NEC), Ministry of Agriculture and Forests (MoAF), Ministry of Economic Affairs (MoEA), Tarayana Foundation and National Statistics Bureau (NSB) to provide technical input and to manage the NHDR formulation process. The committee members who contributed substantively in discussions and provided vital inputs into the Report throughout the preparation process were Mr. Thinley Namgyel, GNHC (Committee Chair); Mr. Thinley Namgyel, NEC; Mr. Tashi Jamtsho, MoAF; Ms. Yeshey Selden and Mr. Wangchuk Loday, MoEA; Ms. Chime Paden Wangdi, Tarayana Foundation; and Mr. Phub Sangay, NSB.

The process involved several participatory consultations designed to generate national ownership and debate around the Report's theme and to draw on the expertise of government officials, civil society members, development practitioners, including members of the UN Country Team, and policy-makers. The first such meeting was convened by the GNHC in collaboration with and support from UNDP Bhutan in April 2010, which marked the formal beginning of the third NHDR preparation process in Bhutan.

The theme selection was made after two rounds of consultations with representatives from various government agencies, development partners and civil society organizations. Subsequently, a presentation to senior policy-makers to sensitize them on the NHDR was made on 4 July 2010 at the GNH Commission meeting. GNHC Secretariat presented the background of the NHDR, proposed theme, objective and the rationale for the theme.

Mr. Tandi Dorji and Mr. Christopher Kuonqui conducted a series of interviews with government partners, United Nations and other multilateral agencies, and civil society organizations. During September-October 2010, 19 discussions on the theme of the HDR were held as well as a one-day research visit to Punakha Valley to hold consultation

meetings and interviews with glacier lake outburst flood-affected residents. A further 36 interviews were conducted with government officials and civil society organizations to extend the concept note and background research for the study. Mr. Sangay Tempa also maintained a close relationship with statistics and data partners in the preparation of the human development and climate change information presented in the Report.

Further discussions were held between UNDP and GNHC on the way forward. Based on the proposed report structure in the concept note, three consultants (principal consultant, statistician, and climate change adaptation writer) were recruited in March-April 2011 to conduct research and analysis, and to draft the Report's chapters.

The first draft chapters were submitted and presented by consultants at a stakeholder consultation meeting in May 2011, which highlighted the main analysis, preliminary findings and challenges faced in drafting, including data gaps and collecting secondary information. After incorporating comments from various sectors, chapters were consolidated into one Report, which was shared for further review by the GNH Commission members, Human Development Report Unit at UNDP Asia-Pacific Regional Centre and Human Development Report Office in New York. Further work was carried out by consultants to refine the Report's content and to update statistical data for final endorsement by the Technical Committee.

We thank all those who contributed ideas and time to the NHDR formulation process. We are very appreciative of their continued guidance and support, which enabled the completion of this Report.

Acronyms

AES	Annual Education Statistics
AF	Adaptation Fund
AHB	Annual Health Bulletin
AIDS	Acquired Immunodeficiency Syndrome
AOSIS	Alliance of Small Island States
APRC	Asia-Pacific Regional Centre (UNDP)
AusAID	Australian Aid for International Development
AWGKP	Ad hoc Working Group on Kyoto Protocol
AWGLCA	Ad hoc Working Group on Long-term Corporative Action
BAP	Biodiversity Action Plan
BLSS	Bhutan Living Standard Survey
BMIS	Bhutan Multiple Indicator Survey
BO	Bhutan Observer (a local newspaper)
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
COP	Conference of Parties
DANIDA	Danish International Development Assistance
DDGP	Decentralized Distributed Generation Projects
DDIN	Druk Dynamic Information Network
DGM	Department of Geology and Mines
DNA	Designated National Authority
DoE	Department of Energy
DoFPS	Department of Forest and Park Services
DRRM	Disaster Risk Reduction Management
EA	Environment Assessment
EDP	Economic Development Policy (2010)
EWS	Early Warning System
FAO	Food and Agriculture Organization
FAR	Fourth Assessment Report of IPCC (2007)
FDI	Foreign Direct Investments
FRDD	Forest Resources Development Division
FYP	Five Year Plan
GCCA-EU	Global Climate Change Alliance of the European Union
GCF	Green Climate Fund
GCFM	Global Climate Financing Mechanism
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas (es)
GLOF(s)	Glacial Lake Outburst Flood
GNH	Gross National Happiness
GNHC	Gross National Happiness Commission
GNHCS	Gross National Happiness Commission Secretariat
GNP	Gross National Product
HDI	Human Development Index
HIV	Human Immunodeficiency Virus
ICIMOD	International Centre for Integrated Mountain Development
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
JSWNP	Jigme Singye Wangchuck National Park
KP	Kyoto Protocol
LDC	Least Developed Country
LDCF	Least Developed Country Fund
LECRDS	Low-Emission and Climate Resilient Development Strategy
LEG	LDCs Expert Group
LFSR	Labour Force Survey Report
LPG	Liquefied Petroleum Gas
MDB	Multilateral Development Bank
MDG	Millennium Development Goals
MoAF	Ministry of Agriculture and Forests
MoE	Ministry of Education
MoEA	Ministry of Economic Affairs
MoH	Ministry of Health
MoHCA	Ministry of Home and Cultural Affairs
MoLHR	Ministry of Labour and Human Resources
MoWHS	Ministry of Works and Human Settlement
MPI	Multidimensional Poverty Index
MTR	Mid-Term Review of the FYPs
MW	Mega Watt
NAMAs	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programme of Action
NAPs	National Adaptation Plans
NCF	National Climate Fund
NDMA	National Disaster Management Authority
NDRMF	National Disaster Risk Management Framework
NEC	National Environment Commission
NECS	National Environment Commission Secretariat
NEPA	National Environment Protection Act
NES	National Environment Strategy – The Middle Path
NGO	Non-governmental Organization
NHDR	National Human Development Report (Bhutan, 2011)

NPPF	National Pension and Provident Fund
NSB	National Statistical Bureau
ODA	Official Development Assistance
OPEC	Organization of the Petroleum Exporting Countries
PAR	Poverty Analysis Report
PHCB	Population and Housing Census of Bhutan (2005)
PPD	Policy and Planning Division
PPP	Public-Private Partnership
RED	Renewable Energy Division
REDD(+)	Reduction of Emissions from Deforestation and Degradation (Plus)
REP	Renewable Energy Policy
RGOB	Royal Government of Bhutan
RIA-RDS	Rapid Impact Assessment of Rural Development Survey
RICBL	Royal Insurance Corporation of Bhutan Limited
RNR	Renewable Natural Resources
RNRC	Renewable Natural Resources Census
RNR-RC	Renewable Natural Resources Research Centre
RNRS	Renewable Natural Resources Statistics
RSPN	Royal Society for Protection of Nature
RTM	Round Table Meeting (with Bhutan's development partners)
RUB	Royal University of Bhutan
SYB	Statistical Year Book
SCCF	Special Climate Change Fund
SDS	Sustainable Development Secretariat, GNHC
SNC	Second National Communication (draft)
TNA	Technology Needs Assessment
UNCDF	UN Capital Development Fund
UNCT	United Nations Country Team
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
V&A	Vulnerability and Adaptation
WB	World Bank
WPB	Water Policy of Bhutan
WPMA	Waste Prevention and Management Act (2009)
WRM	Water Resource Management
WWF	World Wildlife Fund

Executive Summary

Climate change and human development in Bhutan

Bhutan is vulnerable to climate change. Although the country is committed to a high level of environmental protection, it remains at significant risk of the localized impacts caused by global climate change. While Bhutan is a net carbon sink, it suffers from a human development challenge that is not of its own making.

Much climate change attention in Bhutan focuses on the risks of melting glaciers and glacial lake outburst floods. These risks are considerable and are compounded by the threats of flash floods and droughts, changing cropping seasons, and other shocks and gradual shifts. But a missing dimension from public dialogue is precisely how an individual, household or community are vulnerable to climate risks.

This report argues that progress and sustainability of Bhutan's human development achievements define the conditions for vulnerability to climate risks. Where high levels of sustained human development have already been achieved in Bhutan, the impacts of climate change will likely be felt less. High levels of human poverty, on the other hand, serve as markers of disadvantage and where climate risks will likely be felt more. As the country as a whole has only recently succeeded in achieving progress on many human development fronts, Bhutan's gains remain fragile and at risk of reversal.

Bhutan's vision of Gross National Happiness guides its social, economic and environment development strategies and policies. It is through this philosophy that Bhutan aims to balance material well-being and the cultural and spiritual needs of an individual and society. Gross National Happiness and human development together call for a multi-dimensional approach to development that is people-centred and that maximizes the well-being and happiness of the Bhutanese people. The analytical and practical overlap between GNH and human development serves as a framework to analyse climate challenges in Bhutan.

Human development conditions

The core message of this report is that human development conditions characterize vulnerability to climate risks. In this light, accelerating human development progress and closing gaps in achievements figure among the most important responses to climate change. The concept and measures of human development provide insight into different geographical entities and sectors in Bhutan that are already or are likely to be at risk of climate threats.

One of the key tools to assess human development is the human development index (HDI). The HDI measures three basic capabilities in a society: the ability to live at a decent standard of living, to lead a long and healthy life, and to be knowledgeable and literate. This report assesses progress in the state of human development in Bhutan through the lens of achievements in these three areas.

Advances in income drive Bhutan's human development progress. Economy grew at an average of 8.7 per cent a year with inflation largely contained at 7 per cent over the period 2005-2010. In the same period, life expectancy at birth increased from 66.3 to 68.9 years. Changes over time in the literacy rate for Bhutan are difficult to estimate, but indications suggest that 45 per cent of adults could read, write and do basic arithmetic in 1994, progressing to 55.5 per cent in 2007. These achievements produce a steady rise in Bhutan's human development index.

Bhutan also continues to make significant progress in achieving the internationally agreed upon Millennium Development Goals (MDGs) to halve human poverty and deprivation by 2015. The country stands on track to achieve most of the goals and targets. Major improvements have been achieved in income poverty reduction, access to improved drinking water, gender equity in school enrolment, reducing the spread of communicable diseases and in the protection and management of Bhutan's natural resources.

Several challenges remain, however—many of which are compounded

by climate risks. While poverty reduction has been largely exemplary, one in four Bhutanese remain in income poverty. Despite declining child and maternal mortality rates, chronic malnutrition affects one in three children. And overcoming the "last mile" challenge in bringing MDG achievements to the poorest and most marginalized Bhutanese families and communities must also occur, so that all share equally the benefits of human development.

Bhutan's considerable progress in raising the standards of living of the tens of thousands of Bhutanese and in achieving the MDGs is indeed noteworthy. Yet, groups left outside the fold of economic growth are vulnerable to risks that continue to lock them out of human development. Moreover, the gains made by Bhutanese in cities and other areas remain fragile and at risk of reversal in the face of water shortages, floods or other acute weather events likely to become more frequent and intense due to climate change.

Human cost of the climate crisis

The human cost of extreme climate shocks and gradual climate changes include the increasing risk of hunger, disease, poverty, and lost livelihoods. These risks can lead to a double human development threat. Human development achievements already made in Bhutan can potentially contract and reverse. And the potential for Bhutanese who have yet to advance in human development achievements may continue to be held back.

Climate change can impact Bhutanese society in the following ways:

- Food insecurity. More poor people, especially children and elderly citizens, could suffer from hunger due to reduced agricultural yield and livestock as a result of environmental degradation, water scarcity and temperature fluctuations exacerbated by climate change.
- Increased disease. Health threats including diarrhoea, malaria, asthma and stroke affect more people when temperatures rise. The fight against malaria vectors may also need to be won again as a result of potential resurgence with warmer climates.
- Livelihoods destruction. Rural livelihoods can be damaged or altogether destroyed when income from agriculture, livestock, tourism and hydropower is lost due to weather-related disasters and loss of water resources.
- Water scarcity. Increased water scarcity is likely to result from a decline in the overall supply of clean water and more frequent disturbances on catchment areas and supply mechanisms from climate-induced disasters like landslides. Declining water availability holds potential knock-on effects on agriculture that channel into food insecurity, livelihoods and health risks. The change in water regime will also impact hydropower development.
- Population mobility. As livelihoods and opportunities in rural areas recede, many more Bhutanese may move to urban areas—potentially overwhelming the capacity of cities to provide basic services such as clean water and sanitation.
- Changing cultural practices. As rural livelihoods shift, Bhutanese move to cities and abandon traditional practices risking irreversible cultural change in different circumstances. The trend of rural-urban migration is leaving behind mostly elderly citizens in the rural areas could be exacerbated by the climate change. Disability to mobilize resources due to their age and lack of support services in the rural areas to be supported by younger generations is likely to widen the traditional family bond and societal harmony.

If development is about how people manage risks and vulnerabilities, climate change will likely alter the landscape of these risks and vulnerabilities for those who are especially poor and marginalized. The need to comprehend the impacts of climate change on livelihoods, natural resource management, food and water security, and public health therefore becomes critically necessary.

How these impacts are mediated by institutional realities, policy formulation and financial access is crucial for Bhutan. This makes climate change a vital component of the design of sustainable human development and national strategies that aim to achieve human development.

Adapting to the inevitable

Adaptation and mitigation are the two approaches to climate change today. While adaptation reacts to current and on-going climate change influences, mitigation aims to block the onset of future climate change forces.

The Intergovernmental Panel on Climate Change (IPCC) defines climate adaptation as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities." In simple terms, adaptation entails processes that reduce risk to climate change—and reap benefits from it.

Bhutan's National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) and the National Adaptation Programme of Action (NAPA) guide the country's long-term and short-term adaptation strategies. These strategies highlight vulnerable sectors and prioritize required action. Recognized thus far, glacial lake outburst floods stand out as a particular challenge to Bhutan, undermining existing development progress and threatening future plans and programmes in a changing climate scenario.

Integrating adaptation, mitigation, development and disaster risk reduction strategies holds potential to develop mutually reinforcing concepts and policies in Bhutan. These policies are essential to combat the human impact of climate change, but their links to one another have received inadequate attention. Climate change adaptation, mitigation, humanitarian assistance and development aid underpin each other, but are supported by different sets of institutions, knowledge centres, policy frameworks and funding mechanisms.

There are significant benefits to incorporating climate adaptation in development planning. When development programmes help build resilience and reduce vulnerability to climate change, this reinforces and helps the objectives of poverty reduction in the long-term. Such efforts are also urgently needed in Bhutan where rising temperatures and melting glaciers that increase the risk of catastrophic flooding remain closely linked. These floods are especially dangerous because they can occur with no or insufficient advance warning.

Climate adaptation also offers significant benefits in promoting disaster preparedness. The longer term development prospects of communities hit by natural disasters depend crucially on their capacity to cope with emergencies. This is both the case for disaster risk reduction as well as post-disaster relief.

In most countries adaptation is not treated as an integral part of national programmes, even in sectors heavily impacted by climate change like health and agriculture. A significant proportion of development aid needs to be directed at activities potentially affected by climate change. But often little or no attention is paid to the impact of climate change, even in climate-sensitive sectors. Resilience in the face of climate change must be added as an additional pillar to the concept of sustainable development.

Development must not only be sustainable, but also climate-proof. Substantial resources must be accrued and spent on adaptation to climate change. These resources will safeguard past investments in development that have been sourced over decades mainly from public coffers. The developing countries are strongly of the view that mainstreaming makes sense only if there is agreement for additional resources; otherwise the national financial capacity of developing countries is unfairly taxed.

Living within a net carbon sink budget

At the 15th session of the Conference of Parties (COP15) of the UNFCCC held in Copenhagen in 2009, the Royal Government of Bhutan declared that the country shall remain carbon neutral for all time to come, as a commitment to its future generations.

Bhutan's leaders stated: "We commit ourselves to keep absorbing more carbon than we emit – and to maintain our country's status as a net sink for Green House Gases (GHG)." This declaration further strengthened Bhutan's position as a committed, dedicated nation when it comes to ecological conservation and concerns about GHG emissions that lead to climate change. However, consequences and potential trade-offs between socio-economic

development and environmental protection from fulfilling this commitment include the revenue foregone from logging and timber extraction, reduced returns from farming and loss of revenue from mining of mineral resources and adopting non-intrusive forms of tourism. The country will need to bear the additional cost of maintaining ecological balance against a rising population—and the agricultural growth, city infrastructure and industrialisation needed to meet its needs.

Fulfilling the commitment to remain carbon neutral means activities that could potentially harm the environment such as use of pesticides, logging and mining, and mass tourism would be controlled – even if they represent better economic opportunities. In this regard, Bhutan requires the global community to come forward with a mechanism to reward the country's resolution and support Bhutan in undertaking appropriate mitigation and adaptation measures as well as to adapt to climate change.

Recommendations

Recommendation 1: Implement climate change mainstreaming fully

The Gross National Happiness Commission (GNHC) Secretariat facilitates mainstreaming environment into national policies and programmes while the National Environment Commission Secretariat (NECS) supports the development of procedures and tools for environmental mainstreaming. Building on these structures and policies already in place, Bhutan requires the human capital, financial resources and knowledge to implement strategies and achieve full mainstreaming of climate change into development and economic policy. Further, additional activities may include addressing climate proofing of development activities, incorporating climate change into environmental impact assessment procedures, and addressing climate proofing the Policy Formulation Protocol of the Royal Government of Bhutan (RGoB).

Recommendation 2: Design integrated climate change policies, strategies and quantified action plans

As the Royal Government pledged to remain carbon neutral, design and implementation of a road map is necessary with development partners' support. Such an action plan will also give direction to development partners in terms of where assistance is needed.

Carbon-neutrality is a term used to demonstrate that all greenhouse gas emissions from energy consumption (mainly transport), industry, agriculture and waste, are either avoided, reduced or offset, to a net result of zero emissions. The framework for achieving carbon neutrality involves setting objectives, identifying the appropriate technology to deliver the outcomes, creating timeframes, responsibilities and budgets, and being flexible enough to allow for adaptation to changing science, new technologies, government policies and community expectations. There is now an urgent need for the country to draw up an integrated strategy and action plan beyond remaining carbon neutral.

Bhutan therefore needs financial and technical assistance in instituting measures that will meet both mitigation and adaptation needs specific to local areas. The Low-Emission and Climate Resilient Development Strategy (LECRDS) entails a holistic strategy designed to build upon existing strategies and development plans. Working within relevant regional, national and local planning and coordination frameworks, LECRDS is expected to simultaneously address the threats, risks, vulnerabilities and uncertainties associated with global climate change and the pressing development needs countries face as they pursue sustainable development. Well-designed LECRDS can better equip countries to blend domestic and international, as well as public and private climate financing opportunities, helping countries achieve the desired developmental results.

Recommendation 3: Strengthen research and capacity development on climate change

Bhutan's capacity to build knowledge, understanding and rigorous information on

climate must be strengthened. On-going national exercises to improve understanding of the climate challenge needs to be strengthened to produce increasingly reliable and accurate information. Key steps forward should include:

- Develop capacity of technical staff and awareness of climate change for local government (*dzongkhag* and *geog* level) and for civil society.
- Provide seed capital to develop research proposal and pilot studies on climate change in Bhutan relevant for decision making, capacity development and awareness creation in partnership with the Royal University of Bhutan and other relevant institutes.
- Supporting researchers and students to study climate change science in neighbouring countries.
- Develop capacity of technical staff and decision makers in the most relevant line ministries, commissions and governing bodies on climate change (e.g. through attendance of climate risk management training courses offered by reputed institutes in the region).

Recommendation 4: Developed capacity for meteorological and hydrological services and climate modelling

In order to enhance capacity of climate modelling in meteorology and hydrology in services following actions are required;

- Improve capacity to collect and analyse weather data with additional measuring stations where gaps are identified.
- Improve capacity development to prepare early warning and hazard forecasting for the agriculture sector as well as other sectors and urban centres (NAPA priority project).
- Improve capacity for climate change modelling.
- Support continued regional networking including participation in climate change projects with regional institutions.

Recommendation 5: Invest in sustainable energy services and systems.

- Attract and direct public and private investment towards sustainable energy services and systems (including low carbon technologies and sustainable land use practices
- Capacity building, awareness creation and the development enabling of rule and regulations for the sector are some of the interventions required to attract private investments.

Recommendation 6: Promote green industry

Eighty per cent of the total electricity consumed by the nation is utilized by the Bhutanese industry. Apart from electricity, the industry sector also uses coal and wood fuel. To reduce greenhouse gas emissions, Bhutan needs to curtail consumption of fossil fuels by the industries, which necessitates adoption of new technologies. The Economic Development Policy (EDP), 2010 of the Royal Government of Bhutan is already geared towards "Green Development". Successful implementation of the policy is important and necessary.

Recommendation 7: Improve implementation and monitoring capabilities

While Bhutan has impressive plans, strategies and laws, implementation and monitoring capacity needs improvement. Better and more effective capabilities to monitor the implementation of Bhutan's legal framework like the National Environment Protection Act (NEPA), Environment Assessment (EA) Act, Waste Prevention and Management Act and the National Environment Strategy-*The Middle Path,* will ensure more effective and efficient delivery of services to advance human development as well as maintenance of ambient air quality and reduction of GHG emissions in the country.

Recommendation 8: Address climate sensitivity in the agriculture and forest sectors .

Agriculture and ecosystem services are at acute risk in Bhutan. Measures to address climate sensitivities in these sectors can include:

- Research and improvement of crop management, including selection of crop varieties and introduction of climate resilient crops by the Renewable Natural Resources Research Centres in order to reduce farmers' vulnerability to water, soil and temperature variability and their capacity to adapt to and reduce climate change risks.
- Management and utilisation of land and water resources including research and development on efficient and low-cost water harvesting to reduce vulnerability to variability in water availability for agriculture needs.
- Build on traditional knowledge in rural areas on coping mechanisms in the agricultural sector.
- Enhance the implementation of integrated watershed management plans, including forest rehabilitation in vulnerable locations, particularly in upper catchments, (e.g. through pilot projects to protect selected sensitive upper watersheds with vulnerable downstream sites).

Recommendation 9: Enhance civil society and active citizenship participation with special focus on women and their roles.

Following actions are required to enhance gender consideration and capacity of the public in the field of climate change;

- Analyze the climate change impacts from both men and women perspectives.
- Develop and apply gender-sensitive criteria and indicators.
- Pursue disaggregation of statistical data for men and women.
  Capitalize on the skills and knowledge contributions of both men and women. Reflect these when designing and implementing projects and set targets for female participation in activities.
- Prioritize women's access to information, economic resources and education.
- Ensure that women are equally represented in all decision-making processes.
- Focus on gender differences in capabilities to cope with climate change adaptation and mitigation
- Undertake a gender analysis of all national budget lines and financial instruments.

Recommendation 10: Build on and expand on-going climate financing mechanisms.

Bhutan has already gained experience in developing National Adaptation Programme of Actions and implementing some of the prioritized projects. Implementation of the glacial lake outburst floods risk prevention projects, like artificial lowering of water level in a glacial lake and setting up early warning systems, are ongoing with the support from the Least Developed Country Fund (LDCF) for adaptation to climate change. Bhutan has also been actively taking part in international negotiations and exploring the voluntary carbon market as well as establishing a climate change policy and technical committees. In order to enhance national capacity to access more global climate financial and technological resources, the establishment of an independent National Climate Fund (NCF) (like in many countries of the region) or the expansion of the responsibility of the Bhutan Trust Fund for Environment Conservation (BTFEC) to take up the important task, is necessary.

Recommendation 11: Strengthen and implement disaster risk management and community-based disaster risk reduction.

Placing climate change risks and vulnerabilities at the heart of the Eleventh and future Five Year Plans for Bhutan is necessary and critical. It is necessary to ensure that the hard-won gains and achievements made under previous Plans including the Tenth Five Year Plan are not eroded due to the impacts of a changing climate, including the increase frequency and severity of climate-induced natural disasters. In order to ensure disaster risk prevention and management in the national policies and programmes, the

following actions need to be ensured:

- Follow-up on the emerging disaster risk management legislation needs to take place with adequate funding to meet Bhutan's needs.
- Disaster Risk prevention and management funds should be reviewed annually and updated as more information and assessments of climate change impacts become clearer and evident.

Recommendation 12: Integrate human development vulnerabilities into national strategic plans

- The focus on poverty reduction must take into account climate change variability, moved in from indirect and parenthetical consideration to form the heart of development strategies in Bhutan.
- The resilience of communities, families and individuals who remain vulnerable to climate influences needs to be strengthened in order to enable them to deal with the significant risk climate change poses to their human freedoms and development.
- The Royal Government of Bhutan can enact legislation that requires the integration of climate change-related planning and programming, information sharing, etc. into community level committees and other bodies for farmers to protect their livelihoods, property and income.

Recommendation 13: Protect education infrastructure from climate shocks and make climate education part of curricula

- Link targets and strategies for achieving universal primary education to strategies for ensuring that every school built is climate resilient.
- Make climate risks and threats parts of the school curriculum, equipping children with the knowledge they need to reduce health risks and enabling them to become agents of change in their communities.

Recommendation 14: Provide psychological wellbeing services to climate victims and survivors

- Manage counselling for disaster victims and survivors.
- Incorporate school support for children who suffer losses due to climate-related impacts.

1 Climate Change and Human Development in Bhutan

Climate Change and Human Development in Bhutan

Bhutan has achieved immense progress. Cutting income poverty by 8.5 percentage points in just four years from 2003 to 2007, the country is on track to meet most of the Millennium Development Goals. Its environmental stewardship policies are admired the world over. Yet, this small, mountainous country's achievements are at risk of reversal due to the threats of climate change: a challenge, although not of its making, to which the Bhutanese people must rise. Sustaining Bhutan's human development progress must form a national priority—and the basis for international cooperation.

Climate change is widely recognized as one of the most critical and complex challenges facing humanity in the 21st Century. While the world's poorest countries and people bear little to no responsibility for climate change, they stand to bear most of the social and economic consequences. Climate change can roll back human development for a large section of humanity, undermining the international commitment made in achieving the Millennium Development Goals (MDGs) in the process.

As a least developed, mountainous and landlocked country, Bhutan's population and ecosystems are vulnerable to climate change. Although the country is committed to a high level of environmental protection, Bhutan today experiences and will likely further experience the impacts of global climate change caused by emissions in other countries.

Extreme and unusual weather events already take place in Bhutan. But incremental changes are also likely to unfold in the near future. This report argues that how both extreme and gradual changes impact Bhutanese through their vulnerability. Factors including income poverty; remoteness from economic activity, schools or hospitals; limited local governance capacity; little awareness of risks and other markers of disadvantage define an individual's or community's vulnerability to climate change.

In this context, sustaining progress and confronting the demands of equity are critical issues for Bhutan. The sustainability of human development progress requires recognition of the scarcity of resources—including the earth's capacity to absorb carbon (Box 1.2). Use and consumption of the earth's resources fundamentally entails a process of considering the capability of future generations to have similar if not greater freedom of use.

At the heart of Bhutan's development policy is the question of how to balance progress with the needs of deprived people—whether today or in the future. Bhutan's Gross National Happiness (GNH) concept and policy directives open avenues to address these concerns that are useful to build on in tackling climate change risks.

While climate change poses significant threat to human development, it can also be responded to in ways that usher in advances in private sector development and protect investments. Integrating climate change response with poverty reduction in Bhutan can prove a useful strategy. Drawing on social policy lessons from other countries holds further potential to help protect vulnerable and poor communities and individuals.

Box 1.1 **Bhutan and *Human Development Reports***

Human Development Reports serve as critical policy analysis and advocacy tools at global, regional, national and sub-national levels. The main objectives of National *Human Development Reports* are to raise public awareness and trigger action on critical human development concerns. National *Human Development Reports* also contribute to strengthening national statistical and analytical capacity, and constitute a major vehicle for the realization of national and international development goals, such as the Millennium Development Goals.

Launched in 2000, the first Bhutan *Human Development Report* was entitled "*Gross National Happiness and Human Development: Searching for Common Ground*." As the first report of its kind in Bhutan, it traced the country's human development history from 1961 when His Majesty the late King Jigme Dorji Wangchuck ended the country's economic isolation and joined the process of modern development as a member of the global community. The fourth monarch of Bhutan, His Majesty the King Jigme Singye Wangchuck, then introduced the concept of Gross National Happiness to blend indigenous values and culture with economic development, traditionally only focused on increasing Gross National Product. The country embraced the vision of the fourth King by absorbing the concept into its development strategies.

The Bhutan *Human Development Report* 2005 was titled *The Challenge of Youth Employment* and assessed the economy through the lens of the human-centred human development index and analysed opportunities for the youth of Bhutan. This report recognised the demographic importance of youth who made up nearly one-fifth of the country's population and labour force.

The Bhutan *Human Development Report 2011* looks to build on the achievements of the two previous reports in the series. By looking at climate change challenges in Bhutan, this report links analysis to Gross National Happiness – the theme of the 2000 report. Extending analysis of Bhutan through a human development lens, challenges of the youth within a climate context are also taken up. The Bhutan *Human Development Report 2011* aims to enhance public dialogue and policy discussion in Bhutan by contributing a human development perspective to national debate.

Source: GNHC. *Bhutan Human Development Reports, 2000 and 2005.*

The Bhutan *Human Development Report 2011* explores the linkages between climate change and human development in the country's context and conditions. Risks in the shape of climate-related disasters, from water scarcity to glacial lake outburst floods, pose significant challenges to maintaining ecosystems and resources protected for current and future Bhutanese generations. Bhutan's socioeconomic gains and heavily protected environment remain fragile when confronted with rising climate change risks—making adapting to the inevitable effects of a changing climate a necessary national priority.

Equally at stake are questions of global interdependence, equity and responsibility. Climate change as a global force holds no national boundaries, tying countries together to highlight our dependence on a single planet and resources shared by all. Despite aiming to maintain a net carbon sink status, Bhutan will continue to suffer from the effects of a phenomenon not of its own making.

1.1 Climate Change in the rooftop of the world

Climate change will lead to an increase in Bhutan's average temperatures. Different regions and altitudes are expected to be impacted differently. But the temperature changes will likely influence overall rainfall patterns and increase droughts.

Climate models show a likely increase in Bhutan's annual average temperature by 1°C from 2010 to 2039 and by 2°C from 2040 to 2069 (Figure 1.1). These projected temperature changes vary by season. The monsoon or wet season in Bhutan is estimated to experience a 3°C temperature increase by both climate models reported in Bhutan's draft second national communication to the

Box 1.2 What is global climate change?

Global climate change entails a process of increased greenhouse gas emissions as a result of human consumption of energy, food and other resources. These gases become trapped in the Earth's atmosphere, leading to a "greenhouse effect" that causes average temperatures to rise. The anthropogenic greenhouse gases enhance absorbtion of heat from the sun in the atmosphere and reduce the amount of heat escaping into space. This extra heat is among the primary causes of observed changes in the climate system over the 20th century.

The changes in the Earth's temperature in turn lead to shifts in temperature peaks, seasons and variations across different parts of the world and over time. Impacts in agriculture, glaciers and health are not completely certain but the observed and potential impacts can range from innocuous to severe. These changes include increases in global average air and ocean temperature, widespread melting of snow and ice and rising global sea levels. Atmospheric and ocean circulation changes will also likely occur, which influence rainfall and wind patterns. Precipitation patterns will shift with erratic rainfall, later arrival of the rain and geographical shifts in rainfall distribution, which can lead to flash floods and drought in the dry season in combination with lower glacier run-off.

Another serious impact of increases in the greenhouse gas carbon dioxide is ocean acidification. Around a quarter of human-produced carbon dioxide is absorbed by the oceans. As the carbon dioxide dissolves in sea water it forms a weak carbonic acid, making the ocean more acidic. There are early indications that some marine organisms are already being affected by ocean acidification.

Climate change is a global phenomenon with local effects that vary by region, ecosystem and location. It highlights the interconnectedness of humanity living on a shared planet, where changes in one country influence changes in another. The common challenge posed by climate change underscores the need to find lasting ways to build strong human development communities, everywhere in the world.

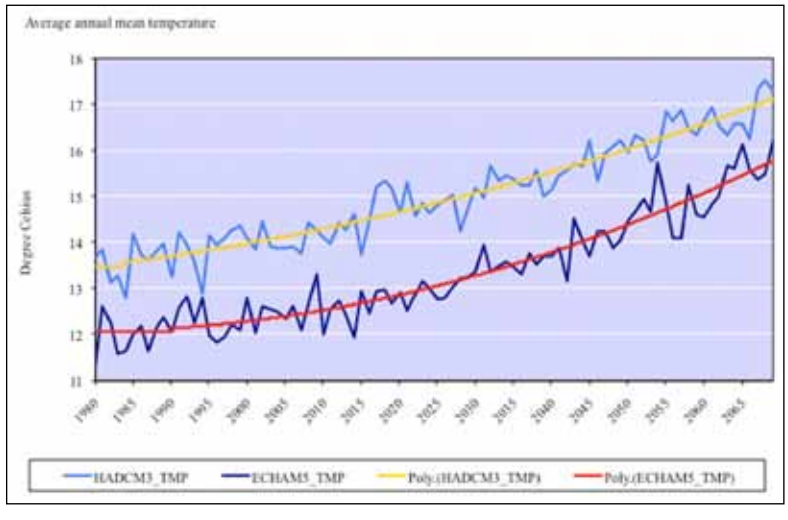
Source: IPCC, 2007. *The Physical Science Basis Contribution of Working Group I to the Fourth Assessment Report*, Cambridge University Press, Cambridge, MA.

United Nations Framework Convention on Climate Change. Winter and dry season air temperature changes, however, are projected to increase at a greater magnitude—between 3.5˚C and 4.0˚C.

Climate models also project changes in the amount and seasonality of precipitation, with wetter conditions in the warm monsoon months and slightly drier conditions in the dry winter months. The change in the amount and seasonality of precipitation will likely affect not only the hydropower and domestic water sector of Bhutan, but also the water used for irrigation (Figure 1.2).

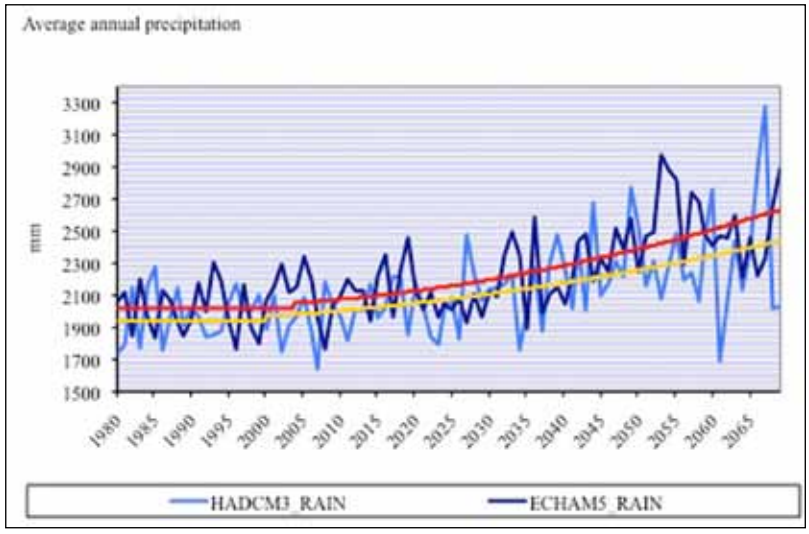
Bhutan's larger regional and topographical context will shape the extent to which climate change influences affect the country.[1] Mountainous regions are particularly vulnerable, both because warming trends are often higher and because impacts are magnified by the extreme changes in altitude over small distances. The Himalaya mountain-range – known as the rooftop of the world –

Figure 1.1 Projected temperature increases



Source: NEC, 2011. *Second National Communication to UNFCCC (draft)*, Bhutan.
Note: HADCM3 and ECHAM5 are downscaled variations of IPCC scenario A1B. The A1 scenarios project rapid economic and population growth combined with reliance on fossil fuels, non-fossil energy or a combination of both.

Figure 1.2 Projected rainfall changes



Source: NEC, 2011. *Second National Communication to UNFCCC (draft)*, Bhutan.

is especially likely to experience acute climate changes.

Life in the Hindu Kush-Himalayan region relies on monsoon systems, and these may be altered by climate change. Shifts in cropping seasons and in the likelihood of extreme weather events increase as a result. Shifts of crop habitat to higher altitudes constraining the agricultural space and adaptive capacity of the societies is another anticipated impact specific to mountain ecosystems. Locally, people's ability to adapt will be challenged. But changes in Bhutan and the Himalayas also hold direct impacts on the broader region, affecting the lives and livelihoods of the 1.3 billion people living in the river basins downstream.[2]

Bhutan is likely to see climate impacts channelled through changes in its glaciers, such as enlarged glacial lakes, in the timing and severity of extreme climate shocks such as flash floods and drought, and in the availability of ecosystem resources and services. Water resources availability in terms of quantity, quality and timeliness emerges as one of the principal climate pressures on broader human development including health, agriculture and livelihoods.

Shrinking glaciers

One of the most visible impacts of climate change in Bhutan is the retreat of glaciers, many at higher rates of reduction than glaciers in other mountain ranges. The permanent snowline has moved significantly higher, although the observations are too few to be able to quantify the actual loss of snow cover in the region.[3]

Continued deglaciation could have a profound impact on the water in the ten large river basins originating in the Hindu Kush-Himalayan region. River discharges are likely to increase for some time due to accelerated melting, but the flow is then likely to be lower as the storage capacity of the glaciers goes down. The effects are likely to be felt most severely in the parts of the region which are already very dry.

Glacial lake outburst floods

Glacial lakes have formed in many places in the area left at the foot of retreating valley glaciers. An inventory compiled by the International Centre for Integrated Mountain Development (ICIMOD) identified 8,790 glacial lakes within selected parts of the Hindu Kush-Himalayas.[4] Some 204 of the glacial lakes were considered to be potentially dangerous, that are liable to burst out leading to glacial lake outburst floods. At least 35 glacial lake outburst flood events took place in Bhutan, China and Nepal during the 20th century.

Bhutan's Tarina *Tsho* and Mouzom *Tsho* increased over the last 50 years. The upper lake, Mouzom *Tsho*, grew from years 1967 to 1988 and was then blocked by a cliff in the upstream area. The lower Tarina *Tsho* expanded from years 1956 to 1967. The lakes then diminished in area, possibly due to an outburst event in 1989/90, but further expansion was reported in subsequent years. Growth of both lakes continued until they reached the upstream bedrock wall, blocking further expansion. A related risk includes overtopping by a surge wave due to icefall into these lakes.

The October 1994 glacier lake outburst flood in Bhutan underscores the nature of the risk. Occuring 90 kilometres upstream from Punakha *Dzong*, the outburst flood from Lugge *Tsho* led to massive flooding on the Pho *Chhu* River, damaging the *Dzongchu* and causing casualties. The event stood out in memory during a recent trip to

Punakha Valley undertaken as part of the background research for this report. Many residents interviewed noted that in 2010 the valley was still recovering from the effects on its lands, communities and agriculture as a result of the flood.[5] With the emerging risk of glacial lake outburst floods from Thorthomi and Raphstreng *Tsho*, a National Adaptation Programme of Action project is underway to artificially lower the water level of Thorthomi *Tsho*.

Flash floods and droughts

From the climate scenarios projected in Bhutan's draft Second National Communication of Bhutan set to be formally released later in 2011, the trend of annual mean rainfall will increase in the northern region, with shorter monsoon period and longer dry season. Droughts are also likely to increase as a result of this factor. Changes in the monsoon regime might lead to an overall increase in precipitation in some areas and a decrease in others. There are also likely to be more flash floods resulting from increased numbers and magnitude of extreme precipitation events, and there may be greater direct runoff and less delayed runoff as less precipitation falls as snow.

Ecosystem services

Climate change affects ecosystem services by impacting forest types and area sizes, productivity, species populations and migration, the occurrence of pests and disease, and forest regeneration. The increase in greenhouse gases is also affecting species composition and changing the ecosystem structure, which in turn affects ecosystem function. The interaction between elevated CO_2 and climate change plays an important role in the overall response of net primary productivity.

Climate change will have a profound effect on the future distribution, productivity, and ecological health of forests. There could be a significant reduction in alpine and cryospheric ecosystems and their services. A major expansion of the tropical zones would cover most of the middle mountains and inner valleys of the region, whereby the quality and quantity of ecosystem services are likely to change dramatically. While potential for new crops like fruits exists, the shifts in current services drawn from ecosystems will require directed adaptation to new strategies and opportunities.

Respondents to the Punakha Valley research trip noted the disappearance of crows in recent years. A change in the animal species also signals changes in the broader functioning of the interconnected ecosystem, including pest management, the effects of which are difficult to estimate. But the disappearance of crows also prevents the simple pleasure of viewing crows in one's environmental landscape.

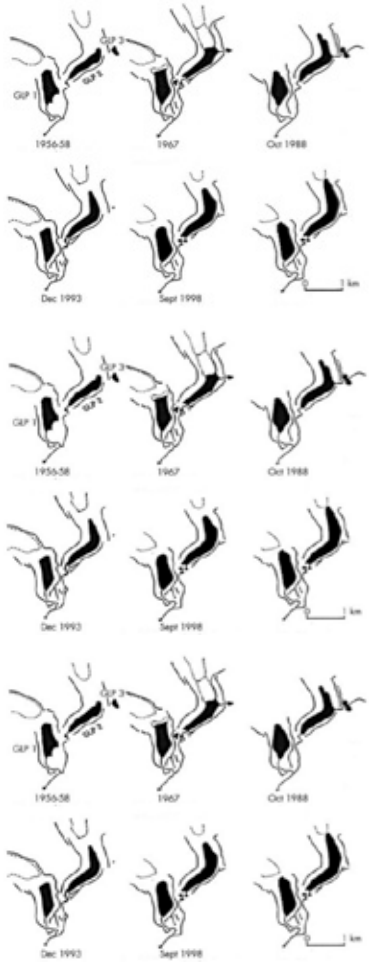
Given the dependence of populations on the ecosystem, the varying effects of climate change can culminate in significant impacts on people's well-being in a variety of ways. It is likely to exacerbate the existing food insecurity and malnutrition. Vector-borne diseases such as malaria and dengue fever are likely to move to higher altitudes and affect more people. Water-borne diseases are also likely to increase with the heightened water stress accompanied by the lack of safe drinking water and basic sanitation in the region. Deaths and morbidity associated with extreme and erratic weather are also likely to increase. Climate change will have differentiated impacts which could be more severe for women, children and poor and marginalised groups.

These climate risks and pressures interact with human vulnerability and capacity to respond and adapt to the climate change challenge. Building on this assessment of climate impacts, chapter 3 analyses in more detail the human costs of climate change in Bhutan.

1.2 Human Development and Gross National Happiness in Bhutan

In his royal address of 17 December 2006, His Majesty Jigme Khesar Namgyel Wangchuck proclaimed that fulfilling the vision of Gross National Happiness (GNH) will be one of the four main responsibilities of his reign. His Majesty underlined that the ultimate goal for social, economic and political changes in Bhutan is fulfilment of GNH. According to the address, a GNH society means the creation of an enlightened society in which happiness and wellbeing of all is the

Figure 1.3 Bhutan's deglaciation leading to expanding glacial lakes



Source: ICIMOD, 2010. *Formation of Glacial Lakes in the Hindu Kush-Himalayas and GLOF Risk Assessment*. Kathmandu, Nepal.

ultimate purpose of governance.

The GNH was a concept promulgated by His Majesty Jigme Singye Wangchuck, the fourth King at the beginning of his reign in 1972. Happiness of the people was made the guiding goal of development. The fact that gross domestic product needed to be channelled towards happiness was quite new in the 1970s. GNH has since attracted significant global attention. In the summer of 2011, the United Nations General Assembly passed a non-binding resolution noting the pursuit of happiness as a valuable international and national aspiration.[6]

A national road map for development in terms of laws and policies consistent with GNH were developed during the reign of His Majesty the fourth King. He believed that happiness is an indicator of good development and good society. He also believed in the legitimacy of public deliberation, public discussion, and public opinion in defining any goal, including GNH, through democracy and enlightened citizenship. Full parliamentary democracy was introduced in 2008 with the declaration of the Constitution of the Kingdom of Bhutan, although decentralization policies had prepared the people for parliamentary democracy from the 1970s onwards.

GNH is a balanced approach to development and stands for the holistic needs of human beings. GNH complements inner skills for happiness with outer circumstances and aims at realizing happiness as a societal goal. It stresses collective happiness to be addressed directly through public policies in which happiness becomes a explicit criterion in projects and programs. The following four priority areas form the four pillars of GNH, defined to create the conditions that would enable every citizen to pursue happiness with a reasonable chance of success.

- Sustainable and equitable socio-economic development.
- Conservation of environment.
- Preservation and promotion of culture.
- Promotion of good governance.

Conservation of the environment is the second pillar of GNH. For the majority of Bhutanese living not only close to but with nature, livelihood depends directly on richness of their immediate natural environment which bestows on them free, wholesome foods, medicines, recreation and a host of essential materials. Foregoing industrial and commercial opportunities, Bhutan has put in place vigorous conservation measures to protect its environment.

GNH and human development advocate the creation of an environment in which people can develop their full potential and lead productive, creative lives in accordance with their needs and interests. The four pillars of GNH are also aimed at achieving the three most basic capabilities of human development which are to lead long and healthy lives; to be knowledgeable; and to have access to resources needed for a decent standard of living and to be able to participate in the life of the community. They thus remain wholly compatible and complementary conceptions of human well-being and measures of the state of human progress.

To operationalize the ideal of Gross National Happiness, nine inter-related domains were developed: 1) living standard, 2) education, 3) health, 4) ecological diversity and resilience, 5) good governance, 6) community vitality, 7) cultural diversity and resilience, 8) psychological wellbeing, and 9) time use and balance.

From a Buddhist perspective, a Bhutanese would understand environment as the four elements of nature (*jung wa zhi*): earth, water, fire and air. A balance of these elements is important for a person's wellbeing just as the right balance of these elements is critical for all forms of life to flourish in the environment. Imbalance in the outer environment can impact our collective consciousness negatively, and vice versa.[7] This fits together with environmental conservation as one of the four pillars of GNH.

The ecological diversity and resilience domain of GNH is based on Buddhist principles such as interdependence, respect for all life forms and diversity, in addition to pre-Buddhist culture of worshipping nature. Drawing its strengths from past heritage and modern science, it aims to bring about a marriage of tradition and modernity and promotes community-based natural resource management to complement modern institutions and legislation.

GNH includes people in the conservation effort and weighs social and economic welfare at par with ecological concerns. It integrates local customs, culture,

beliefs, knowledge and practices of people with scientific knowledge to produce a resilient, practical and equitable natural resource management system. The domain addresses the quality and quantity of both supply and demand of natural resources such as arable land, clean water, air and timber and non-timber forest products. It also looks at emerging environment problems like land, air and water pollution, land degradation, forest fires, waste, fuel wood consumption, chemical fertilizer and pesticide use, and climate change.

The creation of a sustainable society is one important goal of GNH, and the sustainability of any viable community depends on how the natural environment around it is conceptualized, understood and appropriated. The community should not thrive at the expense of the environment, and vice versa; both should flourish side by side.

Some of the core values of GNH promoted through the domains of culture, community vitality and ecology provide opportunities to mitigate and adapt to climate change in a way that integrates all aspects of the ecosystem.

Climate vulnerabilities and human development: a framework

The table 1.1 below sets out a framework linking climate change and human development in Bhutan. Climate change is likely to cause a series of shifts and shocks in Bhutan's temperatures and precipitation patterns:

- Increase in mean temperature in particular during winter and in high altitudes.
- Increase in mean temperature in particular during summer in southern Bhutan.
- Reduction in long-term precipitation in particular during the monsoon seasons.
- Increase in immediate precipitation due to more frequent extreme climate shocks.
- Increased climate variability.

Each temperature and precipitation change poses a range of impacts on Bhutan's environmental and natural resources—which in turn affect human interaction with these resources and result in impacts on human development.

Table 1.1 Climate shock, risk and human development impact

Climate change shifts and shocks	Climate risk and impact	Human development impact
Increase in mean temperature in particular during winter and in high altitudes		
▪ Melting of mountain glaciers	▪ Loss of water reserve ▪ Risk of glacier lake outburst floods ▪ Reduced water flow to down-stream agriculture and hydro-power ▪ Sedimentation problem for hydropower	▪ Loss of lives ▪ Increase of water-borne disease ▪ Food insecurity ▪ Income losses ▪ Energy loss
▪ Reduced frost in highlands	▪ Increased length of growth period ▪ Fewer days with cold spells ▪ Loss of water resources ▪ Shift of biodiversity habitat and extinction of species ▪ Change in crop diversity	▪ Food security gains ▪ Income gains ▪ Drinking water decline
▪ Increase in temperature and evaporation	▪ Changes in range and season for livestock herding ▪ Loss of soil moisture ▪ Migration of invasive species ▪ Loss of indigenous biodiversity species (medicinal plants) ▪ Forest degradation	▪ Change in grazing opportunities ▪ Low milk production from livestock ▪ Loss of food chain, water resources and shelter ▪ Pests and diseases ▪ Land degradation ▪ Loss of livelihood ▪ Expansion of range of vector borne diseases

Climate change shifts and shocks	Climate risk and impact	Human development impact
Increase in mean temperature in particular during summer in southern Bhutan		
▪ Increased evaporation	▪ Increased drought period ▪ Reduced growth period ▪ Reduced water available for drinking and sanitation ▪ Expansion of arid and semi-arid lands ▪ More drought-resistant species in ecosystems	▪ Heat stress ▪ Health risks related to water scarcity and quality ▪ Food security and income losses ▪ Loss of biodiversity and habitat shift
▪ Seasonal droughts	▪ Forest fires ▪ Loss of food and water resources	▪ Impacts on income and livelihoods ▪ Loss of biodiversity and forest ecosystem
▪ Expansion of dry land and ranges	▪ Increased incidence and expanded range of vectors for malaria, dengue fever, Japanese encephalitis, others	▪ Increased exposure to malaria and dengue fever, especially in areas not previously exposed ▪ Children not attending school due to illness
▪ Occurrence of agricultural pests	▪ Loss of agricultural production in particular in marginal areas	▪ Farmers with inadequate access to extension and response measures
Reduction in long term precipitation in particular during the monsoon seasons		
▪ Drought	▪ Reduction or loss of agricultural and horticulture crop production ▪ Loss of water resources for drinking and sanitation ▪ Hydropower decline ▪ Land degradation	▪ Reduced food security ▪ Loss of potential export markets ▪ Loss of water for hydro power generation ▪ Loss of livestock livelihoods ▪ Farmers with limited knowledge and access to adaptation measures
	▪ Decrease in forest areas ▪ Increase risk of forest fires ▪ Loss of forests	▪ Reduced access to clean water results in health risks
	▪ Changes in wildlife migration ▪ Loss of forests ▪ Vulnerable ecosystems ▪ Wildlife crop damages	▪ National parks and tourism facilities decline ▪ Impact tourism income ▪ Pleasure of viewing nature
	▪ Reduced access to safe water in cities	▪ Reduced access to water for public utility services ▪ Increased cost of water supply
	▪ Drying of wetlands ▪ Loss of biodiversity and ecosystem assets and services	▪ Income losses
Increase in immediate precipitation due to more frequent extreme climate shocks		
▪ Flooding	▪ Damage to agricultural crops and soil erosion ▪ Siltation of water ways, e.g. filling up hydropower dams.	▪ Farmers with inadequate soil protection against flash floods ▪ Uncertainty of livelihoods and loss of human lives ▪ Loss of property and assets
	▪ Reduced accessibility due to damage to infrastructure ▪ Increased risk of land slides	▪ Entire economy is vulnerable. ▪ People on flood-prone lands or unstable slopes

Climate change shifts and shocks	Climate risk and impact	Human development impact
	▪ Waterborne diseases from contaminated reservoirs used for drinking water	▪ Vulnerable people with low access to safe water and preventive health care
	▪ Flooding in cities dues to undersized infrastructure	▪ Poor neighbourhoods with lack of infrastructure ▪ Lower-lying residential areas and roads, especially in valleys
Increased climate variability		
▪ Climate variations intensity in frequency and magnitude	▪ Rainfall fluctuation and seasonal variations ▪ Extreme weather events ▪ Uncertainty in weather conditions and water availability	▪ Farmers and rural dwellers with little prior experience in large climate variation and extreme weather events ▪ Accumulated consequences of higher frequencies of extreme weather events.

Source: Adapted from DANIDA, 2008. *Climate change screening of Danish development cooperation with Bhutan.*

Climate change shocks consist of the known and expected influences of climate change on extreme hazard events, weather, seasons, precipitation and other anticipated impacts. In Bhutan, these changes will manifest differently, shifting pressures in the form of increased or transformed exposure to climate-related risks. Yet, a community, family or individual is not impacted by these changes on their own. Rather, their vulnerabilities to these risks and hazards define how climate influences affect their well-being.

Vulnerability emerges under heightened focus from this framework. Vulnerability can be defined as the risk of a decline in human development resulting from a lack of adequate adaptive or coping knowledge and measures. Countries and people are vulnerable when their human development is threatened by various risks such as those posed by climate change.[8]

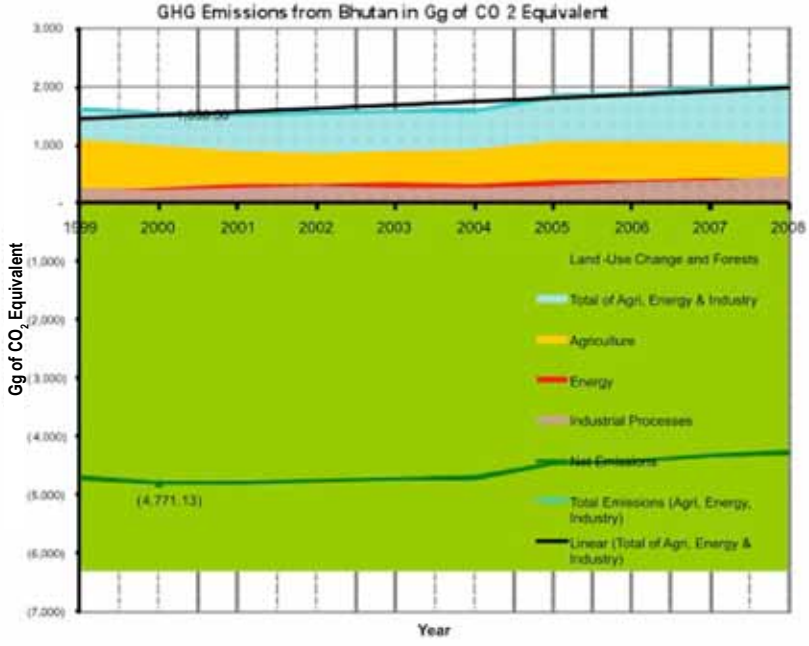
1.3 A Challenge of Responsibility

Bhutan's Buddhist values of respect for nature and life set an example to the rest of the world for protection of forests, biodiversity and habitat. Export of unprocessed timber is banned and the forest cover is reported to be 72 per cent. It is because of absorption of atmospheric carbon by these forests that Bhutan ranks among the few countries in the world as a net sink of carbon dioxide gas. In United Nations climate change negotiations, the government has made a commitment to sustain its carbon negative status.

Comparing carbon footprints

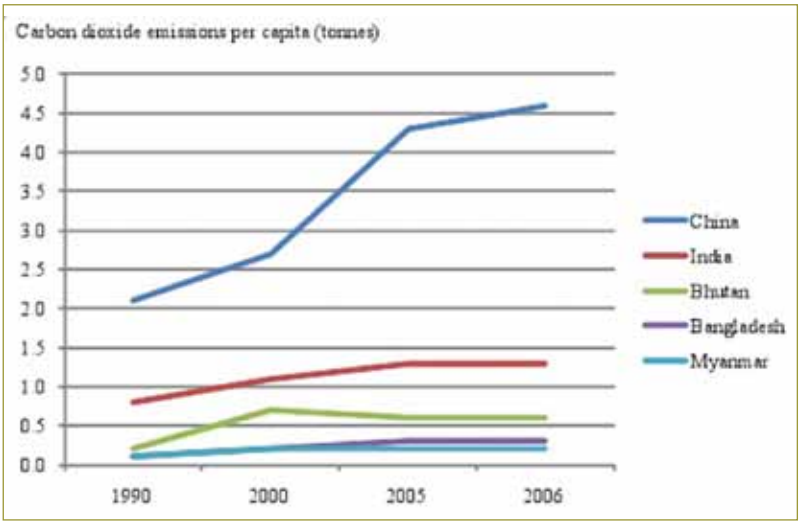
Bhutan's GHG emissions in 2008 amounted to 2,040 Gg of CO_2 equivalent (Figure 1.4). By global standards, this is insignificant. Although such emissions are relatively small, they reflect a steady increasing

Figure 1.4 Greenhouse gas emissions by source and sinks



Source: NEC, 2011. *Second National Communication to UNFCCC*, Bhutan (draft).

Figure 1.5 Bhutan's carbon footprint in regional context



Source: Carbon Dioxide Information Analysis Center, 2010. *Database on carbon dioxide emissions. Oak Ridge*.

trend. Bhutan's forests, however, continue to absorb more carbon than the consumption for agriculture, energy and industry combined, maintaining Bhutan's net greenhouse gas emissions at -4,771 Gg of CO_2 equivalent.

At a per capita level, Bhutan's carbon emissions almost tripled between 1990 and 2000 (Figure 1.5) and such trends need to be monitored. This increase resolved into a steady emissions rate into the first decade of the 21st Century. Data on energy consumption and resulting greenhouse gas emissions remain difficult to estimate in Bhutan. But on-going national exercises to improve understanding of the climate challenge produce increasingly reliable and accurate information.

Scope of the challenge

The United Nations Development Programme's Global *Human Development Report 2007/2008* estimated that stabilizing greenhouse gas concentrations in the atmosphere at a level that prevents catastrophic climate change will require a 50 per cent reduction of greenhouse gas emissions by 2050 from 1990 levels. To achieve this global objective, the report recommended that developed countries cut greenhouse gas emissions by at least 80 per cent by 2050, with 20–30 per cent cuts by 2020. For major emitters in developing countries, it recommended an emissions trajectory that peaks in 2020, with 20 per cent cuts by 2050. The scope of the challenge requires a global response.

While global in nature, the effects of climate change in Bhutan will be highly localized. The people most at risk from climate change live in countries like Bhutan that contribute the least to the energy emissions linked to the recent increase in the rate of warming of the planet. As a least developed country with scarce income and other resources, Bhutan would be one among many other countries least able to cope.

The dual challenge is to find ways to attract enough direct investment to meet Bhutan's development aspirations and need to sustain its economic development. At the same time Bhutan needs to drive these direct investments towards lower carbon technologies, so that the nation is not locked into unsustainable paths for 30 to 50 years.

A rapid scaling up of decisive action on adaptation will also require a dramatic increase in financing. The Global *Human Development Report 2007/2008* estimated that $86 billion will be required annually for building resilience in developing countries by 2015. The financing needed in Bhutan still demands more precise calculation—but the scale of the challenge will likely be larger than any other Bhutan has confronted. It will also demand a shift in the country's planning mechanisms and strategies. Placing climate change at the centre of Bhutan's development goals is critical.

Tenth Five Year Plan and beyond

Bhutan has witnessed momentous socio-political change during the on-going implementation of the Tenth Five Year Plan (2008-2013). This includes expansion of political freedoms with the adoption of the Constitution and the introduction of parliamentary democracy in 2008. At the core of the Tenth Five Year Plan stands a commitment to significantly reduce poverty in Bhutan.

Recognizing that poverty in Bhutan is largely a rural phenomenon stemming from low productivity, limited road access and high exposure to economic vulnerability, the Tenth Five Year Plan addresses this challenge through cross-sectoral rural development. Promotion

of balanced regional development is an integral part of the GNH pillar of ensuring equitable and sustainable socioeconomic development.

Specific priorities for addressing adaptation to climate change are parenthetically included in Bhutan's Tenth Five Year Plan and in the annual rolling development plans.[9] The integration of climate change-related adaptation and vulnerability reduction is discussed in sector policies and regulations.

This report builds the argument that placing climate change risks and vulnerabilities at the heart of the Eleventh and future Five Year Plans for Bhutan is necessary and critical. It is necessary to ensure that the hard-won gains and achievements made under previous Plans and under the Tenth Five Year Plan are not eroded due to the impacts of a changing climate.

The focus on poverty reduction must take into account climate change variability, moved in from indirect and parenthetical consideration to form the heart of development strategies in Bhutan. The resilience of communities, families and individuals who remain vulnerable to climate influences needs to be strengthened in order to enable them to deal with the significant risk climate change poses to their human freedoms and development.

1.4 Conclusion

Climate change primarily poses severe and varied risks to human development. The response represents a significant opportunity to tackle the impacts of climate change. Adopting greener practices in a low-carbon economy will likely deliver considerable social benefits. Fossil fuel pollution itself, for instance, is a leading risk factor for respiratory disease. Mitigating Bhutan's future emissions and current oil- and coal-led energy consumption highlights at least one direct opportunity resulting from addressing climate change.

As warming increases, it will likely become increasingly difficult to manage choices about what to preserve. Protecting communities and the environment will be brought into ever-greater competition with narrow economic interests as costs can become prohibitive. The unique challenge of climate change requires a response which is itself an opportunity for integrating a fragmented international humanitarian and development system. That endeavour should not only enable Bhutan to better combat climate change, but also to draw benefits that can apply to wide-ranging challenges of today and tomorrow.

The construction in Bhutan of a low-carbon economy also presents opportunities to generate new jobs and incomes. Ensuring financing and technology transfer to ensure Bhutan's human development follow paths of sustainability and equity is critical. A global green technology revolution could hold the key to closing the global gaps that continue to limit progress at the cost of developing countries as a result of unequal access to energy and other resources.

Climate change is a global challenge. Bhutan's human development is at risk due to a problem that is not of its own making. This ties Bhutan to other countries and regions making international cooperation and the United Nations-sponsored climate change negotiations a necessity.

Tackling the local impacts must also take on a national character. Building climate risks and vu nerabilities into its development frameworks ..nd partnerships remains a central way forward for Bhutan to ensure its current levels of development—but also to advance its human capabilities.

Efforts to meet the challenge should begin with an understanding of the human face of climate change in Bhutan. The impacts of climate change will influence Bhutan's Gross National Happiness prospects and threaten to reverse its human development achievements. This report takes aim at producing an initial analysis of the relationships between climate change and human development in Bhutan.

Chapter 2 discusses the basic human development backdrop in the country—defining the strengths and vulnerabilities on which climate change drivers have and will continue to play. Chapter 3 analyses in further detail the specific costs of climate change on human development. Chapters 4 continues a dialogue on the adaptation and mitigation responses to rise to the climate challenge in Bhutan. The recommendations emerging from the report are summarized in Chapter 5.

[1] ICIMOD, 2009. **Information Sheet #3/09,** Climate Change in the Himalayas. Kathmandu, Nepal.
[2] ICIMOD. 2009. **Information Sheet #3/09,** Climate Change in the Himalayas. Kathmandu, Nepal.
[3] ICIMOD. 2009. **Information Sheet #3/09,** Climate Change in the Himalayas. Kathmandu, Nepal.
[4] ICIMOD, 2010. Formation of Glacial Lakes in the Hindu Kush – Himalayas and GLOF Risk Assessment, Kathmandu, Nepal.
[5] Punakha Valley interview, 3 October 2010.
[6] United Nations General Assembly. 2011. Happiness towards a holistic approach to development. Resol tion number A/RES/65/309. New York, United States.
[7] Royal Society for the Protection of Nature. 2006. *Buddhism and the Environment*. Thimphu, Bhutan.
[8] United Nations Development Programme, 2010. Human Development Report: *The Real Wealth of Nations*. Palgrave Macmillan, New York.
[9] Gross National Happiness Commission, 2009. Tenth Five Year Plan. Thimphu, Bhutan, pp. 36.

2 Human Development Conditions

Human Development Conditions

Understanding human development conditions is important in its own right to expand human choices. But it is also important to grasp the relationships to climate risks. Communities and individuals with low human development achievements are likely to be more at risk of climate impacts. This chapter sets out the human development progress achieved in recent years in Bhutan —as well as the deficits that remain.

Bhutan has made significant advances on all fronts of human development. But education and health progress must expand more quickly to match the strong growth in income. Some parts of the population lag behind, and all are at risk of reversals or stalled progress in human development due to the onset of climate risks and shocks.

This chapter sets out the basic conditions of human development in Bhutan. It aims to provide an assessment of human development trends based on the best available data. Part of the assessment is that better statistics and availability of quality indicators to measure human development in Bhutan are needed. The review, however, ultimately aims to initiate an assessment of the human development patterns that leave some Bhutanese more vulnerable to climate risks than others.

What emerges from this analysis is that *dzongkhags* and populations in Bhutan with low human development achievement should receive priority for the elaboration and implementation of policies to advance human development through sustainable and climate-resilient pathways.

2.1 The Human Development Backdrop

Human development—concept and measure

One of the key tools to assess human development is the human development index (HDI). The HDI measures three basic capabilities in a society: the ability to live at a decent standard of living, to lead a long and healthy life, and to be knowledgeable and literate. This report assesses progress in the state of human development in Bhutan through the lens of achievements in these three areas.

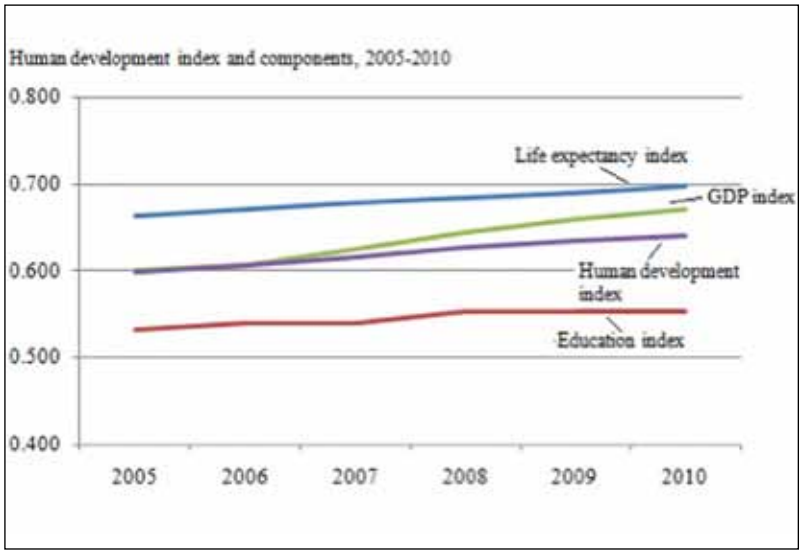
The HDI facilitates comparisons of development achievements across international and sub-national levels. Although constrained by measurement issues including data availability and quality, the HDI offers a broad and objective scope for identifying priority areas in human development.

The three basic capabilities covered by the HDI, however, are not the only capabilities that matter to any individual or society. Freedoms to participate in social life or political decision-making in one's community and nation are also critical, among many others. These core capabilities captured in the HDI are fundamental to other, more complex human choices.

Human development progress in Bhutan

In 2007, Bhutan's HDI was ranked 132nd out of 182 countries. Bhutan has demonstrated steady progress over recent years (Figure 2.1). Economy grew at an average of 8.7 per cent a year with inflation largerly contained within 7 per cent over the period 2005-2010. In the same period, life expectancy at birth increased from 66.3 years

Figure 2.1 Human development advances in Bhutan



Source: Statistical Annex - Table 1

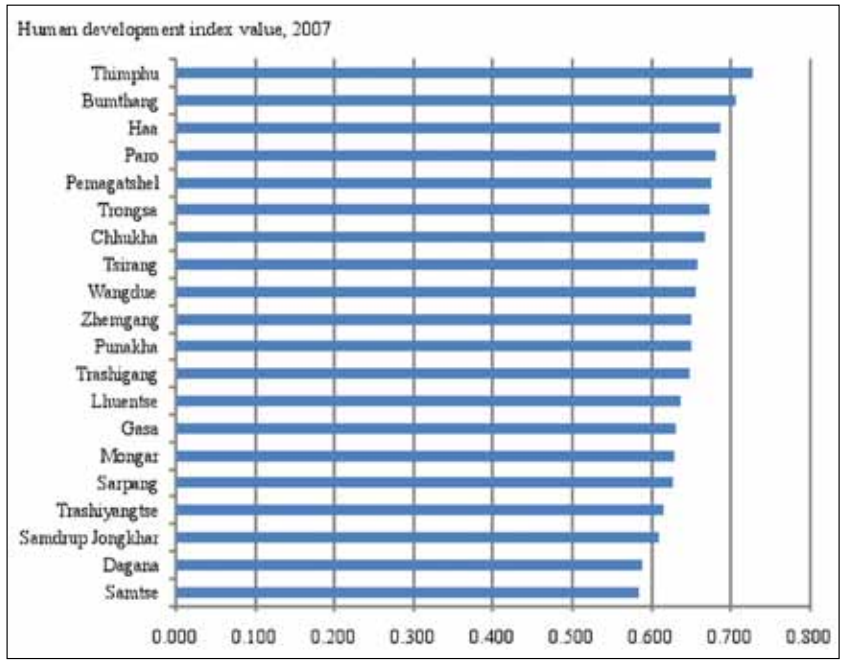
to 68.9. Changes over time in the literacy rate for Bhutan are difficult to estimate, but indications suggest that 45 per cent of adults could read, write and do basic arithmetic in 1994, progressing to 55.5 per cent in 2007. However there is a need for greater emphasis and enhanced investments for human development opportunities.

Improving human development will require identification of priority areas and local geographic levels. The sub-national human development index aims to identify development gaps and to provide evidence to support selection of development choices. The indices draw attention to localized disparities in human development among *dzongkhags*. Human development across *dzongkhags* ranks within the medium human development range (0.500 to 0.799). Thimphu is comparatively the most advanced. The *dzongkags* of comparatively lower human development are Gasa, Samtse, Dagana, Lhuentse and Mongar.

High income achievements in Bhutan do not always lead to high human development attainments. Dagana *dzongkhag*, for example, holds one of the lowest per capita income levels in the country, and correspondingly one of the lowest levels of human development. Yet, at roughly similar incomes, Pemagatshel ranks among the higher achieving *dzongkhags* in Bhutan. Likewise, while the gap between Thimphu and all other *dzongkhags* in terms of per capita income is large, the human development gap is less striking. At nearly twice the income level of Bumthang, Thimphu's human development value is only slightly higher.

Differences between achievements on income and human development highlight

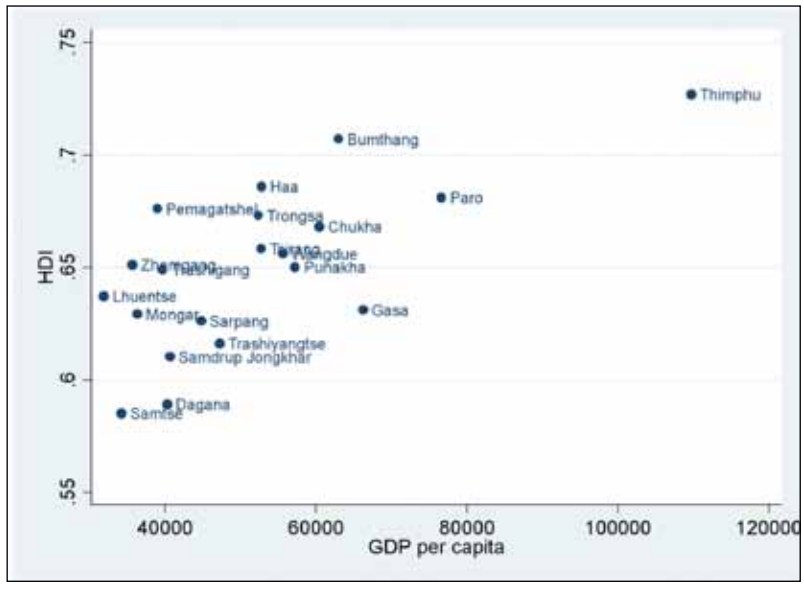
Figure 2.2 Mostly even human development across *dzongkhags*



Source: Statistical Annex - Table 1

two important features of Bhutan's progress (Figure 2.3). First is that high human development levels can be achieved without high levels of income. This means that even low levels of income can transform into higher comparative education and health achievements. Second is that these results also strongly reinforce Bhutan's Gross National Happiness philosophy. While important, income is not the sole determinant of happiness or human development.

Figure 2.3 Income—not a perfect determinant for human development



Source: Statistical Annex - Table 1

Education achievements

While population growth projections are used to define the cohort, students can go to school anywhere in Bhutan. General education in Bhutan comprises seven years of primary education (pre-primary to class VI), two years of lower secondary (class VII to VIII), two years of middle secondary (class IX and X), and two years of higher secondary (XI and XII), followed by tertiary education. The basic education level consists of 11 years of free education from pre-primary to class X.

A chain of colleges under the Royal University of Bhutan (RUB) offers tertiary education that caters to specific educational needs. Institutions include Sherubtse College in Kanglung, College of Science and Technology at Rinchending, Jigme Namgyel Polytechnic in Dewathang, Paro College of Education, Samtse College of Education, Gedu College of Business Studies, Institute of Language and Culture Studies in Semtokha, Royal Institute of Health Sciences in Thimphu, and the National Institute of Traditional Medicine in Thimphu that offer higher education in specific professional streams. Recently a private institution, the Royal Thimphu College also started offering classes in science, arts and commerce.

A small number of students are sent abroad annually to pursue professional courses in medicine, engineering, information technology, architecture, agricultural sciences and law.

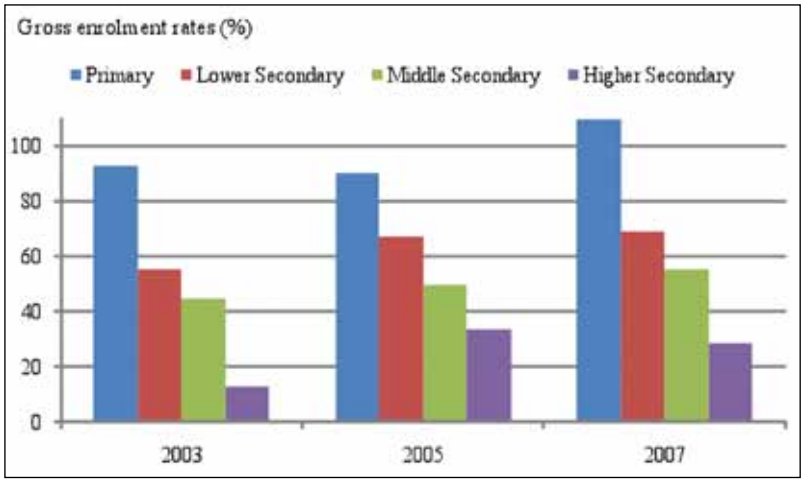
Educational infrastructure

Significant expansion of education infrastructure complemented by consistently large share of successive Five Year Plan budget supported the extensive progress in education. By the year 2010, there were 362 primary schools, 90 lower secondary schools, 52 middle secondary schools and 43 higher secondary schools. At tertiary level, the teacher training institutions under RUB provide infrastructure to ensure equitable access to quality education; training adequate numbers of teachers; development of new curricula, teaching and learning materials as well as the revision and updating of existing curriculum; managing youth activities; and formulating analysis of education policies. Students who do not enrol in Bhutan's colleges are sent on scholarship to foreign universities based on merit.

School enrolment

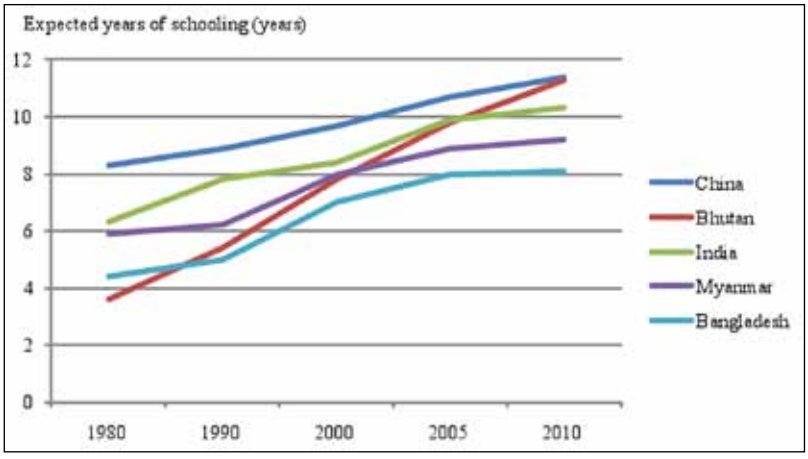
In Bhutan altogether as of 2010 there were 170,405 students enrolled in pre-primary to higher secondary schools. There were a total of 7,067 teachers: 2,405 in primary level, 1,899 in lower secondary schools, 1,433 in middle secondary school and 1,330 in higher secondary school. Total enrolment in schools increased at an annual rate of 5.3 per cent from 122,832 in 2002 to 170,405 in 2010.[1] The rate at which enrolment grew was most pronounced at the higher secondary level as compared to middle secondary or primary levels.

Figure 2.4 Strong primary enrolment progress fails to translate into sustained higher level enrolment gains



Source: NSB, 2003 and 2007. *Bhutan Living Standard Survey;* NSB, 2005. *Population and Housing Census of Bhutan*.

Figure 2.5 Mean years of schooling among neighbouring countries



Source: UNESCO, 2010. *Database on school enrolment, Paris*.

The gross primary enrolment ratio increased from 84 per cent in 2004 to 117 per cent in 2010.[2] The gross enrolment rate at lower secondary school level was 89 per cent, middle secondary school 75 per cent and 43 per cent at higher secondary schools in 2010. The gross primary enrolment ratio for females was slightly higher than males with 118 per cent (females) and 117 per cent (males) in 2010. This was also the case at lower secondary school, with 93 per cent enrolment for females and 85 per cent for males; and in middle secondary school at 76 per cent for females and 73 per cent for males. But the difference is reverse in higher secondary school with gross enrolment rates for females at 42 per cent falling behind the rates for males at 45 per cent in 2010.[3]

Among its regional neighbours, Bhutan's mean years of schooling indicator matches China's education achievements (Figure 2.5). This is the result of a strong education drive over recent decades, raising Bhutan from among the region's lowest expected years of schooling to be among its highest.

Bhutan's national literacy rate rose mainly due to improvements in coverage and accessibility to primary and secondary level education. Yet the ability to read and write remains curtailed in Bhutan: overall literacy rate among the population six years and above is estimated at 56 per cent in 2007, up from 43 per cent in 2003.[4] The urban-rural divide and gender differences serve as dividing markers. Three out of every four urban residents are literate, while slightly less than half of the rural population can read. Literacy among males (66 per cent) is also significantly higher than that of females (46 per cent).

Eighty four per cent males in urban areas are literate as compared to 59.3 per cent in rural areas. Literacy levels vary among women by place of residence. Among the urban women, 64.9 per cent are literate compared to 39.2 per cent among the rural ones. Location defines this difference: literacy among women in Thimphu is about three times higher than in Gasa (Figure 2.6)[5].

Gender disparities in literacy are practically absent among the youngest age group. The gender gap in literacy, however, begins in the 10-14 year old age group, with the gap widening with age. Only 56 per cent

of Bhutanese women between 15-24 years are functionally literate.[6]

Since 1993, the Ministry of Education provided non-formal education, an adult literacy program targeted to those who have not taken part in the system of formal education and early school dropouts. This was also aimed to help address the low level of adult literacy. There were 714 non-formal education centres across the country that helped train 12901 learners through 754 instructors in 2010.[7] This may be compared to 623 non-formal education centres and 16,642 learners and 583 instructors in 2005.

Primary school survival rates[8]

Survival rate of the cohort of students who enrolled in pre-primary schools and survived beyond primary level was 35 per cent in 1990. That increased to over 86.9 per cent by 2010. Efficiency in retention of students at the primary level therefore made a big leap forward. It is close to meeting the target of 100 per cent survival rate by 2015.

Beyond primary levels, the survival rates tapers as it progresses to the higher secondary levels. Of all those who crossed primary level, only 87 per cent reach class VIII; and 80 per cent survive class X to reach class XI. The retention rate in schools has been increasing since 2005.

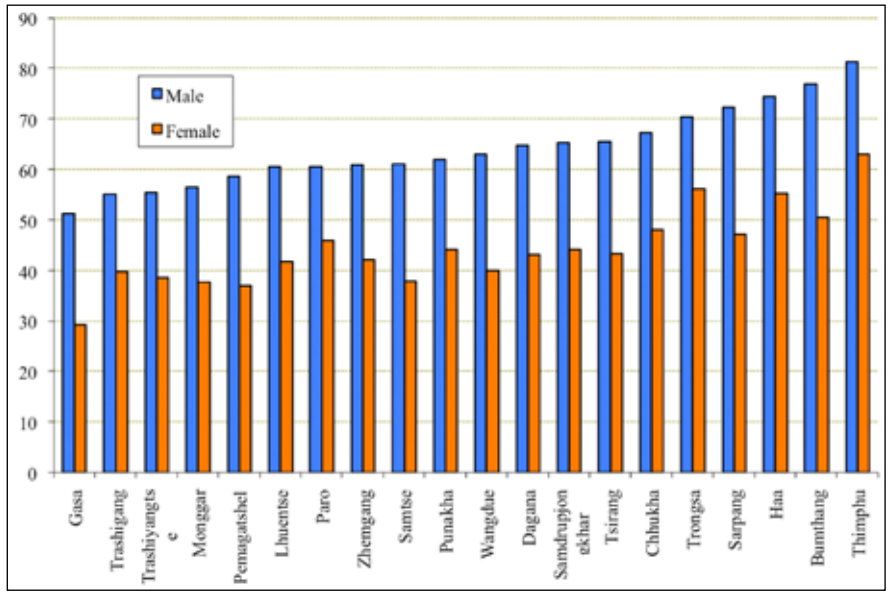
The repetition rate from pre-primary to ten declined from 7.2 per cent in 2005 to 5.6 per cent by 2010 (Figure 2.7). The low retention rate at higher schooling levels would cause a larger proportion of children dropping out of school or who may choose to either repeat in school or seek jobs and add to the number of unemployed youth.

Accessing schools

Bhutan's education policy aims for all children of school-going age to enrol in schools. In effort to promote access to education, the government provides free tuition, textbooks, stationery, sports items, meals and boarding facilities. One of the main constraints in accessibility to education, however, is the sparseness and remoteness of settlements making distance to school the largest factor determining accessibility.

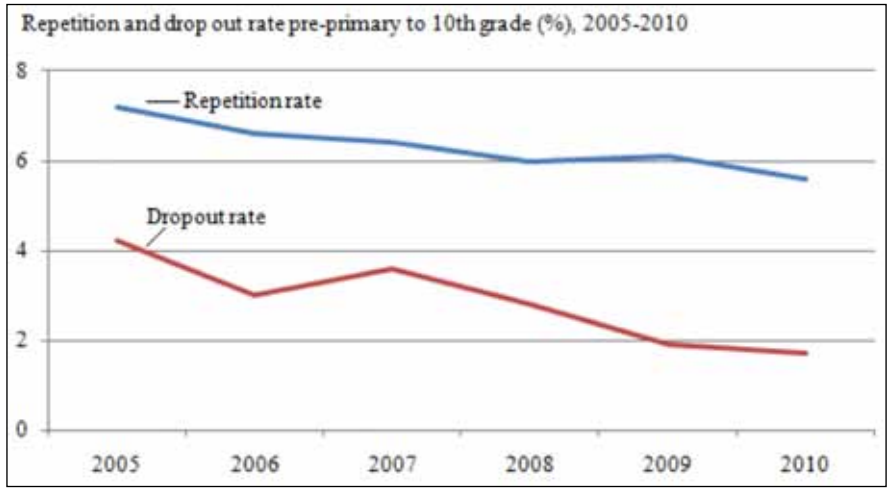
To address the distance challenge and encourage enrolment and retention, the education system aims to ensure walking distance to the nearest school to be one hour or less. In remote areas where settlements are scattered, extended class rooms have been established between the existing school and the settlements to minimize the walking distance. Administration, facilities and teaching resources are provided by the parent school to which extended class rooms are linked.

Figure 2.6 Large gaps remain between men and women's abilities to read



Source: *Adapted from Bhutan Living Standard Survey 2007 and Annual Education Statistics 2010 (Statistical Annex-table 5).*

Figure 2.7 Declining repetition and dropout rates



Source: MoE, 2010. *Annual Education Statistics,* Thimphu, Bhutan.

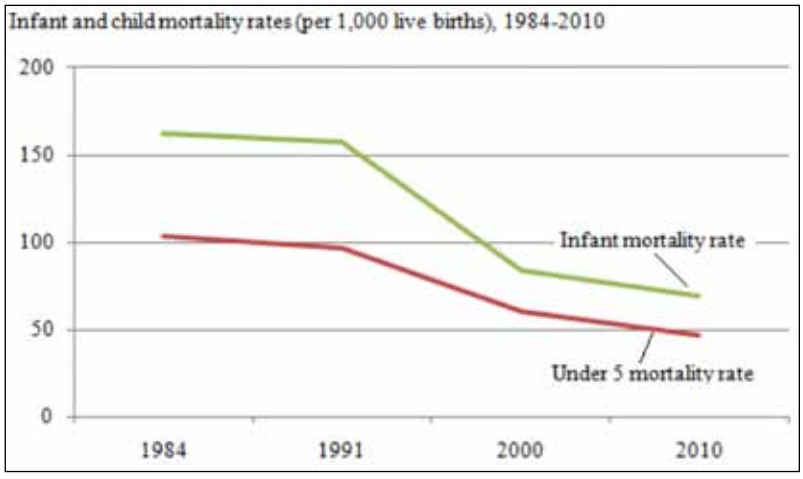
Health progress

The nutritional status of Bhutanese has improved due to interventions and availability of food. The Millennium Development Goal target of halving the rate of underweight children has been more than met with a stark decline from 38 per cent in 1989 to 11.1 per cent in 2007.[9] Vitamin A deficiency also no longer poses a public health risk. Iron deficiency anaemia among pregnant women, however, still remains a critical nutrition concern.

The crude death rate declined from 19.3 deaths per 1,000 people in 1984 to 7.7 in 2005. Infant mortality rate dropped from 102.8 infant deaths per 1,000 live births in 1984 to 40.1 in 2005 (Figure 2.8). The under-five mortality rate declined 18 per cent during the same period.

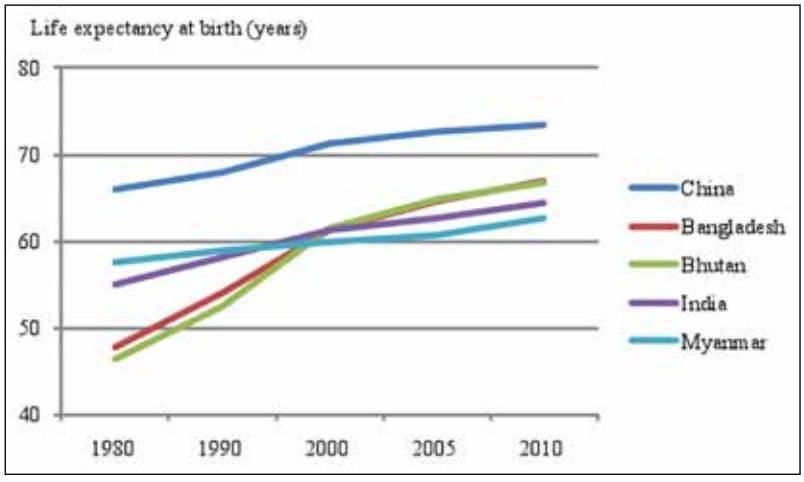
As a result of improved health indicators, the overall life expectancy at birth increased significantly from 47.5 years in 1984 to 66.3 in 2005 (Figure 2.9). This took Bhutan from among the lowest life expectancy achievers in the region to among the highest in a span of 30 years. Life expectancy is estimated to have increased at a gradual pace of 0.5 year between 2005 and 2010.

Figure 2.8 Strong—but slowing—declines in child mortality



Source: MoH, 1984, 2000 and 2010. *Annual Health Bulletin*; NSB, 1991, 2005, 2010 *Demographic and Socioeconomic indicators and BMIS*, Thimphu, Bhutan.

Figure 2.9 Significant life expectancy increase among neighbouring countries



Source: UNDP, 2010. *Human Development Report*, New York, Palgrave Macmillan.

Health services and infrastructure

Human resources and infrastructure in health have significantly expanded in Bhutan. The health system network included 670 health facilities in 2002, increasing to 767 in 2010. The number of health workers more than doubled between 2005 and 2010 (Figure 2.10). The number of doctors increased from 145 in 2005 to 187 in 2010—an average annual increase of around 6 per cent. The ratio of doctors to population for every 10,000 persons improved from 1.7 in 2002 to 2.3 in 2006. But increase in the numbers of doctors lagged behind that of nurses during the same period; further incentives are needed to encourage more people to enter the medical profession in Bhutan as doctors.

Health services in 2010 were delivered through 31 hospitals and 518 outreach clinics. The number of hospital beds per 10,000 people increased to 17 in 2006 from 14 in 2002. This took place with the completion and upgrade of the Jigme Dorji Wangchuck National Referral Hospital, the Mongar Regional Hospital, Phuentsholing General Hospital and Dagana, Trashigang and Trongsa district hospitals. Over the Ninth Plan period, primary health care coverage was sustained at above 90 per cent and immunization coverage at over 85 per cent. This level of primary health coverage contributed to raising Bhutanese health status.

One emerging health risk entails a steady increase in human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) incidence (Figure 2.11). There were 40 deaths due to AIDS out of which 25 were male and 15 female as of 2010. As of June

2010 the total cases of HIV/AIDS detected in Bhutan is 217, male (110) and female (107). Over 83 per cent of surveyed women aged 15-49 had heard of AIDS.[10] However, only 51 per cent of women knew the two main ways of preventing HIV transmission. 60.6 per cent of women knew of having one faithful uninfected sex partner, 66.1 per cent knew the importance of using a condom every time they had sex.

Income achievements

Bhutan's economy maintained consistent growth with an average annual gross domestic product growth rate of 7.8 per cent since the 1990s. The economic gains produced impressive impact on the per capita income. Economy grew at an average of 8.7 per cent a year with inflation largely contained within 7 per cent over the period 2005-2010.[11] Hydropower, donor projects, construction and an expanding financial sector serve as the drivers of this immense economic growth.

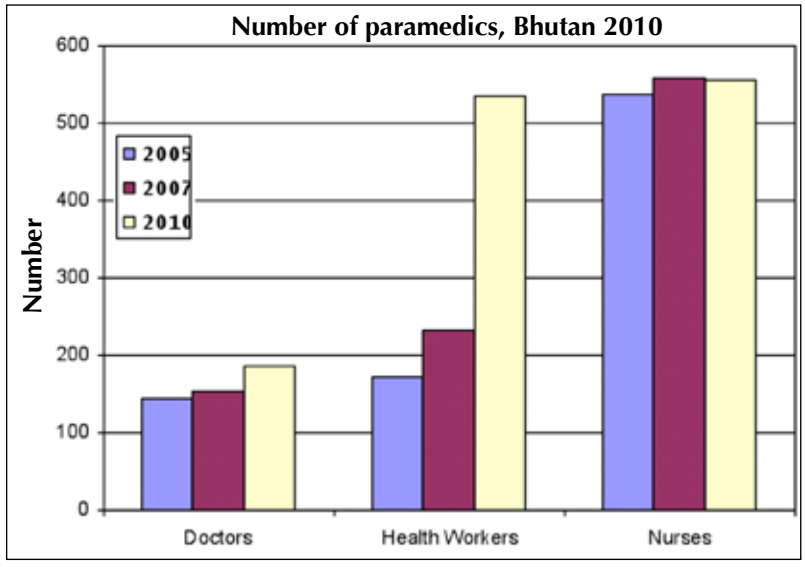
Bhutan's economic growth places it second only to China among its immediate neighbours. Income statistics at sub-national level in Bhutan, however, limit further understanding on the distribution of economic growth to *dzongkhags*, *geogs* and households across the country. But one other factor is indisputable: Bhutan's economic growth has led to substantial cuts in income poverty.

2.2 Income and Multidimensional Poverty [12]

In 2004, 31.7 per cent of the Bhutanese population lived under the income poverty line. Over 71 per cent of the poor worked in agriculture. Of the total income poor, 97.4 per cent lived in the rural areas. By 2007, 23.2 per cent of Bhutanese lived below the income poverty line – of which, 5.9 per cent lived below the food poverty line. Income poverty remains predominantly a rural phenomenon with nearly all the poor (98 per cent) residing in the rural areas.

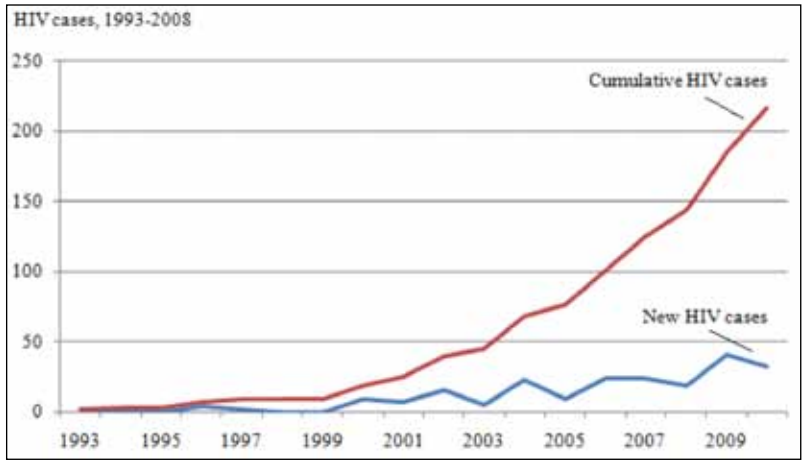
Large gaps exist between rural and urban poverty levels with almost 31 per cent of the rural population poor and only 1.7 per cent poor in the urban areas (figure 2.13). In rural areas, male headed households were poorer than the female headed households. The depth and severity of poverty is also observed to be

Figure 2.10 Numbers of doctors lag behind other health workers



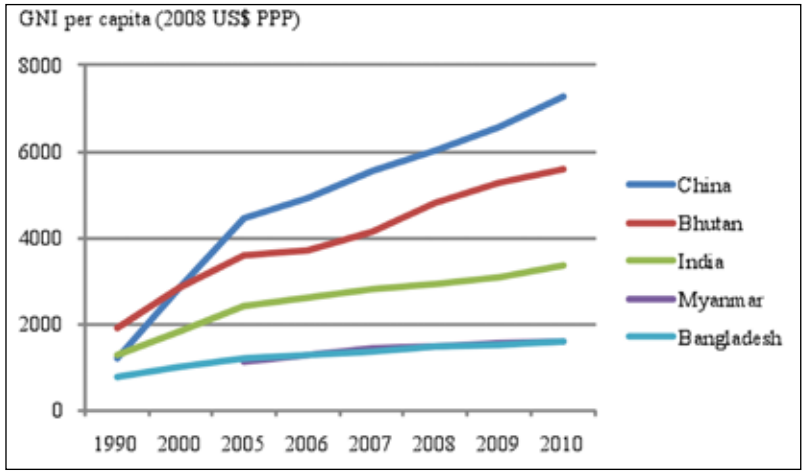
Source: MoH, 2010. *Annual Health Bulletin*. Thimphu, Bhutan.

Figure 2.11 Sharp increase in HIV cases in recent years



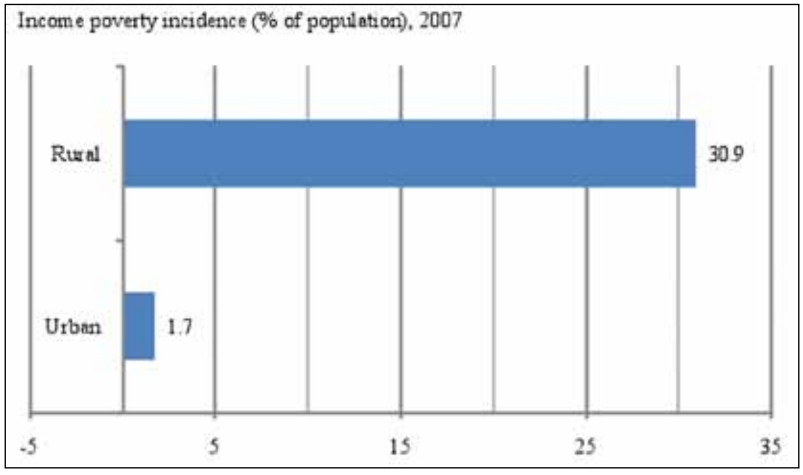
Source: MoH. Various years. *Annual Health Bulletin*. Thimphu, Bhutan.

Figure 2.12 Significant income advances in recent decades



Source: UNDP. 2010. *Human Development Report* . New York: Palgrave Macmillan.

Figure 2.13 Large rural-urban income poverty gap



Source: NSB, 2007. *Poverty Analysis Report,* Thimphu, Bhutan.

higher among male-headed households.

Income poverty, however, is not the only feature of deprivation. The Global *Human Development Report 2010* presented the new multidimensional poverty index (MPI). The MPI complements income poverty measures by reflecting the deprivations that a poor person faces with respect to education, health and standard of living. But it goes beyond income poverty measures. The MPI takes into account three sectors of development: health, including nutrition and child mortality; education (years of schooling and children enrolled); and standard of living (cooking fuel, sanitation, water, electricity, fuel, floor, assets).

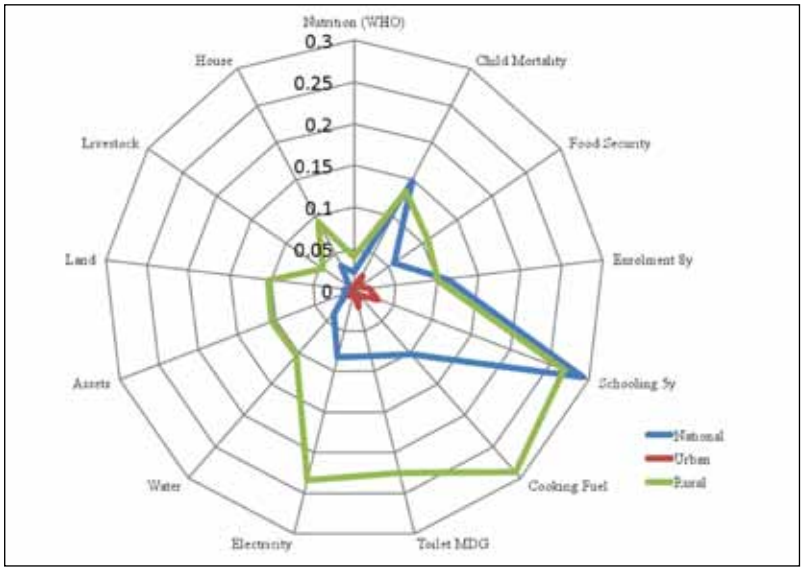
Bhutan has constructed a national MPI, which adapts the international indicators to the Bhutanese context while keeping the same three dimensions. The varied MPI model with slight changes from the global model uses thirteen indicators: primary schooling and children out of school; child mortality, nutrition and food insecurity (health); and electricity, housing, cooking fuel, drinking water less than 30 minutes away, improved sanitation and asset ownership of livestock, land and appliances (living standards).

As per the MPI, a person is poor in multiple dimensions if they are deprived in some proportion (31 per cent) of the weighted indicators. The 2010 MPI shows that about 25.8 per cent of the population was multi-dimensionally poor because they experienced deprivation in over 30 per cent of the dimensions captured in the index. As per Bhutan's National MPI 2010, 53 per cent households reported food insecurity but were not in the bottom quintile of the wealth index.

Access to improved sanitation, to cooking fuel and schooling achievements rank as the areas of highest deprivation in Bhutan (Figure 2.14). From the three core domains, education (41 per cent) contributes the highest to multidimensional poverty followed by living standards (37 per cent) and health (23 per cent).

Some significant disparities across *dzongkhags* emerge—highlighting far deeper inequalities than does the currently available human development index measure (Figure 2.15). With only 3 per cent of its residents multidimensionally poor, Thimphu stands in stark contrast to the 22 *dzongkhags* in Bhutan that have over 20 per cent of its residents multidimensionally poor. Moreover, *dzongkhags* like Gasa show significant difference in levels of poor on the MPI when compared to only the share of people who are income poor—illustrating a sharp divergence in low income poverty translating into low deprivations in other areas.

Figure 2.14 Cooking fuel, literacy, sanitation: largest deprivations in Bhutan



Source: Alkire, S, 2011. *A National MPI for Bhutan: Three trial measures.* Oxford Poverty and Human Development Initiative, Oxford.

Poverty and education

Low proportions of literacy and

educational attainment is a major cause of income poverty in Bhutan. Poor health status among women, indeed, is largely explained by the low literacy among adult women, especially in rural areas. Poor persons had lower literacy rate than non-poor households in both rural and urban areas. Literacy rate was 32 per cent among the poor as against 75 per cent among the non-poor in urban areas. This trend is noticeable also in the rural areas where literacy rate among the poor was 40 per cent as compared to 53 per cent literacy rate among the non-poor. Overall in Bhutan, literacy among the poor was over 40 per cent while the literacy of non-poor was 60 per cent. Lesser proportion of children from poor households was enrolled in schools/institute as compared to the non-poor.[13]

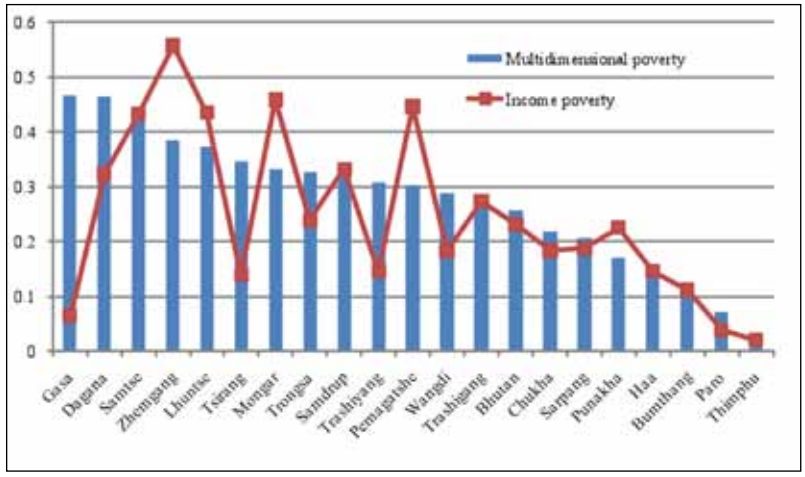
Poverty and mobility

Urban areas in Bhutan are witnessing a very high growth rates straining urban infrastructure, services and other facilities. The capital city of Thimphu is experiencing an influx of population from other *dzongkhags* and it is increasingly associated with urban problems including increased delinquency and crime, lack of housing, insufficiency in water and sanitation facilities, and strain on education, health and other services.

Urban poverty in Bhutan is an outgrowth of rural employment challenges. As Bhutan's youth migrate to its urban centres to locate employment, its cities are overburdened with the job demand. This indicates that the re-allocation of resources and capital to Bhutan's urban areas currently under development will relieve pressure on the dominant cities of Thimphu and Phuentsholing.

Moreover, mobility across international borders is also important. Nearly 90 per cent of all Bhutanese emigrants go to other countries in Asia, with more than 10 per cent residing in high human development countries.[14] Bhutan's poverty reduction strategy mentions positive elements of international migration in terms of impact on development and poverty reduction. Yet, the country is also cautious regarding the creation of inequality due to migration. Emphasizing the creation of skills in concert with neighbours is a powerful tool for Bhutan to continue to pursue.

Figure 2.15 Multidimensional poverty across Bhutan's dzongkhags



Source: Alkire, S, 2011. *A National MPI for Bhutan: Three trial measures.* Oxford Poverty and Human Development Initiative, Oxford.

Youth and unemployment

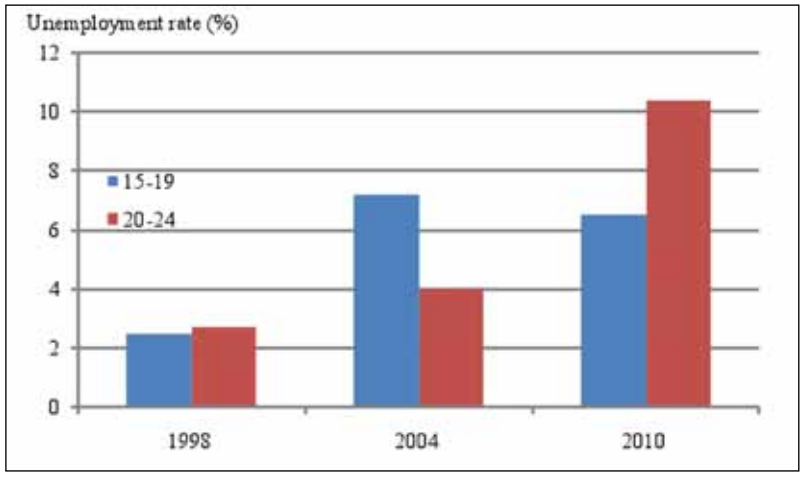
Bhutan's youth is an integral part of its development. Youth account for 31 per cent of the potential labour force, making unemployment for young men and women a crucial issue to address.[15]

Unemployment is high among the teenage youth (15-19), increasing from 2.5 per cent in 1998 to nearly 8 per cent in 2004, declining to just above 6 per cent in 2010 (Figure 2.16). Likewise, unemployment for the 20-24 years old age group increased to 2.7 per cent in 1998 to 4 per cent in 2004 and to 10.4 in 2010. Overall youth unemployment in 1998 was 2.6 per cent and increased to 9.9 per cent in 2007.[16]

2.3 Millennium Development Goals

Bhutan continues to make significant progress in achieving the Millennium Development Goals (MDGs), the internationally agreed goals to halve human poverty. Particular areas of achievement include Bhutan's expanding access to safe drinking water and sanitation, protecting and managing the country's natural resources, child and maternal health mortality, and primary education for both boys and girls.

Figure 2.16 Overall increasing youth unemployment



Source: *Adapted from MoLHR, 2010, Labour Force Survey.*

Many of the MDG indicators overlap with human development indicators analysed in the previous parts to this chapter. The progress, however, in meeting the Goals is important to underscore (Table 2.1). Far ahead of the 2015 target date, Bhutan has already achieved a number of the Millennium Development Goal indicators and is on track to meet most of the other targets by 2015. Bhutan's success can be attributed to the strong political will and commitment of the government in integrating the Millennium Development Goals into the national planning framework.

Reduction in poverty, however, illustrates one of the key limitations of the MDGs framework. Despite the large progress in achieving the goal, one in four Bhutanese remain income poor—and, as discussed in section 2.2, the same proportion are poor across multiple dimensions. This leaves poverty still a large area of attention for Bhutan's public policy even after 2015. And in the face of climate risks, sustaining Bhutan's MDGs achievements will need to shape the basis for continued international cooperation in the spirit of the Millennium Declaration.

Table 2.1 Millennium development goals – status at a glance

Goals, Targets and Indicators	1990	2000	2007	2015	State of Progress
Goal 1: ERADICATE EXTREME POVERTY AND HUNGER					
Target 1: Halve by 2015, the proportion of people living below poverty line					
Proportion of population living below national poverty line (%)	-	36.3 %	23.2 %	20 %	On track
Target 2: Halve by 2015, the proportion of people who suffer from hunger					
Proportion of population below minimum level of dietary energy consumption	-	3.8% (03)	5.9%	1.9%	Needs Attention
Percentage of under-weight under-five children	38% ('89)	19%	-	19%	Achieved
Percentage of under-height under-five children	56% ('89)	40%	-	28%	On track
Goal 2: ACHIEVE UNIVERSAL PRIMARY EDUCATION					
Target 3: Ensure by 2015 children everywhere, boys and girls alike, will be able to complete a full course of primary schooling					
Gross Primary Enrolment Ratios (%)	55%	72 %	106%	100%	Achieved
Net Primary Enrolment Ratios (%)	-	62%	83.7%	100%	On track
Proportion of Pupils starting grade 1 who reach grade 5 (%)	73%	91%	92.4%	100%	On track
Proportion of pupils starting grade 1 who reach grade 7 (%)	35%	81%	85.4%	100%	On track
GOAL 3: PROMOTE GENDER EQUALITY AND EMPOWER WOMEN					
Target 4: Eliminate gender disparity in primary and secondary education preferably by 2005, and to all levels of education by 2015					
Ratio of girls to boys in primary schools (%)	69% ('91)	82%	99.5%	100%	On track
Ratio of girls to boys in secondary schools (%)	43%('91)	78%	97.2%	100%	On track
Ratio of females to males in tertiary institutes (%)	12% ('91)	41%	54%	100%	Needs Attention

GOAL 4: REDUCE CHILD MORTALITY					
Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate					
Under-five mortality rates (per 1,000 live births)	123	84	62	41	On track
Infant mortality rates (per 1,000 live births)	90	60.5	40 (05)	30	On track
Proportion of children covered under immunization programme	84%	85%	90%	>95%	On track
GOAL 5: IMPROVE MATERNAL HEALTH					
Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio					
Maternal mortality rate (per 100,000 live births)	560	255	-	140	On track
Births attended by skilled health personnel	15%	24%	55.9%	100 %	On track
GOAL 6: COMBAT HIV/AIDS, MALARIA AND OTHER DISEASES					
Target 7: Halt and begin to reverse the spread of HIV/AIDS					
HIV cases detected	0	38	144 (08)	-	Needs Attention
Contraception prevalence rate	19% ('94)	31%	35.4%	60% (national target)	On track
Target 8: Halt and begin to reverse the spread of Malaria and Other Major Diseases					
Number of malaria cases per 100,000 population at risk	3,687	875	115*	-	On track
Number of tuberculosis per 100,000	720	168	127*	-	On track

GOAL 7: ENSURE ENVIRONMENTAL SUSTAINABILITY					
Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources					
Proportion of land area covered by forest	72.5%	72.5%	72.5%	-	On track
Ratio of protected area to surface area for maintaining biological diversity	23%	26%	29%	-	On track
CO2 (per capita) emissions	-	-	-	-	Insufficient data
Proportion of population using solid fuels (i.e. wood, charcoal,dung)		75%	70% (2005)	-	On Track
Target 10: Halve between 1990 and 2015, the proportion of people without sustainable access to safe drinking water andsanitation					
Proportion of population without sustainable access to an improved water source	55 %	22 %	19%	27.5 %	Achieved
Proportion of population without access to improved sanitation	33 %	12 %	10%	17.5 %	Achieved
GOAL 8: DEVELOP A GLOBAL PARTNERSHIP FOR DEVELOPMENT					
Target 14: In cooperation with developing countries, develop and implement strategies for decent and productive work for youth					
Youth unemployment rate	-	2.6 % ('98)	9.9 %	-	Needs Attention
Target 18: In cooperation with the private sector make available the benefits of new technologies, especially information and communication technology					
Fixed Telephone Lines in Service	4,052	16,580	35,420	-	On track
Telephone density (per 100 persons)	0.68	2.4	15.6 (05)	-	On track
Computers in use (per 100 persons)	-	0.58 ('01)	2.3 (05)	-	On track
Internet users (per 100 persons)	-	0.43 ('01)	1.2 (05)	-	Insufficient data

Source: RGoB, UNDP, 2011. *Round Table Meeting background document;* GNHC, 2008. Bhutan's Progress: Midway to the Millennium Development Goals

2.4 Conclusion

This chapter underscores Bhutan's significant human development achievements. From conditions of extreme income and multidimensional poverty, the country has made strong gains in recent years. But much remains to be achieved. Reaching the "last mile" of rural populations that are lagging behind in order to meet fully the goals of the 10th Five Year Plan and the MDGs remains a costly commitment. Moreover, as these communities are starting from low levels of the development achievements, much ground remains to be covered.

Through the lens of human development, specific areas of climate vulnerabilities emerge, as defined by the climate risk and human development framework set out in Chapter 1. Income and other dimensions of deprivation remain significant challenges in Bhutan's human development context. These have higher incidence in rural areas, particularly in remote and mountainous ones, where there is greater dependency on natural resources for livelihoods and infrastructure is still precarious. Considering that most Bhutanese people still live in rural areas, this places the country at risk of acute reversal or the blocking of further expansion of development gains as climate change hazards likely increase in frequency and intensity. With the basic human development backdrop set out, we turn to the on-going and potential human costs of climate change in further depth in the next chapter.

---

[1] Ministry of Education, 2010. *Annual Education Statistics*. Thimphu, Bhutan.
[2] Ministry of Education, 2010. *Annual Education Statistics*. Thimphu, Bhutan.
[3] Ministry of Education, 2010. *Annual Education Statistics*. Thimphu, Bhutan.
[4] National Statistics Bureau, 2003, 2007. *Bhutan Living Standard Survey*.
[5] National Statistics Bureau, 2003. *Bhutan Living Standard Survey*. Thimphu, Bhutan.
[6] National Statistics Bureau, 2010. *Bhutan Multiple Indicator Survey.* Thimphu, Bhutan.
[7] Ministry of Education, 2010. *Annual Education Statistics*. Thimphu, Bhutan.
[8] Ministry of Education, 2010. *Annual Education Statistics*. Thimphu, Bhutan.
[9] Ministry of Health, 2008. *National Nutrition, Infant and Young Child Feeding Survey*. Thimphu, Bhutan.
[10] National Statistics Bureau, 2010. *Bhutan Multiple Indicator Survey*.
[11] RGoB, UNDP, 2011. *11th Round Table Meeting Background Document,* Thimphu, Bhutan.
[12] National Statistics Bureau, 2007. *Poverty Analysis Report*. Thimphu, Bhutan.
[13] National Statistics Bureau, 2007. *Poverty Analysis Report*. Thimphu, Bhutan.
[14] UNDP, 2009. *Human Development Report. Overcoming barriers: Human mobility and development*. New York, Palgrave McMillan.
[15] National Statistics Bureau, 2007. *Bhutan Living Standard Survey*.
[16] National Statistics Bureau, 2007. *Bhutan Living Standard Survey*.

3 Human Costs of Climate Crisis

Human Costs of Climate Crisis

Climate change in Bhutan will impact the more vulnerable segments of the population—those with low levels of human development. As the impacts worsen, more vulnerable people and communities will be forced to bear a disproportionate burden of the social and economic consequences. Bhutan's immense progress – including meeting nearly all of the Millennium Development Goals – may be rolled back by climate change impacts.

Bhutan is vulnerable to multiple climate-related hazards including glacial lake outburst floods, floods, landslides, windstorms and forest fires. Bhutan stands witness to increasing incidences of climate change-induced disasters such as the Cyclone Aila flood on 25-26 May 2009, and successive windstorms in February-April 2011. Climate-related disasters affect lives and livelihoods by impairing standards of living and educational and health attainments and by causing food insecurity, and potential losses of natural resources.

Accelerated economic activities and increased demand for resources of a growing population pose pressure on natural resources such as land, air quality and water. Development activities demand increased use of land for the expansion of urban areas, industrial and residential construction, mining and quarrying, expansion of agriculture, solid waste management and other infrastructure projects. Land degradation, potential biodiversity and habitat loss, high fuel-wood consumption and human-wildlife conflicts are some of the resulting consequences. Climate change and climate change-induced disasters will further accelerate the impact.

3.1 Emerging Risks

Climate change will have knock-on effects on nearly every sphere of human activity. Bhutan's fragile mountainous ecosystem and challenges associated with its least developed country status make it particularly vulnerable to the impacts of climate change.

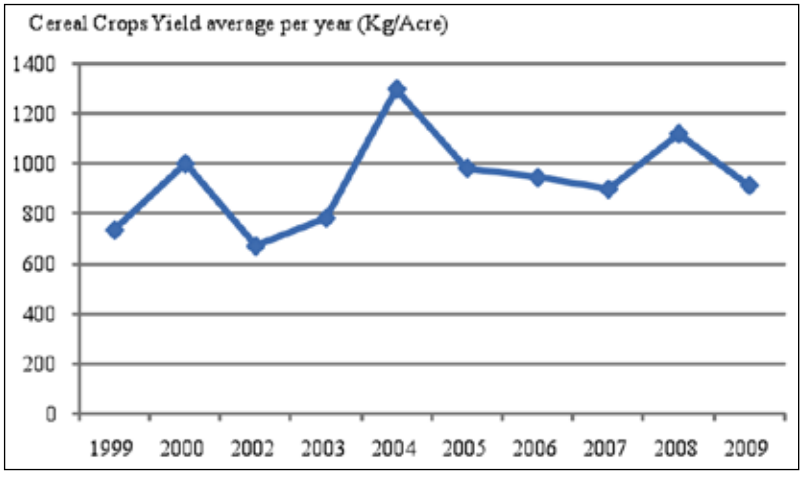
Agriculture and food insecurity

Agriculture is the main source of livelihood in Bhutan. Its contribution to national income was 9.1 per cent in 2008.[1] Agriculture accounts for over 78 per cent of monetary income in rural households.[2] The agricultural production system encompasses production of both cereal and horticulture crops. Cereals are cultivated mostly on wet- and dry lands while horticulture including vegetables, pulses, spices and oilseeds is produced exclusively on dry land—except where irrigation systems are used during the dry seasons.

Almost 70 per cent of the population is engaged in subsistence agriculture on just 7.7 per cent of the total land area.[3] Due to the rugged terrain, almost all arable land is under cultivation already. In 1983, 312,416 acres of land was under crop cultivation that increased to 386,631 acres by 2005 representing an increase of 23.8 per cent. In 2005, average per capita cropland holding was estimated at 0.61 acres and the growing population will further fragment land holdings.

Land holdings are fairly evenly distributed in the country but highly fragmented with land owners holding small parcels of land in different locations. The majority of rural households (54.3 per cent) own less than or up to 3 acres, 39 per cent from 3 to 10 acres, and 6.9 per cent more than

Figure 3.1 Variations in crop yield

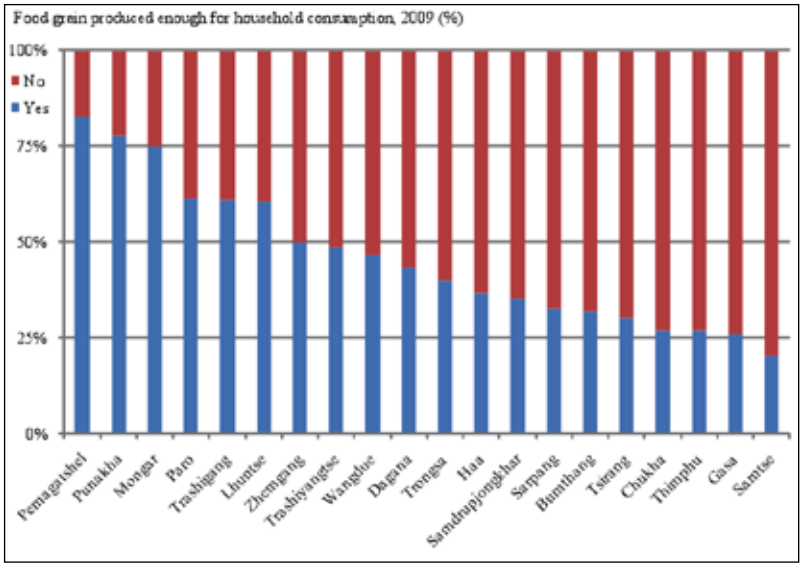


Source: Gross National Happiness Commissions. 2010. *Population Perspective Plan 2010* (draft). Thimphu, Bhutan.

10 acres of agricultural land. On average, rural households own about 4 acres. The landless rural households were recorded to 1.1 per cent sporadically distributed across all 20 districts.

In 2005, around 187 million kgs of cereals were produced from the total harvested area of 193,000 acres. That is equivalent to an average annual production of 294 kg of cereals per person annually. Yield of crops have declined over the recent years (figure 3.1).

Figure 3.2 Perceptions of household self-sufficiency in grain production



Source: NSB, 2007. *Bhutan Living Standard Survey.*

Overall crop yield in 2004 was 1,256.3 kg per acre, with a decline to 909.6 in 2006. Yield of cereals declined by about 28 per cent during 2004-2006. The decline is highest for maize crops with 36 per cent from 2004 to 2006. Except for Paro, Thimphu, Samdrupjongkhar and Gasa, production declined in all *dzongkhags*.[4]

Per capita rice consumption is 172 kg per year one of the highest in the world, making rice the preferred staple food for the majority of Bhutanese. Overall self-sufficiency in domestic rice production, however, is only about 50 per cent (figure 3.2). Paro, Punakha and Wangdue where rice yields are the highest are already threatened by urbanization and industrialization.[5]

Rising temperature and water scarcity as a result of climate change will have implications on the rice growing areas of the country (figure 3.3). Also with an increasing temperature, agro-ecological zones are expected to shift northward and to higher altitudes. Although there may be potential benefits as colder regions experience extended growing seasons, growth and yields are very susceptible to climatic variations, pests and diseases.[6]

A survey conducted by the Planning Commission in 2007 reported that about 35 per cent of the respondents faced food shortages during the year. Of this 35 per cent, 51 per cent faced food shortages for more than 4 months while 49 per cent had inadequate food for three months or less. Inadequate agriculture land and un-productiveness of soil were quoted as the main reasons for food insufficiency according to the Food Security Thematic Paper for Bhutan Climate Summit 2011. Leaving agriculture land fallow is also a factor for food insecurity. The Renewable Natural Resources Census 2009 lists wildlife problem, followed by farmland located far from the residents, lack of irrigation and unproductive land as the main reasons for leaving the farmland fallow (figure 3.4). Seasonal borrowing from households with food surpluses, bartering with other local products, working for food and income from wages or remittances from salaried family members were mentioned as some of the coping strategies.

Bhutan's largely pristine watersheds, heavy monsoon rains and steep terrain lead

to the country's vast hydropower potential. Hydropower contributes about 45 per cent of the national revenue and 19 per cent of the country's gross domestic product.[7] The country's theoretical hydropower potential is calculated at 30,000 MW, out of which 23,765 MW has been found to be techno-economically feasible.[8] While hydropower development is seen as the key to economic growth and sustainability, development of other resources, particularly to meet primary energy requirements, are required to be pursued adequately to address the energy security concerns.

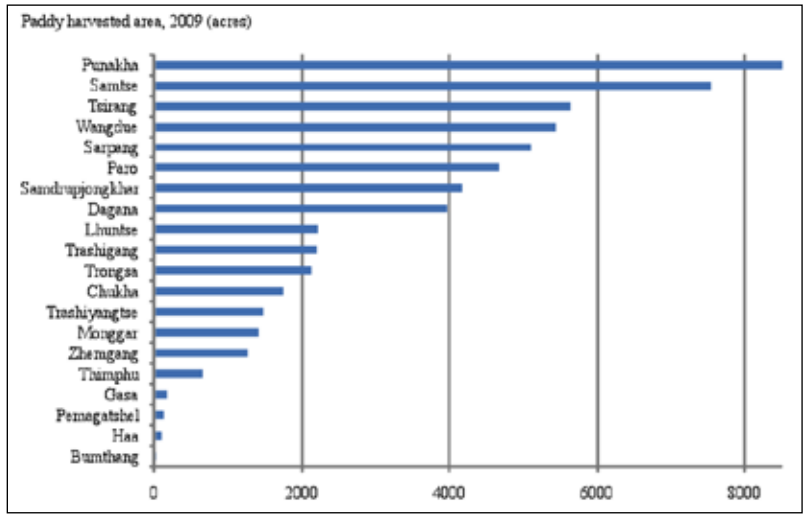
The Royal Government of Bhutan has placed great emphasis on providing adequate, safe, reliable and affordable energy to the Bhutanese people to enhance the delivery and benefits of services in other sectors such as health, education, agriculture, communication and tourism. Today, biomass (fuel wood) is the primary energy resource of the nation accounting for 91 per cent of the country's energy consumption.[9]

However, changes in rainfall patterns and the hydrological system will have a significant impact on Bhutan's water resources and river flow systems. Monsoon rains are needed to recharge the vital sources of water. Erratic and unpredictable rainfall patterns such as intense monsoon and low snowfall in winter will affect agricultural yield, hydropower production, water availability for domestic purposes and also could lead to more intense water use conflicts.

Temperature increase as a result of climate change causes the retreat of glaciers which increases the risk of glacial lake outburst floods.[10] With many fertile agricultural areas and important infrastructure such as hydropower installations located in downstream valleys, glacial lake outburst floods are one of the most immediate threats in Bhutan as any glacial lake outburst floods event will have a devastating impact on human lives, settlements and vital and expensive infrastructure.

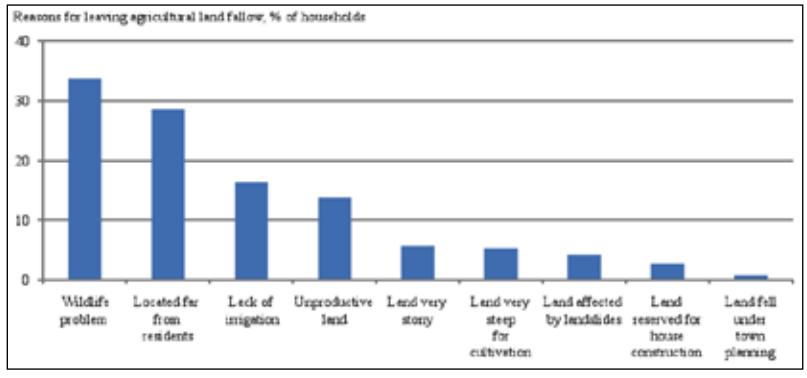
The royal government has set a target of building hydropower plants with a total capacity of 10,000 MW by 2020. Hydropower plants producing more than 6,000 MW are planned in the Punatsangchu Basin, located downstream of Lunana, and in the pathway of potential glacial lake outburst floods. Besides the formation of supra-glacial lakes due to the accelerated retreat of glaciers with increasing temperatures also pose potential dangers.

Figure 3.3 Punakha – largest rice producer



Source: MoAF, 2009. *Renewable Natural Resources Census.*

Figure 3.4 Reasons for leaving agricultural land fallow



Source: MoAF, 2009. *Renewable Natural Res*ources Census.

Climate change impacts can affect water resources in the following ways:[11]

- Increased risk of glacial lake outburst floods.
- Increased run-off variability of glacier retreat.
- More intense precipitation during monsoon and potentially decreased precipitation in winter.
- Increase sediment loading as a result of landsides and glacial lake outburst floods as a result of intense rainfall events.

Current domestic water supply is predominantly met from the springs and small

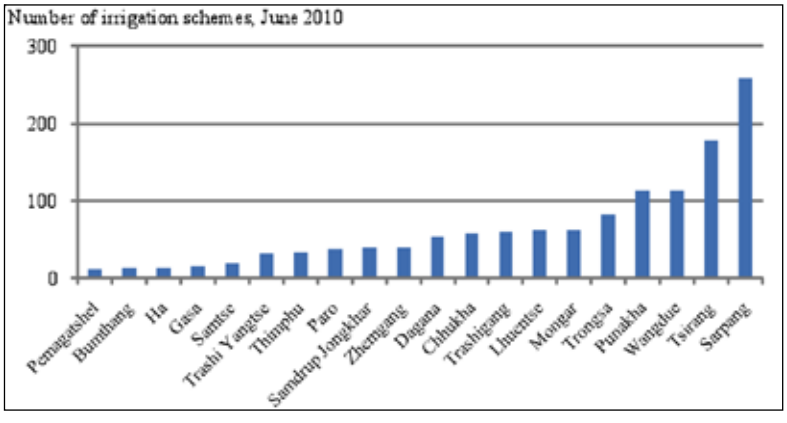
tributaries. However, by taking into account the current pace of development activities inside the river basins, the need of tapping the main rivers for supply of adequate water has already been studied and planned for Thimphu city. This in the long run will have implication downstream, particularly for hydropower projects during the lean flow.

The water supply adequacy assessment carried out by the Department of Energy in 28 urban centres in 2002 revealed that water shortages occurred in 11 towns and future water constraints were possible in an additional 7 towns by 2013. However, localized water shortages occur in various areas due to growing population. The long term mean annual flow of the entire country is estimated at 73,000 million m^3; per capita mean annual flow availability is 109,000 m^3; and per capita minimum flow availability is 20,000 m^3.

Estimates suggest that 422 million m^3 of gross consumptive water was needed to meet demand in 2002. This demand is forecasted to grow to 541 million m^3 by 2022. Per capita consumptive water demand works out to 665 m^3 per year. Irrigation demand accounts for 93 per cent of the total demand. On the other hand, current municipal demand of 2.3 per cent is expected to increase to 3.7 per cent by 2012 and 7 per cent by 2022 with the growth of population.

Non-consumptive water demand including hydropower generation was estimated at 6,700 m^3 for 2002 and is forecasted to grow to 26,900 million m^3 by 2022 keeping in view the upcoming and potential hydropower projects in the future.

Figure 3.5 Unequal access to irrigation across *dzongkhags*



Source: MoAF, 2010. *Country STAT- Bhutan.*

Shaped by the limited agricultural land available for cultivation, access to irrigation is already very unequal in Bhutan (Figure 3.5). Climate change also poses the risk of exacerbating already existing disparities in irrigation access. This can potentially threaten subsistence agriculture and food security as the range of climate change impacts on agriculture take place.

Climate change and health

Climate plays a role in the transmission of many infectious diseases. Many vector borne diseases are sensitive to ambient temperature and precipitation. Climate change is changing the geographical distribution of disease vectors which are migrating to new areas and higher altitudes which will likely expose larger numbers of previously unexposed people to infection in populated highlands. People living at higher altitudes which never knew the threats are now experiencing climate sensitive vector diseases such as malaria, dengue fever and Japanese encephalitis.

Heavy rainfall can lead to flooding, which can increase incidence of waterborne diseases. The sanitation and cleanliness of water and surroundings are challenged as the downpour trigger sewage overflows, contaminating drinking water. Diarrhoeal disease has remained one of the top three causes of morbidity in the last decade, contributing about 10-15 per cent of the morbidity cases.

While epidemiological and health data to determine linkages between health and climate change in Bhutan is very poor, these relationships and emerging trends highlight some of the potential challenges posed by a changing climate. Moreover, different factors including increased mobility of people must be carefully analysed also in terms of transporting diseases.

To fill in some of the research gaps, a study conducted by the Royal Society for Protection of Nature (RSPN) explored linkages between climate change and health in Bhutan.[12] The study linked the impacts of climate change on human health in the following ways:

- Higher morbidity and mortality from extreme weather and climate events and in particular floods.

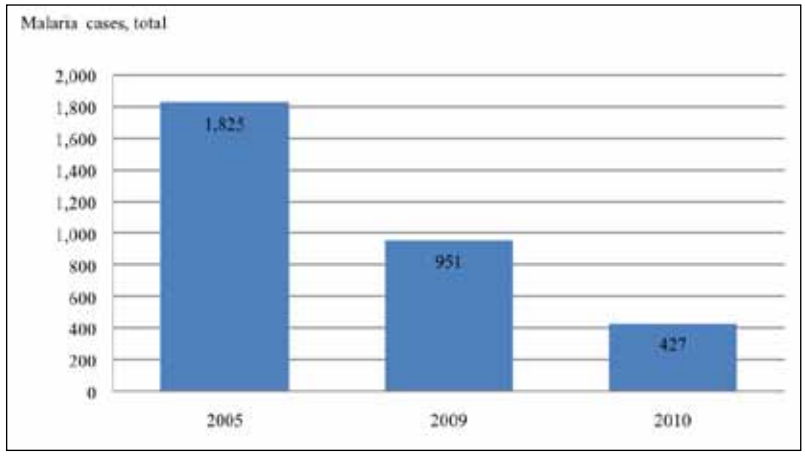
- Expansion of insect- and rodent-borne diseases.
- Increased water-related diseases associated with poor water quality and turbidity during the rainy season.

It reported that climate change has indirect effects on human health as it can cause changes in food yield resulting in food insecurity and changes in nutritional status. Weather conditions may influence air quality resulting in higher incidences of asthmatic cases.

Despite the Royal Government of Bhutan's efforts towards eradication, malaria still persists in Bhutan. Warming temperatures could further increase incidences of malaria in the northern areas where prevailing climatic conditions are a limiting factor. Dengue fever was first diagnosed in southern Bhutan in July 2004 where it has remained endemic during the monsoon period.

As both temperature and rainfall are important for the transmission cycle, malaria is very sensitive to climate change. From 1965 to 1994 the number of recorded cases of malaria increased from 518 to 39,852. Due to improved prevention measures of malaria, Bhutan demonstrated strong success in fighting malaria (Figure 3.6). The number of lives lost due to malaria has dropped from 62 deaths in 1993 to 5 deaths in 2004 and 2005.[13] The increased in the occurrence of malaria at higher altitudes shows that these gains may be reversible in the short-term.

Figure 3.6 Success in fighting malaria



Source: MoH, 2006, 2010, 2011. *Annual Health Bulletins.*

Biodiversity

Owing to its location between two major bio-geographic realms, the Indo-Malayan and Palearctic, Bhutan's biodiversity wealth includes 5,603 species of vascular plants, 400 species of lichens, 200 mammal species and about 700 species of birds.[14] Bhutan's biodiversity reservoirs include 70.5 per cent of the total land area under forests.[15] 51.3 per cent of the country is designated as protected areas and biological corridors. These areas not only conserve Bhutan's rich biodiversity but also absorb enormous amounts of carbon.

The visionary leadership of Bhutan's monarchs and its tradition of living in harmony with nature make Bhutan exemplary in the field of environmental conservation. The country's Constitution mandates the maintenance of a minimum forest cover of 60 per cent for all times to come. Environmental conservation is also considered one of the four pillars for enhancing Gross National Happiness.

Over-grazing, excessive forest use, forest fires, infrastructure development, and population growth and urbanization are among factors causing environmental pressure. According to the Department of Forest and Park Services, more than 2,600 offences of illicit timber extraction, fuel wood collection, and wildlife poaching and fishing took place from 1999 to 2003. Human-wildlife conflict is a growing concern in the country. As per FAO, the monetary value of crop damage by wild pigs amounts to more than Nu 112 million every year. Crop damage by wildlife ranks as the most severe constraint faced by farmers.[16]

A growing population demands additional forest resources, including fuel wood and wood for construction. This leads to deforestation as trees are allocated for construction and fuel. Except for sawn timber which saw a decline in demand, use of all other forms of forest products continue to increase.

Between 1998 and 2007, 643 incidences of forest fire affected 83,759 hectares of forest. From 2001 to 2005, more than 1,300 hectares of forest land were cleared for various infrastructure development and agriculture activities. Roads and electricity transmission lines accounted for 70 per cent of development.[17]

The Forest Resources Development Division defines degraded forest as all forest

area with less than 10 per cent crown density in a contiguous area not less than a half hectare. An estimated 95,439 hectares of degraded land were observed in 2005, with the vast majority degraded forest at 77,211 hectares.[18] Data from the 1990s have indicated that about 95,430 hectares of land have been affected by landslides and soil erosion.

These activities cause habitat loss. Harsh climate, ecosystem breakdown, lack of water and shade, and near irreversible degradation of land no longer fit for crops or grazing means most inhabitants have to look for economic opportunities elsewhere.

A recent survey found that many Bhutanese lack understanding of climate change and remain unprepared to manage potential impacts.[19] Many survey respondents also noted that they had observed changes in the physical environment such as rising temperature, changing rainfall pattern, change in frost occurrence and in snowfall pattern. The survey covered 16 *dzongkhags*, 31 *geogs*, 154 villages and 417 households across the country representing four broad eco-floristic zones of the country.[20]

Population dynamics and mobility

Mobility of the population from one place to another occurs in pursuit of better economic and higher educational opportunities. Generally in Bhutan, migration takes place from rural to urban areas. There were 19,992 persons that moved from urban to rural areas as compared to 111,770 persons from rural to urban as of 2005[21]. If this trend continues, there will be greater pressure on land, environment, urban infrastructure and services and if not managed well, this may lead to higher urban poverty levels.[22] The rural-urban migration can be further exacerbated should climate change induced soil erosion and other natural calamities increase on the steep slopes of the rural areas.

Population growth demands larger resources, more food, shelter, employment opportunities, higher expenditure for education and health facilities. The national economy requires sustained growth to feed the growing population.

Bhutan's population stands at 708,265 in 2011. This is projected to increase to 887,000 by 2030. That represents an increase of around 25 per cent by 2030. With an annual growth rate of 1.8 per cent per annum, Bhutan will witness continuous rise in population size over the next few decades. The pace of growth has slowed down since late 1990s due to the declining fertility rate. Total fertility rate has been declining since 1991 from a high rate of 6.5 in 1991 to 3.6 in 2005, and is estimated to reach 1.87 by 2030.

Ecological crisis and disaster risks

Climate change will incite an increase in the frequency and magnitude of natural disasters such as forest fires, windstorms, cyclones, landslides, flooding and epidemics. Flash floods in 2009 due to Cyclone Aila highlight part of the challenge. Heavy raining triggered in north-eastern Bhutan recorded 12 loss of lives and economic losses worth approximately US$ 17 million.

Glacial lake outburst flood threats

The risk of glacial lake outburst floods remains among the most serve climate change-induced risk in Bhutan. Bhutan has an estimated 2,674 glacial lakes with an area of 107 square kilometres.[23] Increases in temperature already result in the retreat of glaciers, increasing the water volume of glacial lakes and ultimately provoking glacial lake outburst floods with potential catastrophes. 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.

According to the Department of Geology and Mines (DGM) and the International Centre for Integrated Mountain Development (ICIMOD), the average annual glacial retreat has doubled in recent years from 15–20 metres in the 1990s to 35–40 meters during 2004– 2006.

Based on the condition of the lake and topographic features, 25 glacial lakes in Bhutan are considered to be potentially dangerous. Geological surveys of two lakes have predicted risks of outburst as early as in 2010. The risk of outburst of one of these lakes, *Thorthormi tsho*, is being mitigated

through artificial lowering of the water level to reduce the water pressure through a Global Environmental Facility (GEF)-Least Developed Country Fund financed NAPA project. The project also addresses community awareness of climate change adaptation, policy measures and the establishment of a glacial lake outburst flood early warning system in the Punakha-Wangdue valley.

3.2 Mapping Risks and Vulnerabilities

Climate change impacts leading to erratic and extreme weather events, floods, landslides, droughts, and glacial lake outbursts will have multiple effects on food sources, biodiversity, energy, water resources including water supply, human health, and infrastructure. As the majority of the Bhutanese are farmers living in rural areas, they are the ones most vulnerable to the impacts of climate change—many of whom holdlimited knowledge and resources to adapt to climate change. The effects of climate change are also expected to severely impact the sustainable development prospects of already low-income households.

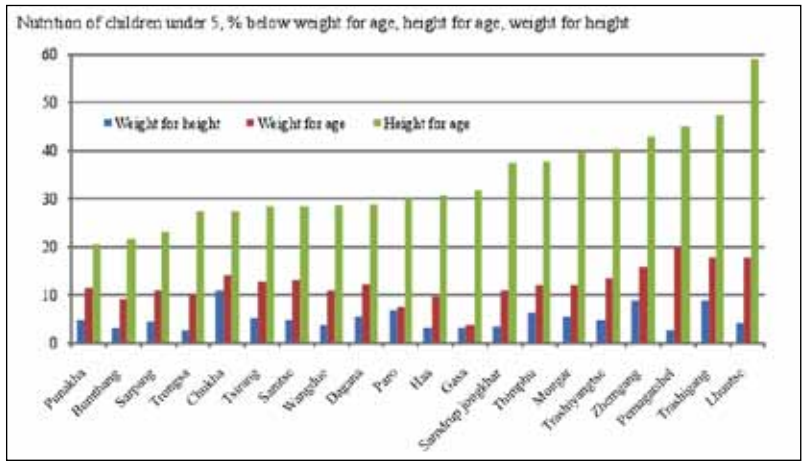
Poverty and inequality [24]

Marginalization in Bhutan is unique and yet simple: it is primarily the prevailing divide between the rural and urban population. Inequalities between the rural and urban population are relatively high, with poverty being more of a rural phenomenon. Of the 23.2 per cent of the poor Bhutanese, only 1.7 per cent of the urban population is poor compared to 30.9 per cent of the rural population.[25]

Poverty rates were found to be high in Zhemgang, Samtse, Mongar, Lhuentse, and Samdrupjongkhar. Among these *dzongkhags*, Zhemgang and Samtse have very high poverty measures.

The percentage of under-weight children less than five year olds halved from 1989 to 19 per cent in 2000. By 2010, 12.7 per cent of children were moderately to severely underweight for age.[26] Poverty serves as a marker of separation: low birth weight is severe among the poorest Bhutanese in terms of income (12.2 per cent) compared to richer households (7.3 per cent). Climate change can threaten to widen this gap (figure 3.7).

Figure 3.7 Child nutrition remains a challenge in some *dzongkhags*



Source: NSB, 2010. *Bhutan Multiple Indicator Survey.*

One in three farmer reports food insufficiency. Subsistence agriculture is under threat by climate change. And the gender differences in poverty are likely to grow—in this case, against male-headed households. Research into these differences is critical to help prevent further inequalities and deprivations.

The present government recognizes this and calls for greater protection and support to the rural populace through the Tenth Five Year Plan (2008-2013). The plan aims to provide farm roads and make rural life more productive, profitable, comfortable, and attractive by providing access to electricity, promote and support the growth of cottage and small industries with the provision of business development services, establishment of market linkages including information and communications technology establishments, and access to micro credit facilities

Challenges to connectivity: roads and infrastructure

Connectivity is crucial for improvements in access to better health and education services, in linking farmers to markets, and opening up other economic avenues. Without connectivity the rural mass will continue to remain marginalized as the prevailing social and economic disparities will

only increase. The climate change resilience and adaptive capacity of communities will further suffer. Therefore, underscoring it as a special priority, the Royal Government of Bhutan committed to provide road and communication centres to every *geog*.

According to the Population and Housing Census Survey 2005, about 21 per cent of Bhutanese households live one to four hours walking distance from the nearest all-season road and another 21 per cent live in places that are more than four hours walking distance (figure 3.8). As of the beginning of the Tenth Plan, Bhutan had a total network of 4,545 km of roads, including 1,556 km of national highway and 597 km of farm roads. During the Tenth plan 34 suspension bridges with another 18 under construction; 201 km of new roads; and 166 km of feeder roads including feasibility studies were being undertaken as of June 2010.

Construction of quality roads entails large costs. Budgetary problems have resulted in poor quality works leading to vulnerability to extreme rainfall patterns. Farm roads and power tiller tracks, are often damaged during the rainy season, thus de-linking farmers. Landslides further hinder access. The absence of good quality roads limits incentives to produce and restricts rural-urban linkages.

Bhutan has made substantial progress in providing for its citizens a range of telecommunication services. Although the popularity and usage of information and communications technology is growing fast in urban areas, Bhutan still faces daunting challenges in ensuring that all citizens get access to its benefits, regardless of where they live. However, information and communications technology and every development efforts come with its fair share of challenges in bringing benefits to all the citizens.

The rugged terrain makes it difficult and expensive to install information and communications technology infrastructure like phone lines and radio towers. The low income of rural citizens makes the cost of information and communications technology goods and services relatively high. Limited availability of skilled information and communications technology workers makes it difficult to meet the demands of government and industry.

However, the Royal Government of Bhutan, in its continuing and strong bid to provide information and communications technology, even to the unreached, has chalked out a strategy to address these challenges

The government has increasingly focused attention for information and communication technology public service delivery to improve rural livelihood in rural areas. By the completion of the Mid-Term Review for the Tenth Five-Year Plan, Bhutan achieved 97.5 per cent national coverage of mobile services and is working towards universal connectivity by end of 2011. Bhutan Telecom, one of the two mobile service providers alone has 350,000 registered subscribers covering 204 *geogs* of the 205 *geogs* with only one *geog* Lunana which is eight days walk from the nearest road point to be covered by the end of 2011.

To improve efficiency and transparency in the public sector and to reduce the overall turnaround time in accessing public services, 109 community centres are being established. The government plans to establish such centres all the 205 geogs by June 2012 which would be concurrently undertaken with rural electrification programme. The centres are expected to provide online public services and also offline services such as photocopying, printing, etc. With the national broadband network using fibre optics now available in all the 20 *dzongkhags,* this facility will be extended through Dielectric Self-Supporting technology to connect 131 community centres and ensure high speed internet connectivity and faster services.

With increasing use of mobile phones, Bhutanese farmers now have access to market prices by using Interactive Voice Response system, which allows farmers to access the prices of their closest market in one of four languages – Dzongkha, Sharshop, English or Lothsam. If farmers have the latest price information, farmers will be able to negotiate meaningfully with commission agents and middle-men and reach good farm gate prices. They will also be able to plan to send their produce to auction yards with a better idea of the prices they can expect.

Rural livelihoods

Rural livelihood in Bhutan depends

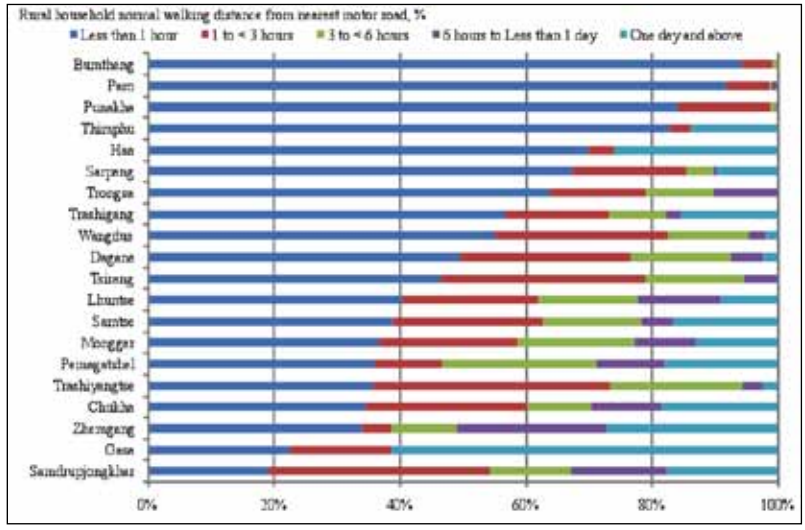
on renewable natural resources and constitutes the core of the Bhutanese economy with more than 65 per cent of the population living on subsistence farming. With only 7.7 per cent of the total land area arable, prospects of agricultural expansion are limited, and the success of agricultural operations depend largely on sustainable management of natural resources and protection of ecosystems services in the face of increasing threat from climate change.

Rice and maize are the most important cereal crops. And some of the important cash crops cultivated by the Bhutanese farmers are potatoes, apples, oranges, and chillies. These cash crops are a major source of income for the rural residents. For example, apples and oranges accounted for 90 per cent of Bhutan's fruit production.[27] One of the policy objectives of the Tenth Five Year Plan is to enhance sustainable rural livelihood. Improved agricultural and livestock productivity and expanded commercial prospects shape support towards achieving this objective.

Agriculture should grow at a sustained annual rate of 4 per cent to reduce rural poverty rate to 15 per cent in the Tenth Plan. However, the sector grew at only 1.9 per cent in 2008 and 2.2 per cent in 2009.[28] In recent years, Bhutan has experienced loss of arable lands, damage to crops and loss in production, changes in temperature and rainfall patterns affecting production and food security and increasing water conflicts amongst farmers and communities as water becomes increasingly scarce for crop production, particularly rice. Several acres of paddy fields were lost to flash floods in Trashiyangtse in 2009 and Sarpang in 2010.

Due to changing weather patterns, humidity and temperatures there has been a dramatic rise in pest and disease outbreaks in many crops. In maize, two devastating fungal diseases, turcicum leaf blight and grey leaf spot caused huge losses in maize production. The diseases occurred in epidemic scale throughout the country in 2006. Likewise in rice, a major epidemic outbreak of blast disease occurred in 1995 leading to a loss of 1,099 MT of rice or Nu 11 million. The disease is associated with high rainfall and overcast conditions.

Figure 3.8 Connectivity challenges differ across *dzongkhags*



Source: MoAF, 2009. *Renewable Natural Resources Census.*

Community opportunities

The government accords high priority to promote and support the growth of cottage and small industries. The government will support these enterprises for the development of business services, establishment of linkages with large industries as ancillary activities, credit guarantees, access to micro credit facilities and space in the industrial areas. Promoting non-greenhouse gas emitting cottage industries at the rural communities' level is fully in favour of the carbon neutral commitment. Targeting agriculture investment, the Ministry of Agriculture and Forests introduced One *Gewog* Three Products program in 2009 as a strategy to strengthen product diversification and value addition. About 61 products have been identified as priority products, which would support community business and enterprises.

There are several marketing outlets for agricultural products. The popular channel is the weekend markets such as the Farmers' Centenary Market in Thimphu, which are in place in all 20 *dzongkhags*. The government is making efforts to improve access to markets and marketing facilities. The initiatives include facilitating the formation of cooperatives, farmer associations and developing services and capacity. Further, policy support is

Box 3.1 Shifting crops and changing seasons: farmers' perceptions

Farmers in Bhutan have been experiencing rising temperatures, changing rainfall patterns, in frost occurrence, and in snowfall. Like Rinchen from Thimphu, many farmers in remote communities discuss the changing seasons and consequences on their livelihoods. The long dry spell in June 2007 and heavy rains rains during September 2007 resulted in delayed rice planting resulting in poor yield of rice and potato. Farmers note the shifts in temperature and rainfall have not yet consolidated into new, predictable patterns. The absence of predictability limits farmers' preparation and exacerbates farming vulnerability to seasonal change.

Farmers' perception on change of rice cropping patterns, other cropping patterns and systems in general are noteworthy. Information from Taryana Foundation workers supporting rural agriculture illustrates changes taking place in farmer seed selection and crop timing. But awareness is not wholly widespread. One survey of 366 farmers found that 19 per cent observed change in cropping pattern, while 63 per cent did not observe any change and the remaining 19 per cent were uncertain of the change.

The most prominent changes farmers perceive and relate to climate change are broadly shifts in cropping seasons and expansion of crop growing limits. With warmer winters and earlier rainfall, farmers are forced to start rice transplanting early. Shifts in rice transplanting translate into large changes in the yearly cropping calendar. At higher altitudes, farmers experience lower yields and later crops from warmer winters.

With the rise in temperature and delayed frost, many crops conventionally grown in sub-tropical environments including maize, chilli, mustard and rice can be easily grown in higher altitudes. Farmers in high altitudes like Bumthang and Ha related the possibility of cultivating chilli and maize to rising temperature. This represents an expanded opportunity for farmers in higher altitude to adapt to the rising temperature.

Drying up of water bodies and natural springs as well as declining stream discharge results in farmers leaving rice fields fallow, without secure irrigation water. These farmer perceptions and stories underscore the emerging changes already visible in Bhutan's climate and agricultural landscape.

Source: Kuensel, 7 July 2007 and 4 August 2007. Interview with Head of Tarayana Foundation, September 2010.

underway to develop an efficient marketing infrastructure including retail, whole sale, assembly markets and storage facilities.

Ecosystem goods and services are the basis on which the Bhutanese economy or community livelihoods and well-being function. At the community level, a mechanism called payment for environmental services provides for alternative livelihoods of communities mostly in rural areas where this mechanism allows for reward or incentives for those who provide environmental or ecosystem services and payment by those who use these services. Such a system is built on sustainable use of resources and means to alternative livelihoods in the context of a majority of the vulnerable Bhutanese population who are dependent on climate sensitive agricultural sector.

In the last few years, the agriculture ministry mainstreamed sustainable land management practices in all *dzongkhags* and protected forest areas were opened for ecotourism. In managing forestry resources sustainably, the concept of community forestry management is being promoted as a means to improve natural resource management and local governance, and thus to contribute to poverty reduction. By having decision-making power over natural resources, the local communities are expected to be able to better adapt to the consequences of climate change. Non-Wood Forests Products also have great

potential for income generation for the poorer sections of the Bhutanese society if resources are harvested in a sustainable manner. For instance, legalization of harvesting cordycep (Ophiocordyceps sinensis) earned a total of Nu 89 million for some high altitude rangeland communities across Bhutan in 2010.[29] Many opportunities for adaptation to climate change lie in the ability to manage Non-wood forests products through various policy, institutional, implementation and legal frameworks.

3.3 Conclusion

This chapter aimed to show the state of knowledge on climate impacts—while not overstating the links and inter-linkages. Current availability and quality of data and information limit absolute assessments of the human development impacts of climate change in Bhutan.

Adaptation and future mitigation are twin strategies to meet the climate challenge. Supporting the vulnerable groups and communities identified in this analysis to adapt to the current and future impacts is critical to prevent reversal in development gains made thus far. Building international cooperation ties and meeting responsibilities to help Bhutan connect its people to energy services and engage on high growth human development pathways through mitigation financing and technology forms the other critical pillar. The next chapter discusses each of these strategies as they relate to Bhutan.

[1] National Statistics Bureau, 2009. *Statistical Year Book,* Thimphu, Bhutan.
[2] Ministry of Agriculture and Forests, 2009. *Natural Renewable Resources Census,* Thimphu, Bhutan.
[3] Ministry of Agriculture and Forests, 2009. *Natural Renewable Resources Census,* Thimphu, Bhutan.
[4] Ministry of Agriculture and Forests, 2009. *Natural Renewable Resources Census,* Thimphu, Bhutan.
[5] Bhutan, 2011. *Bhutan Climate Summit for a Living Himalayas 2011, Impacts of Climate Change on Food Security in Bhutan (Draft).*
[6] T. Namgyel, 2003. *UNFCCC Expert Workshop on Local Coping Strategies and Technologies for Adaptation to Climate Change.* Country Presentation on Bhutan.
[7] National Statistics Bureau, 2010. *Statistical Year Book,* Thimphu, Bhutan.
[8] Bhutan, 2011. *Bhutan Climate Summit for a Living Himalayas, National Road Map for Energy Security (2012 - 2021).*
[9] Bhutan, 2011. *Bhutan Climate Summit for a Living Himalayas, National Road Map for Energy Security (2012 - 2021).*
[10] National Environmental Commission, 2006. *National Adaptation Programme of Action,* Thimphu, Bhutan
[11] Bhutan 2011. Climate Summit for a Living Himalayas 2011, *Securing the Natural Freshwater Systems of the Himalayas: Climate Change and Adaptation measures on Water Resources in Bhutan.*
[12] Royal Society for Protection of Nature, 2005. *Health and Climate Change Study-Bhutan.* Thimphu. Bhutan.
[13] Royal Society for Protection of Nature, 2005. *Health and Climate Change Study-Bhutan.* Thimphu. Bhutan.
[14] Minsitry of Agriculture and Forests, 2009. *Biodiversity Action Plan,* Thimphu, Bhutan
[15] Bhutan, 2011. Climate Summit for a Living Himalayas. *Biodiversity Persistence and Climate Change in Bhutan.*
[16] Ministry of Agriculture and Forests. 2009. *Natural Renewable Resources Census,* Thimphu, Bhutan.
[17] Ministry of Agriculture and Forests. 2009. *Natural Renewable Resources Census,* Thimphu, Bhutan.
[18] Ministry of Agriculture and Forests, 2004. *The Plantation Master Plan*, Thimphu, Bhutan
[19] Bhutan, 2011. *Climate Summit for a Living Himalayas, Biodiversity Persistence and Climate Change in Bhutan.*
[20] Bhutan, 2011. *Climate Summit for a Living Himalayas, Biodiversity Persistence and Climate Change in Bhutan.*
[21] Ministry of Agriculture and Forests, 2005. *Rural Urban Migration in Bhutan.*
[22] National Statistics Bureau, 2005. *Population and Housing Census,* Thimphu, Bhutan.
[23] United Nation Environment Programme, 2001. *Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods: Monitoring and Early Warning Systems in the Hindu Kush-Himalayan region.* Kathmandu, Nepal
[24] National Statistics Bureau, 2007. *Poverty Analysis Report,* Thimphu, Bhutan
[25] National Statistics Bureau. 2007. *Bhutan Living Standard Survey 2007.* Thimphu, Bhutan.
[26] National Statistics Bureau. 2010. *Bhutan Multiple Indicator Survey.*
[27] Tobgay, S. McCullougli, E., 2008. *Linking small farmer to markets, the importance of road access*, Thimphu, Bhutan
[28] Gross National Happiness Commission, 2011. *Tenth Five Year Plan, Mid-term Review.*
[29] Bhutan Observer, 2011, *Easing Cordyceps Business. April 27, 2011.* Thimphu, Bhutan.

4 Adaptation and Mitigation in Bhutan

Adaptation and Mitigation in Bhutan

Adapting to climate change is a necessary part of human development for Bhutan. Sustaining the country's commitment to remain carbon neutral in the face of a growing economy is a serious challenge. Local knowledge, community-based responses and international cooperation are important pillars to Bhutan's adaptation and mitigation demands.

Adaptation and mitigation stand as pillars of national and international response to climate change. Climate change adaptation is defined as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities."[1] Mitigation, on the other hand, requires limiting forms of economic activity and consumption that produce greenhouse gases. Each is critical for human development and managing climate-related risks and vulnerabilities.

Bhutan needs financial and technical assistance in instituting measures that will meet local needs. Support for efforts to mainstream environmental concerns into development plans and programmes so that environmental issues are integrated into national and sub-national plans need to continue. In addition, guidelines have been developed to aid the national governments of developing countries in preparing the Low-Emission Climate Resilient Development Strategy and grounding necessary financing mechanisms. The Low-Emission Climate Resilient Development Strategy entails a holistic climate change strategy designed to build upon existing strategies and development plans. Working within relevant national, local and regional planning and coordination frameworks, Low-Emission Climate Resilient Development Strategy is expected to simultaneously address the threats, risks, vulnerabilities and uncertainties associated with global climate change and the pressing development needs countries face as they pursue sustainable development.

A well-designed Low-Emission Climate Resilient Development Strategy can better equip Bhutan to blend domestic and international, as well as public and private climate financing opportunities, helping countries achieve the desired developmental results. The low-emission and climate-resilient development strategy therefore is not new from the conventional climate change strategy integrating mitigation and adaptation options.

National adaptation programme of action

In accordance with the decision of the 7th session of the Conference of Parties of the United Nations Framework Convention on Climate Change held at Marrakesh, Morocco in the year 2001 and the guidelines developed by Least Developed Countries Experts Group, the 49 least developed countries who are signatory party to the Convention were required to develop National Adaptation Programme of Action to assess and identify urgent coping mechanisms against the immediate threats of climate change.

Efforts focused on determining immediate indigenous or scientific mechanisms capable of addressing small-scale and localized climate induced disaster risks and impacts. As the first least developed country to submit its National Adaptation Programme of Action in 2006, Bhutan has accessed funding from the Least Developed Country Fund and is currently implementing a project comprising of three priority activities out of nine activities. The project with a funding of US$ 3.5 million from the Least Developed Countries Fund and an equal co-financing from other partners

is in the third year of implementation.

The 14th Conference of Parties held in Poznan, Poland in December 2008 approved requirements for the revision of National Adaptation Programme of Action. The Royal Government of Bhutan is currently revising its National Adaptation Programme of Action with an update of ten prioritized activities centred on disaster risk reduction and water management. The revised National Adaptation Programme of Action has extended its coverage to encompass rural and local participation in project implementation and gender equality and is expected to be finalized within 2011.

In the light of climate change adaptation challenges, four countries of the southern slopes of the Eastern Himalayas – Bangladesh, Bhutan, India, and Nepal – on the initiative of the government of Bhutan with support from international organisations and non-governmental organisations, have decided to come together to develop and agree on a sub-regional road map for climate change adaptation. The objective is to adopt a 10-year regional road map addressing emerging climate related challenges to ensure food, water and energy security while maintaining biodiversity and eco-system services in the Eastern Himalayas. Cross-cutting issues such as health, gender and disaster risks related to climate change will also be integrated in the roadmap.

The roadmap is under preparation to be presented at the Climate Summit for a Living Himalayas, hosted by the Royal Government of Bhutan in November 2011. Along with the roadmap, the initiative aims to ensure further political commitment for cooperation within the sub region, create and operationalise regional expert groups to advice governments and secure pledges from partner countries and institutions to fund and collaborate in the implementation of the road map.

The initiative is the first important step towards an emerging regional position for climate change. The Climate Summit is expected to leave a legacy allowing governments and partners to better address the impacts of climate change on the economies, people and their livelihoods, and the environment. The initiative will, in addition, build capacities of the countries involved to formulate National Adaptation Programmes (NAPs) and Nationally Appropriate Mitigation Actions (NAMAs), which are requirements to access funding and technological resources under the United Nations Framework Convention on Climate Change Cancun Agreement. The initiative will in this way provide governments as well as partners with a stronger foundation for sound decision making, prioritization and cooperation to address the common challenges and generate social and economic benefits for the countries and people of the Eastern Himalayas

These recent advances are cornerstones of Bhutan's adaptation and mitigation strategies. They indicate that the Royal Government of Bhutan has started on pathways to sustain and advance its human development achievements. The remainder of this chapter is organized into two parts: the first discusses in greater detail current adaptation strategies, while the second part reviews potential mitigation opportunities in Bhutan.

4.1 Adaptation Strategies

Bhutan ratified the United Nations Framework Convention on Climate Change in August 1995 and the Kyoto Protocol in August 2002. The Initial National Communication (INC) to the United Nations Framework Convention on Climate Change was submitted in December 2000. The preparation of the Second National Communication was initiated in July 2007 and is expected to be submitted to the United Nations Framework Convention on Climate Change by end of 2011.

Bhutan's National Adaptation Programme of Action includes nine priority adaptation projects selected among 55 projects originally proposed. The projects were ranked according to four criteria:

- human life and health saved by the intervention;
- arable land saved by the intervention;
- essential infrastructure; and
- estimated costs.

The budget for the identified nine priority projects for urgent and immediate action was US$ 7.9 Million.[2] Three of the nine priority projects, all related to glacier lake outburst

flood are currently under implementation.

The national climate change focal point for the United Nations Framework Convention on Climate Change is the National Environment Commission Secretariat. The National Environment Commission Secretariat is currently also the Designated National Authority (DNA) for the Clean Development Mechanism (CDM) of the United Nations Framework Convention on Climate Change's Kyoto Protocol. There are relevant climate change mandates in several ministries including agriculture and forestry in the Ministry of Agriculture and Forestry, and energy and meteorology in the Ministry of Economic Affairs. The Ministry of Home and Cultural Affairs is the national focal agency responsible for coordination of all aspects concerning disaster management, response and preparedness.

Rural livelihoods and adaptation

Agriculture, rural livelihoods, sustainable management of natural resources and food security are inextricably linked within the development and climate change challenges of the twenty-first century. Bhutan is predominantly agrarian in nature with 69 per cent of its population living in rural areas mostly dependent on subsistence agriculture, livestock rearing, and small scale forest management.

As chapter 2 discusses, poverty is widespread and pervasive in rural areas (98 per cent of the poor live in rural areas).[3] These areas are characterised by uneven distribution of land, loss of crops and livestock to human-wildlife conflict, low level of infrastructure development, and lack of employment opportunities. The complexities and fragility of Bhutan's mountain ecosystems and geophysical conditions render rural livelihoods vulnerable to natural disasters and other physical and economic risks.

Adaptation strategies are mainstreamed into the Ministry of Agriculture and Forestry's 29 programmes including the Druk Dynamic Information Network, institutional reforms, and policies on land, food, nutrition and irrigation. Yet, adaptation challenges are often compounded by lack of human resources and capacity issues, inadequate financial investments, economic opportunities and low level of coordination among the stakeholders.

Technology needs for the agriculture sector

The first technology needs assessment for Bhutan was carried out in 2000 for the agriculture, industrial and meteorology sectors. Adaptation technology needs for the agriculture sector included both soft and hard components, including genetic improvements, mechanisation, soil and pest management, land use, cropping systems, databases and early warning systems (Table 4.1).

Table 4.1 Technology needs for agriculture Sector

	Technology identified (hardware and knowledge including local technologies)	What national or sector policies and goals does this technology meet?	What environmental benefits do they have? Does this technology aid in mitigation or adaptation to climate change?	What local situations need to be considered for this technology with regard to sustainability, suitability and local capacity
1	Genetic improvement of crops	Food security	Adaptation	Limited arable land
2	Irrigation water management	Conservation	Mitigation	Capacity and skills
3	Mechanization of agriculture	Increased income	Adaptation	Landforms
4	Integrated Pest Management	Food security	Mitigation	Capacity and skills
5	Improved soil management	Food security	Mitigation/adaptation	Traditional practices
6	Appropriate land use system	Food/conservation	Mitigation/adaptation	Sectoral demands
7	Increased efficiency of fertilizer use	Food security	Mitigation	Local resources
8	Improved cropping system	Food security	Mitigation/adaptation	Access to market
9	Introduction of improved animal breeds	Conservation/ food	Mitigation	Local resources
10	Develop data base system	Capacity building	adaptation	Not accessible
11	Early warning system	Food security	Adaptation/mitigation	Poor infrastructure

Source: NEC, 2000. *TNA Report, Agriculture Sector.*

Adopting indigenous knowledge to adapt to climate change

Indigenous knowledge can play an important role in building resilience to

climate change. Planning or implementing climate adaptation strategies to reduce the impacts of future climate change should include: an assessment of existing coping or adaptation strategies, and building on the indigenous knowledge systems of the specific communities to integrate adaptation strategies into plans and programs.

Information on indigenous knowledge in Bhutan is both scarce and ambiguous. Existing literature, nevertheless, provides a basis for opportunities in further research and exploration. An indigenous natural resource management system, for instance, exists in the communities in Central and Eastern Bhutan, which defines monitoring, accepting leadership, sanctions, and seasonal harvesting of sustainable bamboo production.

The foundation of these indigenous arrangements is that it exerts responsibilities to users, controls excessive harvesting, and monitors 'free riders' from harvesting the same resource base. In a similar manner *ladam* or *ridam* (seasonal prohibition of mountain scavenging) restricts entrance for humans and domestic animals into parts of forested areas to allow shoots to mature unhindered in many bamboo harvesting communities. Sacred groves and landscapes across rural communities often contribute to watershed protection and are viewed as an indigenous forest management practice. These types of knowledge repositories provide an important contribution to the conservation of biological diversity and complement modern approaches to natural resource management.

Urbanization and climate adaptation challenges

Existing urban development problems and future projections – where up to three out of every four Bhutanese already live in cities – compound the climate challenge.[4] For urban centres in Bhutan, flooding from heavy and prolonged rainfall or increased river flows is a direct threat to livelihoods as most centres are located in river valleys. Apart from immediate infrastructure damage and loss of lives, climate change will likely bring about health, food and water security issues to urban populations.

The degree of risks and vulnerabilities will be influenced by the quality of housing and infrastructure, urban planning and land-use management, level of preparedness among populations and climate resilience in terms of water supply and treatment, transportation, and energy systems in the urban sector. Current development controls and regulations for planned urban centres include flood and landslide mitigation measures such as drainage outlets and prohibition of constructions along floods and landslide prone areas. But the gap between policy and implementation has resulted a significant lack of adherence to these rules and regulations by property owners.

Flood water management in land use planning is also limited. In the event of heavy rainfall or storm, large volumes of water often overwhelm the drainage systems exacerbating already evident localised flooding in Thimphu valley, for instance. Coupled with inadequate waste management, severe health risks arise. Urban development swallowing prime agriculture fields and exerting pressure on food security is another issue deserving a serious review from the combined perspectives human development and climate change risk.

Climate change will likely be felt in Thimphu valley through changing precipitation patterns. The city's inadequate drainage system leaves people vulnerable to flooding after heavy rains. As rainfalls increase in number and intensity, more frequent landslide incidences are likely to occur in settlements on steep gradients as well as floods in low lying areas of Thimphu city.

Interventions will likely need to include fundamental changes such as improved urban planning and drainage systems, behavioural changes and policy decisions to support adaptation. In the context of cities this may involve targeting land use, infrastructure, transport, and social and economic security.

Disaster risk management in Bhutan

Bhutan is prone to flash floods, landslides, earthquakes, glacial lake outburst floods and forest fires considering its geophysical setting geological structure, fragile mountain ecosystems, varying micro climatic conditions and active tectonic processes occurring in the region. These recurring natural disasters have often caused extensive damages to lives, properties and infrastructures further

aggravating livelihoods and general socio-economic conditions of the Bhutanese people. It is expected that climate variability and change will add to severity and frequency of these disasters to some of the most vulnerable communities in Bhutan. The 2004 monsoon in the six Eastern *dzongkhags* brought about massive loss to lives and property (9 lives lost, 55 houses washed away or collapsed, 107 houses partially damaged, 664 acres of wet and dry land destroyed and hundreds of tonnes of food crops damaged).

Similarly in 2009, within 24 hours from 9 am on 25 May to 9 am on 26 May, an average rainfall of around 76 mm, the highest in the last five years according to Hydrometeorology Services Division, Department of Energy, was triggered by Cyclone Aila that hit the Bay of Bengal area. The record rainfall led to numerous streams and rivers swelling to perilously dangerous flood levels all over Bhutan. Rivers and streams reached record levels unheard of in the past forty years.

The floods resulted in the loss of 12 lives (9 males and 3 females). There were widespread damages to roads, bridges, crops, livestock, community infrastructure, drinking water supply systems, schools, government buildings, and hydro projects with far reaching impacts , which were felt mostly by the poorer sections of the rural population. The rains also triggered massive landslides at numerous places cutting off communities and affected areas. This hampered provision of relief assistance and evacuation of affected population at many places. In total, the estimated damages and losses amounted to Nu 719 million (US$ 17 million).

Since disaster management is multi-sector and multi-disciplinary in nature, the Ministry of Home and Cultural Affairs has been designated as the nodal agency to synergize and coordinate policies, plans and programs among various stakeholders throughout the country. The National Disaster Risk Management Framework outlines a national approach to disaster risk reduction.

Key components of the framework include:

- Institutional, legislative and policy frameworks;
- Hazard, vulnerability and risk assessment;
- Early warning systems; disaster preparedness plans; disaster management system;
- Mitigation and integration of disaster risk reduction in development sectors;
- Public awareness and education; capacity building; and communications and transportation.

Box 4.1 Cities and adaptation interventions

Climate change in urban Bhutan can impact the ways people work, live and recreate together. Accessing food may prove more difficult if agricultural systems produce less food as a result of declining water or shifting cropping seasons. Drinking water and sanitation services may be impacted by declining water availability or, in turn, overburdened by flash floods. Health, school, roads and other infrastructure are also subject to damage or destruction as a result of climate-related weather shocks. And the location of where poor city residents live may also shift—as the urban poor tend to also have the most vulnerable shelter and services.

Some climate change interventions could include:

- Relocation of residential population and economic activities to less vulnerable parts of urban areas.
- Channelling investments and shifting land use toward less vulnerable areas.
- Assisting poor and informal settlements to vacate vulnerable areas.
- Adoption of land-use planning and building codes that internalize climate change constraints and disaster risks.
- Climate proofing infrastructure systems including remodelling drainage systems that can accommodate sudden downpours.
- High capacity water supply and storage systems for drought periods.
- Enhancement of waste management and related services.
- Hydro-geological consolidation work for flood defence system
- Enhance health facilities and emergency preparedness measures

Glacial lake outburst floods

In Bhutan lives, livelihoods and human development stand at risk. This challenge is especially acute as the majority of Bhutanese population, economic activities and infrastructure development are concentrated in the country's large river valleys.

Roughly 1 in 10 Bhutanese live in Punakha-Wangdi and Chamkhar valleys, the two most vulnerable areas. The two valleys also hold 8.1 per cent of total agricultural land—a substantial part of the 7.7 per cent of Bhutan's land area suitable for farming[5].

Hazard risk reduction related to glacial lake outburst floods is carried out through artificial lowering of one of the 25 potentially dangerous glacier lakes situated in the Bhutan Himalayas. Thorthormi Glacial

Lake is one of Bhutan's most dangerous glacial lakes which was earlier predicted to burst as early as 2010. Since 2008, a multidisciplinary team and approximately 350 workers have succeeded in lowering the water level by 2.23 metres against a target of 5 metres by 2012 by draining water out of the lake to release the pressure on the moraine dam.

Since use of heavy machinery at the site was not feasible and would further de-stabilize the moraine dam of the glacial lake, the excavation work at Thorthormi Lake is done manually with simple tools and implements to dig ice and remove boulders to create a channel to drain out water. This approach also provides income to more than 350 local workers and contributes to local enterprise development through their savings.

Working under a hostile and harsh environment above 4,200 metres, the multi-disciplinary team responsible for planning and carrying out the artificial lowering has established a strong partnership between various government agencies. This partnership contributes not only to national capacity building in artificially lowering the lake level but also to effective planning and monitoring of the workforce as well as management of environmental, health and safety aspects

The draining of Thorthomi Lake demonstrates the potential of integrating climate risk projections into existing disaster risk management and development practices. Although the Department of Geology and Mines has sufficient technological skills in engineering and adequate capacity to carry out geotechnical assessments and mapping, it still lacks advanced equipment and innovative mechanisms to lower the water levels. At the same time involvement of district authorities and local communities, their comprehension and acknowledgement of glacial lake outburst floods and associate impacts is still limited.

Additionally, monitoring and assessments of the glacial system are sporadic depending mostly on availability of funding opportunities. Therefore, consistency in follow up action, replication and scaling up of similar initiatives is temporal, spatial and resource specific in nature. Other challenges include:

- Lack of adequate preparedness mechanisms and institutional set-up for risk reduction and hazard mitigation.
- Poor resource base of communities and lack of accessibility and communication.
- Information gap between science and research institutions, policymakers and communities on glacial lake outburst floods hazards/risks.
- Tough terrain and daunting weather conditions, which hamper accessibility.
- Over-dependence of communities on the government for risk mitigation and preparedness initiatives.
- Lack of community cohesion obstructing effective community-based disaster preparedness/mitigation planning.

Community-based disaster risk management

Under the national disaster risk management framework, the promotion of community-based and people-centred approaches to disaster risk management is considered a vital component because communities are the primary beneficiaries of the disaster risk management processes. More importantly, through such initiatives, communities are better positioned to comprehend local opportunities and disaster management constraints. Growing evidence also exists that top-down approaches to disaster risk management fail to address specific local vulnerabilities. Broad, consensus-based strategies established by practitioners need to place further emphasis on enhancing local involvement in disaster risk management.

The framework identifies the following strategies to enhance the capacity of local communities to participate effectively in planning and implementing disaster risk management interventions:

- Enhance community capacity in multi-hazard risk management and preparedness in vulnerable administrative units in a prioritized manner.
- Build the skills and aptitude of the community including vulnerable groups.
- Capacity building and training in developing disaster preparedness plans at the community level.
- Tap expertise from relevant organizations to facilitate the process.
- Rehearse preparedness planning at community levels at regular intervals to ensure sustainability of the process and to ensure updating of the plan.

- Using participatory approaches to involve all members of the community in planning.
- Understand local gender roles, including different vulnerabilities

Community-based disaster risk management trainings and planning processes have been successfully promoted on a pilot basis in nine of Bhutan's 20 districts. A draft Disaster Management bill has been underway since its formulation in 2008 in order to further strengthen disaster risk management in Bhutan. The draft bill was further strengthened in 2010 and 2011 to include lessons and best practice from recent disasters in Bhutan as well as with inputs from the international experts. Upon adoption by the Parliament, the Disaster Management act is expected to strengthen the institutionalization and decision-making processes related to disaster risk management for disaster preparedness, risk reduction, response and recovery through, among others:

- Establishment of a coordinating National Disaster Management Authority.
- Appointment of district disaster management focal points and committees (already introduced on a pilot basis).
- Establishment of central and district Emergency Operation Centres.
- Improved mechanisms for international relief assistance and financial allocations for disaster management.

Constituting the legislative framework for disaster management, the bill will also strengthen Bhutan's capacities for reducing risks from and responding to climate-related hazards.

4.2 The Role of Ecosystems in Climate Adaptation

The climate-environment-poverty nexus

There is a complex set of relationships that exist among climate change adaptation, the livelihoods and well-being of the poor, and the resilience of ecosystems and their associated services. At the outset, poverty and environmental sustainability are inextricably linked in Bhutan where many depend on forest resources to supplement income and livelihoods.

Climate-proofing natural resource management plans and programmes

Climate change is already impacting on ecosystems and livelihoods, but enhanced protection and management of biological resources can mitigate these impacts and contribute to solutions as nations and communities strive to adapt to climate change. Protecting forests and other natural ecosystem can provide social, economic, and environmental benefits, both directly through more sustainable management of biological resources and indirectly through protection of ecosystem services. Improved protection of high biodiversity forests, grasslands, wetlands, and other natural habitats provides benefits for biodiversity as well as carbon storage.[6]

Conservation initiatives in Bhutan are broadly carried out through protected areas, community forestry, social forestry, non-wood forest products and water resources management. However, the creation of the network of protected areas and other natural resource management plans and programmes are based on a static climate scenario.

Considering climate change impacts on natural resources and subsequent effects on livelihoods of a majority of the Bhutanese population, it is vital that future conservation and natural resources management plans and programmes integrate adaptation outcomes and objectives into its strategies. Even as it ensures ecosystem services, it also creates the opportunity for enhancing the role of forests as a carbon sink. For the purpose of both mitigation and adaptation to climate change, natural resource management in Bhutan will require additional knowledge and skills, technologies, capacities, coordination and partnerships among relevant stakeholders in natural resource management.

Forest and biodiversity

To address climate change impacts on forest and diversity sector, it is important to enhance knowledge on the linkages between climate change and various ecosystems and species and develop models to predict change. Inorder to improve management intervention,

there is a need to conduct comprehensive biodiversity assessment and inventories of the totality of genes, species and ecosystems and their composition, distribution and dynamics and assess technological needs to improve management of pests, fires, invasive species and other stressors on biodiversity. Other intervention include:

- Develop strategies to enhance awareness and education on climate change impacts on biodiversity amongst stakeholders and beneficiaries.
- Mainstream climate change adaptation and mitigation into biodiversity policies, plans and programs.
- Enhance coordination and partnerships among stakeholders and communities including public, private and civil societies.
- Build community and stakeholder capacities to conduct research, plan, implement and evaluate.

Water resource management

Several key interventions can be focused in water resources management. A priority is to improve understanding of the impacts of climate change on water resources and water-related sectors. This will entail determining data and information gaps and detailed assessments on physical and natural attributes, stressors and impacts.

At the institutional level there is a need for better coordination mechanisms among water stakeholders to bring about synergies in piecemeal mandates, jurisdiction overlaps, accountability and liability.[7] Other interventions include the following:

- Bring about a holistic water perspective through the integrated water resources management processes to synergize climate adaptation among water related sectors such as agriculture, forestry, energy, health and so forth.
- Build human resource capacity in water resource management at the community, *dzongkhag* and central levels to enable integration of climate adaptation into water resource management.
- Apart from the 'soft components' invest in hard components such as technologies and infrastructure development to ensure water security in accordance with the water user priorities in the Water Policy of Bhutan.

Payment for ecosystem services and climate adaptation

Payment for ecosystem services is the practice of offering incentives to farmers or landowners in exchange for managing their land to provide ecological services. Conceptually, payment for ecosystem services reinforces the case for sustainable resource management and incentive applications for conservation and livelihoods. This requires better understanding of the local natural resources and ecosystem, and protection of watersheds and forest resources.

Paying for services and resources from the natural ecosystems incentivizes sustainable resource management, orienting economic activities toward long term sustainability of resources and diversifies local livelihoods through alternative income generation schemes. Natural resource markets exist at many scales, from global carbon markets to local water and forest markets. Similarly, buyers and sellers could be at the scale of individual nations or local actors such as communities living upstream and downstream. While there are no formal standards for ecosystem payments, transactions can take place in the form of compensation schemes including monetary payments, local infrastructure, social and public services like health and education.

Increased local participation in decision-making and control or ownership over resource management is also a benefit of paying for ecosystem services. These positive trends are expected to translate into better response capacity in local communities. Combined with better resource management and livelihood incentives, payment for ecosystem services is believed to improve the adaptive capacity of communities in the face of climate change. Bhutan can rely on its history of local participation to develop adaptive capacity further as climate risks likely mount.

At the national level, given Bhutan's water, forest and biodiversity resource base, watershed ecosystem in Bhutan is considered to have the most feasible ecosystem service along with biodiversity and aesthetic services. According to a study on the 'Analysis of the contributions of protected areas to social and

economic development' carried out by the Department of Forests and Park Services, Jigme Singye Wangchuck National Park alone contributed a total of Nu 25.748 million to the local communities through provision of forest products, tourism, and other ecosystem services such as drinking water and irrigation. At the national level, total contribution from the six protected areas to the socio-economic development of Bhutan was estimated at Nu 1150.147 million from resource use, hydropower generation, tourism and other ecosystem services.

Some of the supporting conditions and opportunities to link climate adaptation to ecosystem services are already present in existing policies and programmes in the energy sector, tourism, and environment and forest sectors. This could be further strengthened by addressing a number of constraints within the institutional set up, plans and programmes.

Local level payment for ecosystem services strategy for Bhutan could include the following:

- Assess watershed and biodiversity ecosystem services.
- Improve understanding and information on buyers and providers of ecosystem services.
- Enhance understanding and information on the linkages between climate adaptation and existing ecosystem services and develop payment mechanisms.
- Build awareness among both service providers and buyers on the concept of payment for ecosystem services and its linkages to climate adaptation.
- Build local and stakeholder capacities in resources assessment, management, monitoring, valuation and various other issues.
- Establish a platform to bring ecosystem providers and users together and enhance communication, dialogue, negotiation, and trust among the stakeholders.

4.3 Social Protection Policy—links to Climate Adaptation

In most developing countries, states play the major role in providing social and economic well-being to its citizens. But in many instances, development and well-being often do not trickle down to the weakest section of societies. For these groups incomes are not rising at par with the nation as a whole, and they often lack access to key services and basic necessities. Therefore, social protection initiatives that transfer income or assets to the poor, protect the vulnerable against livelihood risks, and enhance the social status and rights of the marginalised should be extended to reduce the economic or social vulnerability of poor, vulnerable and marginalised people.[8]

Yet, such initiatives have not considered the long term climate change risks of some of the most vulnerable communities. In many instances, climate change adaptation and disaster risk reduction are obscure technical processes within the given institutional environment with objectives and outcomes that are often driven by those who provide the financial resources.

Social protection policies and institutions need to learn from and incorporate adaptation and disaster risk reduction approaches to ensure interventions and programmes effectively support livelihoods and protect the poor and marginalized from climate change shocks. Bringing social protection, adaptation and disaster risk reduction into a unified perspective can integrate multi-sector approaches, make communities and societies more resilient to shocks and stresses, and demonstrate approaches to minimizing risks to vulnerable communities.

Social protection in Bhutan covers most categories including labour markets interventions, social insurance, social assistance or transfer of resources to the poor and the vulnerable. Social protection is provided by the Tenth Five Year Plan, which specifically focuses on poverty reduction as an over-arching goal. In terms of labour market, the 2007 Labour and Employment Act of Bhutan provide some protective strategy in terms of employment and working conditions. The 2002 National Pension and Provident Fund Rules provide for those already employed, pension management services. This is supplemented by the National Housing Development Policy that ensures provision of safe and affordable shelter to all Bhutanese. Similarly, the health and education policies ensure access to basic health and education services.

Apart from the state-run institutions providing social services, the civil society group

Table 4.2 Promoting adaptation through social protection

Social Protection Category	Social Protection instruments	Adaptation and disaster risk reduction benefits
Protective **(coping strategies)**	-social service provision -social transfers (food/cash), including safety nets -social pension schemes -public works programmes	-protection of those most vulnerable to climate risks, with low levels of adaptive capacity
Preventive **(coping strategies)**	-social transfers -livelihood diversification -weather-indexed crop insurance -social insurance	-prevents damaging coping strategies as a result of risks to weather-dependent livelihoods
Promotive **(building adaptive capacity)**	-social transfers -access to credit -asset transfers or protection -starter packs (drought/flood-resistant) -access to common property resources -public works programmes	promotes resilience through livelihood diversification and security to withstand climate related shocks - promotes opportunities arising from climate change
Transformative **(building adaptive capacity)**	-promotion of minority rights -anti-discrimination campaigns -social funds - Proactively challenging discriminatory behaviour	-transforms social relations to combat discrimination underlying social and political vulnerability

Source: *POVNET Task Team on Social Protection and Empowerment*

is an emerging entity that compliments the programme and interventions of the state in providing the Bhutanese with social security. Most programme are aimed at enhancing the capabilities of the most vulnerable sections of the Bhutanese society that includes the poor and the marginalized, women, children and the disabled through direct transfer of cash and assets, or through provision of education and training services. Additionally, the financial institutions and insurance companies provide access to financial services, micro credits and insurance schemes.

Tapping into insurance potentials

The Royal Insurance Corporation of Bhutan Limited founded under the Royal Charter in 1975 was the only insurance company until 2010 when the Bhutan Insurance Limited with a joint private ownership was established. In the Bhutanese context, the concept of financial vulnerability and risk sharing through insurance is popularized through two broad categories under life insurance and general or non-life insurance schemes (motor, fire, marine, aviation, cattle). Under the fire insurance policy, an additional premium payment extends insurance for property to the risks posed by most natural disasters including earthquake, storm, floods, landslides or rockslides, explosions and other calamities. However, the use of insurance is limited given the economic and cultural context.

The rural house insurance scheme covers permanent and semi-permanent houses for fire, earthquake, flood, landslide, and storm, all of which are common events in Bhutan. The scheme was revised in January 2000 to give compensation of Nu 100,000 for a permanent house with an annual premium of Nu 150, and Nu 40,000 for a semi-permanent house with an annual premium of Nu 60. Total claims have increased considerably since the revision (from Nu 2.2 million in 1999 to 93.2 million in 2010).

Role of corporate social responsibility in national insurance companies

Considering the existing insurance

institutional set up, their human and financial capacity, and the profit-oriented nature of these entities, there is an opportunity to tap into their insurance schemes and products through the introduction of concept of corporate social responsibility into their policies and plans. Corporate social responsibility by definition is the deliberate inclusion of public interest into corporate decision-making by honouring the people, planet, and profit. These companies could therefore institute a set of tailored insurance services for climate related risks and vulnerabilities especially for the low-income and marginalized communities and households.

Crop insurance

Conventional crop insurance is a financial risk reduction tool for safeguarding farmers against crop losses due to natural calamities and hazards. The most common two categories of crop insurance are crop-yield insurance and crop-revenue insurance. The Royal Insurance Corporation of Bhutan in collaboration with the Department of Agriculture plans to introduce a crop insurance scheme for the first time in Bhutan. The scheme will mainly cover the insurance of staple crops against rain, storm, earthquake, pests and wild animals. The scheme is provided as a form of corporate social responsibility to Bhutanese farmers in high climate-risk contexts.

However, conventional crop insurance accrues high monitoring and administrative costs, adverse selection and moral hazard, and is often seen as a poor model for developing countries with resource constraints. As opposed to conventional crop failure insurance, index-based insurance including rainfall measurements at a local weather station is expected to act as a proxy for crop losses rather than using crop yields to determine claims. Without field inspections, monitoring costs are low and measurements are based on specific and objectively verifiable data.

In Bhutan, a majority of the total arable land is rain fed – 68.2 per cent or 263,811 acres is dryland. Although index-based insurance seem feasible based on arable land use, there are prerequisites to this type of insurance schemes that includes reliable network of weather stations, historic rainfall data, relatively uniform weather patterns, similar soil holding capacities for farms insured against a specified station, ability to provide education and training, and so forth. This will entail a detailed assessment on the feasibility of crop insurance scheme taking the Bhutanese agricultural system into context.

Box 4.2 Insurance lessons

In 2003, with the World Bank's technical assistance an Indian insurance company, ICICI Lombard, designed a pilot weather-based insurance and BASIX, a microfinance institution, marketed it. Reinsurance was guaranteed by Swiss Re. In 2003 policies were sold to 148 farmers with an average of 2-10 acres of land. During this pilot project two major problems emerged:

- Cash availability during marketing days, since timing of sales coincided with seed purchasing.
- Complexity of the insurance, since most farmers did not understand "millimetres of rainfall."

Based on feedback from farmers, the insurance has then been improved and by the end of 2006, 150,000 farmers bought the insurance. According to ICICI Lombard, weather insurance needs extensive government support for product promotion, subsidy and service tax.

These two principal lessons can be applied in developing climate insurance markets for Bhutanese farmers.

Source: Climate and Disaster Governance and Mechler et al. 2006

Micro-insurance/community-based insurance

Studies on micro insurance or community-based insurance are being conducted by the Royal Society for Protection of Nature to look at the feasibility of insurance concepts in management of human-wildlife conflicts in specific locations. This pilot project could demonstrate the practicability of community-based insurance schemes and if successful could be replicated and scaled up to include larger areas of operation and include elements related to climate change and disaster risk reduction.

Lessons from other countries

In other parts of the world, insurance organizations have been specifically established to ensure services for the low-income market through non-governmental organisations or other micro finance entities often called micro-insurance companies. Other types of insurance

that cover low-income and vulnerable groups include mutual insurers which are non-profit organizations with professional insurance management capacity, and Non-Governmental Organisation (NGO) insurers that focus on low-income groups since the schemes and products are not driven by profit motives.

Bajaj Allianz launched its first micro insurance product in 2003 in India, and went on to cover more than 100,000 customers. The humanitarian crisis which followed the tsunami in 2004 prompted Allianz to partner with CARE International, an organization with extensive experience in microfinance in India. The partnership provides tailor-made packages specifically for people who live near the coast and work in fishing, agriculture and plantations. In Indonesia, they are teaming up with GTZ to offer a micro insurance pilot product, 'Paying Keluarga' (meaning 'family umbrella'). In Egypt, Allianz have worked in collaboration with Planet Finance, Surety Fund and a number of European reinsurers to develop a pilot project offering death and disability insurance to more than 30,000 customers.

Approaches to linking adaptation, risk reduction and social protection policy

Potential exists to develop a framework for adaptation, disaster risk reduction and social protection policy that includes mapping and improving evidence base through applied research and improvements in information and knowledge.

Social protection policies, instruments and programmes should have a longer term perspective on social protection while planning interventions that considers climate change impacts and disaster risk reductions.

Social protection interventions need to address social issues and vulnerability based on the reality of each community context rather than relying on a blanket programme for all. Therefore, it should be people-centred with specific focus on community-based adaptation.

Social protection programmes and interventions should allow for coordination among stakeholders and institutions to ensure synergies in the three fields of social protection, adaptation and disaster risk reduction.

Gender and climate change adaptation

Throughout the world, there are gender-specific differences in consumption patterns, lifestyles, access to and control of resources and power, and vulnerability to climate change. A growing body of literature discusses the connection between gender and the effects of climate change. Understanding and integrating gender-specific vulnerabilities help ensure that the implementation of gendered adaptation practices relieves some of the disproportionately high burdens of the adverse effects of climate change that women bear.

Studies in the region indicate that women folks in general will experience a higher level of adverse impact of climate change due to their social, economic and cultural circumstances. Poor access to resources, limited mobility, education, restricted rights and low level of participation in the decision making process are some factors that could contribute especially to their vulnerability to the negative impacts of climate change.

On the other hand, gendered roles are believed to create opportunities for climate adaptation. Women are considered to possess valuable knowledge and have comprehension (from long interaction and experience) about managing water and forest resources, soil conservation, social networking, nurturing children, and recently financial prudence has been added to the list in a case on loan servicing by the Bank of Bhutan.

Considering the special vulnerabilities and opportunities, it is crucial that adaptation plans and programmes consider the different roles, needs, adaptive capacity, knowledge and perspectives of men and women.

- Due to a gender-based division of labour, men and women perform different jobs/ tasks. Climate change will alter what they can do, exposing men and women to different risks and opportunities. Men may migrate for work while women may spend more time collecting fuel and water, for example.
- Men and women have different access to resources, including physical resources like land, social resources like networks, and financial resources like income-generating work and credit. In times of

change, they will have different options and 'safety nets' for coping with change.

- Based on their distinct roles, women and men have different sets of knowledge and skills, such as knowing which seeds to plant during a dry spell or knowing how to dig a well. Recognizing their contributions will result in a wider range of options for preparing for and coping with change.
- Participation in decision making and politics, and access to decision makers is not always equal for men and women and this may affect their participation and the representation of their ideas in short- and long-term decision making on climate change.
- The time women spend caring for children made ill by waterborne diseases diminishes their opportunity to engage in productive work.

To achieve this, the population perspective plan 2010 recommends that national plans and programmes mainstream gender issues, strengthen information, advocacy, and awareness on gender equality, promote participation in politics and the decision-making process, and enhance employment opportunities. Gender mainstreaming within the national policy, plans and programmes is seen as an important component of climate change framework in general and adaptation in particular.

Bhutan's draft revised National Adaptation Programme of Action includes only one reference to women noting the need to recognize gender balance, especially in the implementation of developmental activities and in the participation of both men and women.[9] While this keynote reference is critical, there is no other mention as to how to implement the inclusion of women in to the design and implementation of development activities and building climate-resilient projects. The inclusion of women into adaptation in Bhutan must take on deeper degrees of participation.

Role of private sector in climate adaptation

The case for private sector engagement in climate adaptation

Climate change will have increasing repercussions on private sector businesses through direct and indirect risks and impacts on investment conditions and factors such as (i) the availability of and demand for resources; (ii) the performance of physical assets and; (iii) supply of and demand for products and service. The magnitude, increasing frequency, and steep financial losses due to several recent climate events are evidence that the private sector is not immune to climate risks. On the other hand, climate change adaptation effort is expected to generate new business opportunities for the private sector in risk management and increased demand for new technologies and infrastructure.

Apart from private sector financing and insurance opportunities for climate change adaptation, potential exists for specific competencies and capacities to make unique yet effective contributions to adaptation. These could occur through the design of resilient infrastructures, innovative technologies, and development of improved communication and information—while managing hydropower, housing and road construction in Bhutan. Potential private sector contributions can cut across all sectors, from agriculture, energy and urban planning, to environment and health.

In the agriculture sector for instance, opportunities for future investment in relation to climate change includes but is not limited to developing and/or adopting soft and hard technological components such as drought resistant crop varieties, fertilizers, crop rotation patterns, and irrigation equipment and technologies that are conducive to the vagaries of weather and climate. In the urban sector, climate adaptation strategies will require private investments and engagement in creative and effective technology and innovation in engineering, construction, water treatments, and waste treatments to mitigate the risks posed by climate change.

Public-private partnership in climate adaptation

Private sector in Bhutan is relatively under developed but has seen some growth and transformation over the years. Today, the sector is engaged in a wide range of activities from trading and manufacturing to services industries in tourism and education. Even as the sector is relatively small and emerging as an 'engine of growth' in the country's overall growth process, it is often constrained by access to financial resources, knowledge and skills, adequate infrastructure, and market opportunities. Recent developments and public sector initiatives such as the Economic Development Policy and Foreign Direct Investments places emphasis on strengthening the capacity, mobilizing resources, and providing a set of incentives to encourage the development of the sector in Bhutan.

From the perspective of the role of private sector in climate adaptation, the opportunity to capitalise on the ongoing processes of public-private partnerships and collaboration is apparent. However, there is still the need for public sectors to engage and mobilise private sector more effectively, through more inclusive consultation and explicit role of the private sector actors in national adaptation plans, programmes and policies. Studies suggest that engagement may be better harnessed if some of the issues related to information, knowledge, capacity, communication, partnership and collaboration are addressed to some degree. For the private sector, this requires:

- Comprehensive understanding and knowledge of both threats and opportunities of climate change in terms of investment requirements through improved information and availability of climate science data, location specific and sector specific impacts.
- Improved tools and resources for priority mapping to support investment decision-making.
- Access to financial resources and incentives to change the structure of 'business as usual' attitude, plans, policies and strategies.
- Better understanding of Corporate Social Responsibility to make a case for responsible businesses and engage in (i) collaborative efforts to build climate resilience and (ii) social protection policies and plans related.
- Improve collaboration and dialogues among the public, private and civil society sectors for development of climate related risk management frameworks (One way to do that would be to open up regional and/or global mechanisms to private sector participation).

Meanwhile existing collaboration between public and private sectors in development and growth needs more prioritizing and strategising to (i) improve focus on resilience building efforts; (ii) align growth agenda with development agenda especially in areas where there are conflicts over resource use and management; (iii) clear points of reference for common challenges.

4.4 Living within a Carbon-neutral Budget

At the 15th session of the Conference of Parties of the United Nations Framework Convention on Climate Change held in Copenhagen in 2009, the Royal Government of Bhutan declared that the country shall remain carbon neutral for all time to come, as a commitment to its future generations.

Bhutan's leaders stated: "We commit ourselves to keep absorbing more carbon than we emit – and to maintain our country's status as a net sink for GHG." The 'Declaration of the Kingdom of Bhutan – the land of Gross National Happiness – to save our planet' stands among the world's first national commitment to live within a zero carbon budget. The declaration pledged that:

- For all times to come, Bhutan will remain carbon neutral.
- Bhutan will continue to follow and be guided by a strong sense of conservation ethics.
- Bhutan will not produce GHG in excess of what the country can sequester but will also serve as a carbon sink for the world in general.

The Declaration further strengthened Bhutan's position as a committed, dedicated nation when it comes to ecological

conservation and concerns about greenhouse gas emissions and climate change.

Bhutan's commitment, however, does not come without costs. These include loss of revenue from restrictive logging and timber extraction, reduced returns from farming and mineral resources mining as well as non-intrusive forms of tourism. Besides, the cost of maintaining ecological balance against rising population, agricultural growth, urbanisation and industrialisation, and the cost of conservation are some of the challenges.

This commitment requires a twin approach. First, creating ways to keep absorbing carbon is necessary. This makes the 60 per cent forest cover commitment double as a mitigation strategy and demand for carbon absorbing technology critical.[10] Second is the need to engage on sustainable pathways of human development that are low-carbon based. The expansion of income, health, education and other social and political achievements in Bhutan should be built on low-carbon trajectories.

The global community holds a defined responsibility to come forward with a mechanism to reward Bhutan's resolve and support appropriate mitigation and adaptation measures.

Broader, global implementation of carbon emissions mitigation strategies are part and parcel of Bhutan's human development. Slowing and altogether ending the future effects of climate change is an endeavour that binds all nations and peoples. Achieving a post-Kyoto agreement thus is an important step in limiting the human costs of climate change - a problem for which Bhutan holds no responsibility, yet suffers severe consequences from. Bhutan's zero carbon budget commitment figures as a key recognition of this global interconnectedness.

The reality is that maintaining a zero or net carbon sink budget for Bhutan will not shift global climate change trajectories. But the implications of the commitment are far-reaching, for Bhutan and globally. Changing understandings of economic growth is critical in Bhutan. Decoupling emissions from growth in economic planning is necessary to sustain human development advance. Yet, Bhutan's net carbon sink commitment is also an example to the international community—a small, mountainous country rising to the climate challenge.

Decoupling emissions and economic growth

An initial reaction is that the declaration to remain carbon neutral would forever mean Bhutan will have to forego considerable economic opportunities. As a developing country, Bhutan would have otherwise seen an increased per capita emission while pursuing its development goals. But this does not have to be the case. Delinking carbon emissions from economic and human development is the horizon that Bhutan – and indeed the world – must look toward.

Tackling other drivers of carbon emissions

Maintaining a net carbon sink through future mitigation strategies and clean technologies is crucial. Yet, other factors also influence carbon emissions outside of the normal menu of mitigation options. As drivers of Bhutanese climate change, population growth, rural to urban migration, erosion of traditional values, and their resulting effects on society and ecology demand greater recognition.

Protecting development advances is crucial, as Bhutan has experienced significant socio-economic development over recent decades. The Millennium Development Goals are recognized to have been largely on track to achieve their targets—paradoxically posing severe concern for the reversal of development gains by unmitigated climate change impacts. Climate-proofing development is a key demand for Bhutan's national development strategy.

The remoteness and difficult terrain in different parts of the country, with pockets of poverty spread all over the country, is also set to interact with climate-induced impacts, including floods destroying bridge and road infrastructure—potentially blocking a community's ability to secure food and other commodities in support of its livelihoods and preventing children from accessing schools. To reach these marginalized and often poorer communities, there is a need to implement prudent policies for furthering the Millennium Development Goals through

targeted interventions and tackling.

Fulfilling the carbon neutral commitment means that activities that would harm the environment such as use of pesticides, logging and mining, mass tourism, industrial growth, transportation, waste management and consumption needs to be managed properly even though they represent better economic opportunities. The following are some initiatives that need to be supported to help Bhutan remain carbon neutral.

Technology transfer

Renewable energy technology options

Although Bhutan is dependent mainly on hydropower, a relatively clean and benign source of energy, for its electricity requirements, extension of grid to far flung and remote areas is an expensive option. In this context, it is worthwhile to examine other renewable energy technologies, including micro hydels, mini-hydel, solar and biomass gasifier, as decentralized energy options. Support must continue for Royal Government of Bhutan's initiatives for mini-micro hydels, solar PV systems for off-grid rural areas and for reviewing of solar energy programmes and formulation of a sustainable solar energy programme.

Improved technology to reduce fuel wood consumption

Most Bhutanese in rural households use wood for cooking and heating purposes thereby affecting the local environment. Efforts to provide improved stoves that not only reduce fuel wood consumption but also offer health benefits must continue.

Introduction of fuel-efficient vehicles

The number of vehicles in the country has almost doubled in the five years from 2005 to 2010 (Figure 4.1). As of December 2010, the number reached 53,382, giving an average growth of around 9 per cent annually. Out of the 53,382 vehicles, almost 55 per cent are registered in Thimphu region, 34 per cent in Phuentsholing region and 6 per cent in Samdrupjongkhar and 4 per cent in Gelephu region. With the increase in vehicles in the country, CO_2 emissions are also increasing. Fiscal and technological support is needed to encourage the import of fuel-efficient cars.

Innovation and public involvement

Innovation will be central to Bhutan's remaining a carbon-neutral country. Prize funds led by the Government and financed by development partners to locate especially tailored mitigation strategies to Bhutan's context can pave the way for new technologies.

Though the public seldom see themselves as responsible for climate change, public involvement and an understanding of climate change is absolutely critical to ensuring that emissions are reduced in a cost-effective way and that current and future climate risks are addressed. More education and fact-based public discussion is needed to educate Bhutanese of all ages on the effects of climate change and the steps the Government is taking now and in the future. The mass media is the best avenue for this, though the education system should also include topics related to climate change.

As a country that has taken large strides in economic and social progress and with a strong concern for the environment, Bhutan is prepared to move forward as a global leader in addressing climate change, as underscored by its zero carbon commitment. Minimising the impacts of climate-related risks on human development, Bhutan must now take centre stage in its development strategies and frameworks.

The Bhutanese public is both concerned and willing to act. Bhutanese institutions have the political will to avoid the worst damages from climate change by taking on the responsibility of reducing emissions. The Bhutanese scientific and research community must also rise to advance understanding of climate risks. The next several decades are critical for the development of methodologies which will help alleviate the dire impacts of global climate change and also protect Bhutan from climate-related damages. As the last decades of environmental stewardship have shown, Bhutan is ready to meet this challenge.

Ending energy poverty—part of the climate fight

Connecting households

As access to adequate energy services benefits health, agriculture, education, communication and tourism sectors among others, providing access to adequate, safe, reliable and affordable energy has been one of the main development priorities of the Royal Government of Bhutan. Availability of efficient, reliable, affordable, clean and uninterrupted supply of lifeline energy therefore determines energy security in Bhutan.

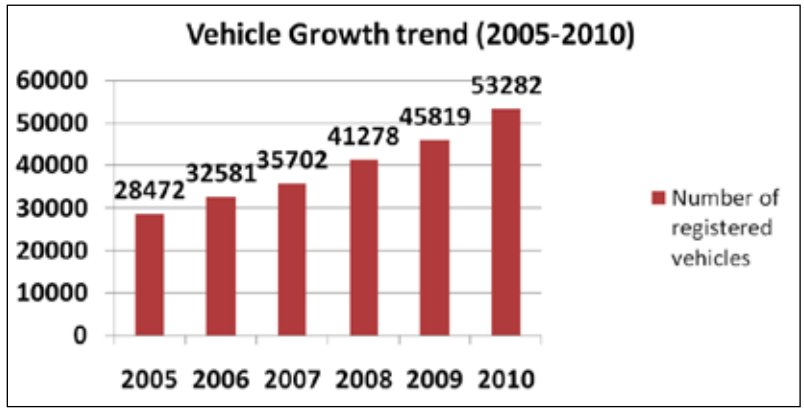
While biomass and hydropower are the primary energy sources, Bhutan also imports fossil fuels to meet its energy requirements, especially for the transport and industrial sectors. Today, about 73 per cent of Bhutan's rural population has access to clean and renewable energy and the Royal Government of Bhutan has set a target to provide electricity for all by 2013.[11] The Rural Electrification Department, Bhutan Power Corporation, is responsible for the construction of medium voltage and low voltage electricity distribution infrastructure by grid extension and ultimately providing service connections to rural areas. During the Tenth Five-Year Plan period BPC has been entrusted with the responsibility of providing electricity service connections to over 40,000 rural households.

Sustainable alternative energy

As the country is totally dependent on hydropower for its electricity needs, Bhutan is very vulnerable to the impacts of climate change. Therefore, in Bhutan's context, "responding to climate change effectively is also an opportunity to secure energy security through diversification of the energy supply mix. The supply mix could come through the promotion of non-conventional renewable energy resources supplemented by energy efficiency and demand side management."[12]

Today, hydropower is not only one of the primary sources of energy for the country but is also one of the most important elements of Bhutan's economy, contributing about 45 per cent of the national revenue while making up about 19 per cent of the country's gross domestic product. As mentioned in Chapter 3, studies show that the country has a theoretical hydropower potential of 30,000 MW out of which 23,765 MW is techno-economically feasible.

Figure 4.1 Vehicle growth trend



Source: Bhutan Climate Summit Energy Expert Group, 2011

While it is acknowledged that Bhutan has vast water resources and impressive potential for hydropower development, any likely change in the flow regime due to increased glacier melt as a result of rise in temperature and erratic rainfall patterns caused by climate change will have direct impacts on the energy security of the Bhutanese people. The energy security of the rural Bhutanese population is also at risk as biomass is their primary energy source -biomass sources are also vulnerable to climate change impacts and excessive exploitation of this resource could lead to soil erosion, landslides and glacial lake outburst floods.[13]

Therefore, while it is appreciated that hydropower is a primary energy source in the country and a major contributor to economic growth in Bhutan, equal attention needs to be given to the development of other energy sources in order to ensure energy security of the country. Fossil fuels imported by the country include petrol, diesel, LPG, kerosene and aviation turbine fuel. High fuel prices hold a significant impact on Bhutan's balance of payments. Small deposits of sub-bituminous coal are found in south-eastern Bhutan and are used by some of the industries. Right now, solar energy is harnessed as a part of the rural electrification programme for lighting homes, powering telecommunication equipment and

for heating water in some institutions. The feasibility of tapping wind energy is being studied.

Other issues related to energy security include:

- The rugged topography poses a huge challenge in ensuring access to grid supply, therefore decentralized energy systems have to be promoted to make the vision of electricity for all by 2020 cost efficient;
- Population growth could lead to an increase in the use of conventional fuels and in increase in greenhouse gases thereby placing stress on the available carbon sink.
- With the expansion of the road network all over the country, vehicle ownership is increasing every year, especially in the more urban cities of Thimphu and Phuntsholing. Therefore, more focused initiatives have to be taken to develop efficient mass transport systems in urban areas. The introduction and promotion of low emissions vehicles are also essential to reduce emissions from the sector.
- This must be supported by improvements in planning and designing roads, capacity building, and initiatives to encourage the private sector to provide the technical services for the introduction of such new technologies.
- There is also an urgent need for increased collaboration and technical assistance in terms of financing, technology transfer and institutional capacity strengthening both within the region and with developmental partners.

A Renewable Energy Policy is under finalization by the Government. The renewable energy policy highlights a target to generate 20 MW by 2020 through a mix of solar – 5 MW, wind – 5 MW, biomass – 5 MW and others – 5 MW. Renewable energy-based Decentralized Distributed Generation projects, stand-alone systems, and modern energy technologies covering improved cook stoves, solar water heaters, biogas, hybrid systems, etc will be included under the Renewable Energy Policy.

4.5 Accessing Adaptation Financing

The climate change funding landscape is complex and far from optimal from a developing mountain country's perspective in general, and the strong thematic or *geog*raphical focus of the funding mechanisms adds to the existing complexities. The governance of the funds, for instance, is not equally transparent for all the funding sources; also not all of the funds show an equally high thematic affinity for mountainous countries. Here, especially the Kyoto/United Nations Framework Convention on Climate Change funds including the Least Developed Country Fund, Special Climate Change Fund, and the Adaptation Fund lead the way. The Adaptation Fund is probably also the most accessible one for developing mountain countries with regard to adaptation.

- *Global Environment Facility Trust Fund's Sustainable Forest Management and Reducing Emissions from Deforestation and Forest Degradation-Plus Program.* The program's goal is to "achieve multiple environmental benefits from improved management of all types of forests" and a separate US$ 250 million funding envelope for Sustainable Forest Management and Reducing Emissions from Deforestation and Forest Degradation-Plus Program is to be created to operate this incentive mechanism. All Global Environment Facility-eligible countries with forests capable of delivering benefits in biodiversity, greenhouse gas emission mitigation, and local livelihoods are eligible to receive funding.
- *The Least Developed Countries Fund* was established to assist least developed country Parties to prepare and support the National Adaptation Programme of Action processes. All least developed countries are eligible for funding from the Least Developed Countries Fund; they are allowed to submit more than one project proposal after completing their National Adaptation Programme of Action. Bhutan has been able to access US$ 3445,050 for reducing glacial lake outburst floods risks in Punakha, Wangdiphodrang and Chamkhar valleys for the period between April 2008 and December 2012. Based on the updated National Adaptation Programme of Action, Bhutan will be eligible and the government is planning to apply for additional funds from the

Least Developed Countries Fund.

- *Strategic Priority on Adaptation* with an initial allocation of 50 million dollar was created within the regular Global Environment Facility Trust Fund to finance pilot and demonstration projects addressing local needs and resulting in global benefits in Global Environment Facility focal areas. It had been fully committed by September 2009. The Global Environment Facility Council has concluded that the project categories financed under the Strategic Priority on Adaptation are to be incorporated in the broad mandate of the Special Climate Change Fund.
- *The Adaptation Fund* was set up to fund adaptation activities in developing countries party to the Kyoto Protocol, and is chiefly financed by 2 per cent of Certified Emission Reductions proceeds from Clean Development Mechanism transactions. All developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change are eligible to receive this funding.
- The *Special Climate Change Fund* under the Convention was established in 2001 to finance projects relating to adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification. The Special Climate Change Fund's focus on adaptation in water resources and land management, agriculture, and fragile ecosystems, makes it an important option for mountain countries to respond to the most imminent climate change threats. In general though, the structure of Global Environment Facility funds for adaptation make accessing funding difficult and time-consuming.
- *Pilot Programme on Climate Resilience* seeks to mainstream climate change adaptation into national development planning through a long term programmatic approach which ideally frames all donor climate change adaptation interventions. It will build upon National Adaptation Programs of Action. Eligibility will be built on ODA-eligibility and active MDB country program initiative.
- *The Local Climate Adaptive Living Facility* is the United Nations Capital Development Fund's facility for investment in local level climate resilience. In Bhutan, it will be operational by mid-2011 as a pilot of global finance for local climate resilience with first year funding of US$ 600,000 to assist four local government units during the next fiscal year. The total value of grants over the course of the pilot is US$ 3.6-4 million. The Facility channels global adaptation finance to local governments – who are at the frontline of dealing with the effects of climate change – and enables them to invest in building local resilience. The Facility connects to existing national intergovernmental fiscal transfer systems and supplements capital grants to local governments with performance-based climate adaptation top-ups. Local Climate Adaptive Living Facility thus provides a fast and effective means to channel adaptation finance to where it is most needed, while at the same time ensuring ownership, accountability and results"
- *Reducing Emissions from Deforestation and Forest Degradation-Plus* activities can be financed through public funds or on a carbon markets basis. These markets, in turn, can either be voluntary carbon markets, or compliance markets, i.e., markets emerging from an international regime with binding emission targets. In fact, a combination of both funding options is the most likely scenario over the medium term.
- *Green Climate Fund* was an outcome of CoP 16 in Cancun, Mexico with a plan to amass US$ 100 billion by 2020. The Fund will support projects, programmes, policies and other activities in developing country Parties using thematic funding windows.

There are several other initiatives on climate financing in general and adaptation through official development assistance, private and commercial financing, foreign direct investments and so forth.

- *Japan International Cooperation Agency's* Cool Earth Partnership has a total of US$ 10 billion including US$ 2 billion for adaptation and clean energy for

developing countries provided through grant aid, technical assistance, and aid through international organizations for adaptation and clean energy activities.

- *AusAID* has invested US$ 150 million on climate adaptation including improved scientific information and understanding; vulnerability assessments; implementing, financing, and coordinating adaptations; and multilateral support for adaptation for developing countries. This assistance will be scaled up by US$ 178.2 million over two years to 2012–13.
- *The Pilot Programme for Climate Resilience* has US$ 240 million administered by the World Bank.
- *The Millennium Development Goal Challenge Fund* is funded by the Spanish government in partnership with United Nations Development Programme and it focuses on climate change related environmental and natural resources management for the promotion of rural development and food security.
- *The Global Climate Change Alliance of the European Union* is highly relevant for mountain countries in terms of disaster risk reduction as the Alliance supports and seeks research and improves climate forecasting and information systems, and translation of data into effective preparedness measures.

Domestic resource flows

There is opportunity for developing domestic resource flows through investments in adaptation. Many public, private, bilateral and multilateral sources now offer countries new opportunities to address climate and development needs. While this new landscape of climate change funds offers increased resources, it also brings increased complexity. One tool that can help countries respond to these challenges is institutionalization of a National Climate Fund. The National Climate Fund mechanism will support countries to manage their engagement with climate finance by facilitating the collection, blending, coordination of, and accounting for climate finance.

Such an institution will be even more instrumental when the Green Climate Fund materializes, which is currently being negotiated in the United Nations Framework Convention on Climate Change negotiation processes and its modalities are being designed by the designated Transitional Committee. Bangladesh allocated US$ 40 million from its national budget to set up a Trust Fund on Climate Change, while Sri Lanka is taking a different approach and passed a 2008 environment levy that would be used, in part, to fund adaptation.

Strengthening institutional capacities

In the process of identifying adaptation strategies for Bhutan, the framework for the Initial National Communication and National Adaptation Programme of Action recognises the need for institutional strengthening, community participation, national capacity, locally appropriate methodologies for analyzing these effects and increased understanding of current interactions of climate and environmental and socio-economic effects and changes.

In addition to strengthening institutional capacities as a means to adapting to climate change, the role of private sector needs mention from the perspective of climate change adaptation and human development mainly because private sector provides opportunities for climate adaptation plans and programmes and is itself a vulnerable sector in terms of adverse climate impacts.

Table 4.3 Assessment of adaptation funds for mountainous developing countries

Fund/Criteria	GEF	LDCF	SCCF	AF	PPCR	GCCA
Focus on mitgation, adaptation or sequestration	Mitigation/cross-cutting	Adaptation	Adaptation	Adaptation	Adaptation	Adaptation and mitigation
Transparency of fund governance	X	XX	XX	XXX	X	X
Thematic affinity for mountain country	x	xxx	xxx	xxx	xxx	xx
Accessibility for mountain country	xxx	xx	xxx	xxx	xxx	xx
Integratedm multicomponent, sustainable development	xxx	x	xx	XXX	xxx	xx
Addresses longer-term needs	xxx	x	xxx	XXX	xxx	xx
Funds for systematic onservation/knowledge base	NA	NA	xxx	XXX	NA	xx
Short project preparation lead time	x	x	x	XXX	xxx	xx
Eligibility for regional projects	xxx	NA	xx	xxx	NA	x

NA=not applicable; x=low, xx= medium. xxx high compliance with the criterion

* e.g. ecosystem approach

** special window for mountain country advocacy under UN-REDD's or FCPF's global activities

Source: Adapted from ICIMOD. 2010. Global Climate Financing Mechanism and Mountain Systems.

Second National Communication

The provisions under Article 4 and 12 of the United Nations Framework Convention on Climate Change requires all parties to submit periodic national communications related to national inventory of anthropogenic emissions by sources and removals by sinks and general steps taken to meet the objectives of the Convention. The general structure of the national communication report includes: emissions by sources and removals by sinks of all GHG not controlled by the Montreal Protocol, measures to mitigate and facilitate adequate adaptation to climate change, any other relevant information to achieved the objective of the convention. It also encourages parties to include any cross cutting issues that could lead to envisaged activities and measures in fulfilling the Convention objectives.

Bhutan submitted its Initial National Communication in 2000 with its GHG inventory baseline year of 1994. The Second National Communication is expected to be finalized by end September 2011 and submitted to the United Nations Framework Convention on Climate Change in its Conference of Parties 17 in December 2011. The Second National Communication with its greenhouse gas inventory and emission estimates and projections up to 2010, and climate modeling scenario demonstrates significant advancement in climate change knowledge, and builds a solid foundation for further climate studies.

Technology needs assessment

Financial resources and technology are the principal resources needed for effective climate change adaptation and mitigation. The long-term objective of the United Nations Framework Convention on Climate Change to avert dangerous levels of GHG concentration can only be achieved with adequate emissions reduction to avoid future climate change coupled with climate-resilient activities to sustain livelihoods.

Technology development can be scientific-base or build on existing indigenous knowledge. A key feature is that technology requirements will necessarily need to shift to meet changing lifestyle, ecosystems, economies and baseline technologies in a specific locality. Technology transfer similarly can be between developed and developing nations as well as south-south cooperation. Therefore, it is crucial to assess specific requirements of technology needs. The National Environment Commission Secretariat convened the second phase Technology Needs Assessment in early 2011.

4.6 Conclusion

Adaptation and mitigation are important strategies for Bhutan. But they are not needed with equal measure. Adaptation is urgent to prevent the roll-back of human development achievements as well as to remove impediments to the expansion of human development in Bhutan.

For a net carbon sink country, mitigation is a lower order priority—more important in the medium- to long-term perspectives in Bhutan. Immense opportunities exist, however, in creating a low carbon society in Bhutan that facilitates poverty reduction and human development without the cost to the environment and the earth's climate.

Adaptation and mitigation in Bhutan calls for lasting and meaningful international cooperation that goes beyond current negotiation frameworks. The foundation for financing and technology transfers that allow Bhutan to adapt to current on future climate impacts – and to limit future emissions – will need to arise from deeper cooperation from development partners. This chapter aimed to show some of these potential areas of collaboration.

[1] *Intergovernmental Panel on Climate Change, 2007.*
[2] National Environment Commission, 2006. *Bhutan National Adaptation Programme of Action.*
[3] National Statistics Bureau. 2007. *Poverty Analysis Report,* Thimphu, Bhutan.
[4] Ministry of Work and Human Settlement, 2008. *Bhutan National Urbanization Strategy.*
[5] National Statistics Bureau, 2010. *Statistical Year Book,* Thimphu, Bhutan.
[6] IBRD/World Bank, 2008. *Biodiversity, Climate Change and Adaptation: Nature-Based Solutions from the World Bank Portfolio.*
[7] Watershed Management Division, 2011. *Roadmap for Watershed in Bhutan.* Thimphu, Bhutan.
[8] *Devereux and Sabates-Wheeler 2004.*
[9] National Environment Commission. 2011. *National Adaptation Programme of Action update (draft).* Thimphu, Bhutan.
[10] *Constitution of the Kingdom of Bhutan, 2008,* Thimphu, Bhutan
[11] Bhutan, 2011. *Climate Summit for a Living Himalayas, National Road Map for Energy Security (2012-2021), Bhutan.*
[12] Bhutan, 2011. *Climate Summit for a Living Himalayas, National Road Map for Energy Security (2012-2021), Bhutan.*
[13] Bhutan, 2011. *Climate Summit for a Living Himalayas, National Road Map for Energy Security (2012-2021), Bhutan.*

5 Recommendations

Recommendations

As pointed out in the *Global Human Development Report 2007/*2008, climate change confronts humanity with stark choices. We can avoid 21st Century reversals in human development and catastrophic risks for future generations, but only by choosing to act with a sense of urgency. Facing up to that threat will create challenges at many levels. Perhaps most fundamentally of all, it challenges the way that we think about progress. There could be no clearer demonstration than climate that economic wealth creation is not the same thing as human progress.

There is a clear notion that Bhutan has done well in preserving the environment but now there are additional external pressures due to climate change. The main potential impacts are water-related and could influence the development of the hydropower sector and agriculture.

Bhutan has completed a National Adaptation Plan of Action with nine priority projects and three of these are now being funded as the first ever project under the Global Environment Facility managed Least Development Countries Fund for adaptation with co-financing from the Royal Government of Bhutan, Austria and World Wildlife Fund. The project concerns the reduction of the risks of glacial lake outburst floods. This may create a momentum in Bhutan for other climate change adaptation activities. However, despite the relative high concern regarding climate change the institutional capacity is modest. This may change with a growing concern and understanding of the issue of climate change and also with an improved documentation of its impact. Non-governmental organisations and formal civil society organisations in Bhutan could contribute to further attention and complementary development of capacity on climate change and development.

Actions to address climate change by the Royal Government should now be aligned with the Five Year Plans. At the moment, besides the National Adaptation Plan of Action, there is no specific national policy or programme for climate change adaptation and mitigation to guide external assistance. However, the Second National Communication will be completed by the end of the year and will provide a better framework for climate change activities in the country. The 11th Five Year Plan will provide ample opportunities for aligning climate change issues within the planning framework and the results and findings of major events like the Round Table Meeting, the Climate Summit and the Bhutan *Human Development Report 2011* should be incorporated in the next Five Year Plan.

The following recommendations should be developed in close collaboration with stakeholders including donors in the concerned sectors.

Recommendations

Recommendation 1: Implement climate change mainstreaming fully

The Gross National Happiness Commission (GNHC) Secretariat facilitates mainstreaming environment into national policies and programmes while the National Environment Commission Secretariat (NECS) supports the development of procedures and tools for environmental mainstreaming. Building on these structures and policies already in place, Bhutan requires the human capital, financial resources and knowledge to implement strategies and achieve full mainstreaming of climate change into development and economic policy. Further, additional activities may include addressing climate change-proofing of development activities, incorporating climate change into environmental impact assessment procedures, and addressing climate change proofing in the Policy Formulation Protocol of the Royal Government of Bhutan (RGoB).

Recommendation 2: Design integrated climate change policies, strategies and quantified action plans

As the Royal Government pledged to remain carbon neutral, design and implementation of a road map is necessary with development partners' support. Such

an action plan will also give direction to development partners in terms of where assistance is needed.

Carbon-neutral is a term used to demonstrate that all greenhouse gas emissions from energy consumption (mainly transport), industry, agriculture and waste, are either avoided, reduced or offset, to a net result of zero emissions. The framework for achieving carbon neutrality involves setting objectives, identifying the appropriate technology to deliver the outcomes, creating timeframes, responsibilities and budgets, and being flexible enough to allow for adaptation to changing science, new technologies, government policies and community expectations. There is now an urgent need for the country to draw up an integrated strategy and implementation action plan beyond remaining carbon neutral.

Bhutan therefore needs financial and technical assistance in instituting measures that will meet both mitigation and adaptation needs specific to local areas. Efforts to address the concerns around climate change need to continue being part of development plans and programmes. The Low-Emission and Climate Resilient Development Strategy (LECRDS) entails a holistic strategy designed to build upon existing strategies and development plans. Working within relevant regional, national and local planning and coordination frameworks, LECRDS is expected to simultaneously address the threats, risks, vulnerabilities and uncertainties associated with global climate change and the pressing development needs countries face as they pursue sustainable development. Well-designed LECRDS can better equip countries to blend domestic and international, as well as public and private climate financing opportunities, helping countries achieve the desired developmental results.

Recommendation 3: Strengthen research and capacity development on climate change

Bhutan's capacity to build knowledge, understanding and rigorous information on climate must be strengthened. On-going national exercises to improve understanding of the climate challenge needs to be strengthened to produce increasingly reliable and accurate information. Key steps forward should include:

- Develop capacity of technical staff and awareness of climate change for local government (*dzongkhag* and *geog* level) and for civil society.
- Provide seed capital to develop research proposal and pilot studies on climate change in Bhutan relevant for decision making, capacity development and awareness creation in partnership with the Royal University of Bhutan and other relevant institutes.
- Supporting researchers and students to study climate change science in neighbouring countries.
- Develop capacity of technical staff and decision makers in the most relevant line ministries, commissions and governing bodies on climate change (e.g. through attendance of climate risk management training courses offered by reputed institutes in the region).

Recommendation 4: Developed capacity for meteorological and hydrological services and climate modelling

In order to enhance capacity of climate modelling in meteorology and hydrology in services following actions are required;

- Improve capacity to collect and analyse weather data with additional measuring stations where gaps are identified.
- Improve capacity development to prepare early warning and hazard forecasting for the agriculture sector as well as other sectors and urban centres (NAPA priority project).
- Improve capacity for climate change modelling.
- Support continued regional networking including participation in climate change projects with regional institutions.

Recommendation 5: Investment in sustainable energy services and systems

- Attract and direct public and private investment towards sustainable energy services and systems including low carbon technologies and sustainable land use practices

- Capacity building, awareness creation and the development of enabling rules and regulations for the sector are some of the interventions required to attract private investments.

Recommendation 6: Promote green industry

Eighty per cent of the total electricity consumed by the nation is utilized by the Bhutanese industry. Apart from electricity, the industry sector also uses coal and wood fuel. To reduce greenhouse gas emissions, Bhutan needs to curtail consumption of fossil fuels by the industries, which necessitates adoption of new technologies. The Economic Development Policy (EDP), 2010 of the Royal Government of Bhutan is already geared towards "Green Development". Successful implementation of the policy is important and necessary.

Recommendation 7: Improve implementation and monitoring capabilities

While Bhutan has impressive plans, strategies and laws, implementation and monitoring capacity needs improvement. Better and more effective capabilities to monitor the implementation of Bhutan's legal framework like the National Environment Protection Act (NEPA), Environment Assessment (EA) Act, Waste Prevention and Management Act and the National Environment Strategy-*The Middle Path,* will ensure more effective and efficient delivery of services to advance human development as well as maintenance of ambient air quality and reduction of GHG emissions in the country.

Recommendation 8: Address climate sensitivity in the agriculture and forest sectors .

Agriculture and ecosystem services are at acute risk in Bhutan. Measures to address climate sensitivities in these sectors can include:

- Research and improvement of crop management, including selection of crop varieties and introduction of climate resilient crops by the Renewable Natural Resources Research Centres in order to reduce farmers' vulnerability to water, soil and temperature variability and their capacity to adapt to and reduce climate change risks.
- Management and utilisation of land and water resources including research and development on efficient and low-cost water harvesting to reduce vulnerability to variability in water availability for agriculture needs to be enhanced.
- Build on traditional knowledge in rural areas on coping mechanisms in the agricultural sector.
- Enhance the implementation of integrated watershed management plans, including forest rehabilitation in vulnerable locations, particularly in upper catchments, (e.g. through pilot projects to protect selected sensitive upper watersheds with vulnerable downstream sites).

Recommendation 9: Enhance civil society and active citizenship participation with special focus on women and their roles.

Following actions are required to enhance gender consideration and capacity of the public in the field of climate change;

- Analyze of the climate change impacts from both men and women perspectives.
- Develop and apply gender-sensitive criteria and indicators.
- Pursue disaggregation of statistical data for men and women.
  Capitalize on the skills and knowledge contributions of both men and women. Reflect these when designing and implementing projects and set targets for female participation in activities.
- Prioritize women's access to information, economic resources and education.
- Ensure that women are equally represented in all decision-making processes.
- Focus on gender differences in capabilities to cope with climate change adaptation and mitigation
- Undertake a gender analysis of all national budget lines and financial instruments.

Recommendation 10: Build on and expand on-going climate financing mechanisms.

Bhutan has already gained experience in developing National Adaptation Programme of Actions and implementing some of the prioritized projects. Implementation of the glacial lake outburst floods risk prevention projects, like artificial lowering of water level in a glacial lake and setting up early warning systems, are ongoing with the support from the Least Developed Country Fund (LDCF) for adaptation to climate change. Bhutan has also been actively taking part in international negotiations and exploring the voluntary carbon market as well as establishing a climate change policy and technical committees. In order to enhance national capacity to access more global climate financial and technological resources, the establishment of an independent National Climate Fund (NCF) (like in many countries of the region) or the expansion of the responsibility of the Bhutan Trust Fund for Environment Conservation (BTFEC) to take up the important task, is necessary.

Recommendation 11: Strengthen and implement disaster risk management and community-based disaster risk reduction.

Placing climate change risks and vulnerabilities at the heart of the Eleventh and future Five Year Plans for Bhutan is necessary and critical. It is necessary to ensure that the hard-won gains and achievements made under previous Plans including the Tenth Five Year Plan are not eroded due to the impacts of a changing climate, including the increase frequency and severity of climate - induced natural disaster. In order to ensure disaster risk prevention and management in the national policies and programmes, following actions need to be ensured:

- Follow-up on the emerging disaster risk management legislation needs to take place with adequate funding to meet Bhutan's needs.
- Disaster Risk prevention and management funds should be reviewed annually and updated as more information and assessments of climate change impacts become clearer and evident.

Recommendation 12: Integrate human development vulnerabilities into national strategic plans

- The focus on poverty reduction must take into account climate change variability, moved in from indirect and parenthetical consideration to form the heart of development strategies in Bhutan.
- The resilience of communities, families and individuals who remain vulnerable to climate influences needs to be strengthened in order to enable them to deal with the significant risk climate change poses to their human freedoms and development.
- The Royal Government of Bhutan can enact legislation that requires the integration of climate change - related planning and programming, information sharing, etc into community level committees and other bodies for farmers to protect their livelihoods, property and incomes.

Recommendation 13: Protect education infrastructure from climate shocks and make climate education part of curricula

- Link targets and strategies for achieving universal primary education to strategies for ensuring that every school built is climate resilient.
- Make climate risks and threats parts of the school curriculum, equipping children with the knowledge they need to reduce health risks and enabling them to become agents of change in their communities.

Recommendation 14: Provide psychological wellbeing services to climate victims and survivors

- Manage counselling for disaster victims and survivors.
- Incorporate school support for children who suffer losses due to climate-related impacts.

This report looks at the climate changes in Bhutan through the prism of human development. Vulnerability to climate change is influenced by the level of human

development at *dzongkhag*, community, household or individual holds. Limitations in data, information and knowledge exist. Yet, human development is at acute risk of stalling or reversal due to climate shocks. This is a concern that must come to the centre of Bhutan's policy design, development strategies and implementation.

Bibliography

Abarquez, Imelda and Zubair Murshed. 2004.Community-based Disaster Risk Management, field practitioners' Handbook. Asian Disaster Preparedness Center. Pathumthani, Thailand.

Adaptation Knowledge Platform. 2011. Adaptation Knowledge Platform 2011. Fourth Sharing and Learning Seminar.

Adger, W. Neil, Saleemul Huq, Katrina Brown, Declan Conway and Mike Hulme. 2003.Adaptation to climate change in the developing world. SAGE.

Alkire, Sabina. 2011. "A National MPI for Bhutan: Three trial measures." Oxford, Oxford Poverty and Human Development Initiative.

Asian Development Bank. 2005. Pacific Studies Series. "Climate Proofing: A Risk-based Approach to Adaptation." Manila, Philippines.

__. 2011.Gender Equality Results: Case studies Bhutan. Manila, Philippines.

Asian Tiger Capital Partners. 2010.A Strategy to Engage the Private Sector in Climate Change Adaptation in Bangladesh. IFC.

Bajracharya, Samjwal Ratna, Pradeep Kumar Mool and Basanta Raj Shrestha. 2007. Impact of Climate Change on Himalayan Glaciers and Glacial Lakes: Case Studies on glacial lake outburst floods and Associated Hazards in Nepal and Bhutan. Nepal, ICIMOD.

Carbon Dioxide Information Analysis Center.2010. Database on carbon dioxide emissions. Oak Ridge.

Chhetri, B.B., Kasper Schmidt and Don Gilmour. 2009.Community Forestry in Bhutan, Exploring Opportunities and Facing Challenges.Thimphu, Bhutan.

Climate Summit for a Living Himalayas 2011, National Road Map For Energy Security (2012-2021). Bhutan.2011

__. 2011. Impacts of Climate Change on Food Security in Bhutan. 2011.

__.2011. Securing the Natural Freshwater Systems of the Himalayas: Climate Change and Adaptation measures on Water Resources in Bhutan, 2011.

__.2011. Biodiversity Persistence and Climate Change in Bhutan. 2011.

Davies, Mark, Jennifer Leavy, Tom Mitchell and Thom Tanner. 2008.Social Protection and Climate Change Adaptation. Commission on Climate Change and Development.

Dekens, Julie. 2007.The Snake and the River Don't Run Straight: Local Knowledge on Disaster Preparedness in the Eastern Terai of Nepal. ICIMOD.

Department of Forests and Park Services. 2010. National Strategy for Community Forestry. Ministry of Agriculture and Forests. Thimphu, Bhutan.

Esther W. Dungumaro, Goran Hyden. Challenges and Opportunities to Climate Change and Sustianable Development Among Tanzanian Rural Communities.

Gampat, Ramesh and NiranjanSarangi. 2009. Estimating Sub-national Human Development Indices in the Presence of Limited Information (discussion paper). The Case of Bhutan 2009.UNDP Regional Centre for Asia Pacific. Colombo, Sri Lanka.

Gross National Happiness Commission. 2000. Bhutan Human Development Report 2000. Gross National Happiness and Human Development – Searching for Common Ground. Thimphu, Bhutan.

__. 2005.Bhutan Human Development Report 2005. The Challenge of Youth Employment. Thimphu, Bhutan.

__. 2008a.Bhutan's Progress: Midway to

Bibliography

the Millennium Development Goals. Thimphu, Bhutan.

__. 2008b.Rapid Impact Assessment of Rural Development Survey 2008. Thimphu, Bhutan.

__. 2008c. Tenth Five-Year Plan (2008-2013). Thimphu, Bhutan.

__. 2010.Population Perspective Plan 2010 (draft). Thimphu, Bhutan.

__.2011.Turning Vision 2020 into Reality: The Development Challenges Confronting Bhutan, Tenth Round Table Meeting. Thimphu, Bhutan.

International Centre for Integrated Mountain Development. 2009. Information Sheet #3/09, "Climate Change in the Himalayas" Kathmandu, Nepal.

—. 2010.Mountains of the World-Ecosystem Services in a Time of Global and Climate Change: Seizing Opportunities – Meeting Challenges. Nepal.

__.

Intergovernmental Panel on Climate Change. 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.

—. 2007.Climate Change 2007 – Synthesis Report: Summary for Policy Makers", Valencia, Spain, 2007.

ISET-International. 008.Climate Adaptation in Asia: Knowledge Gaps and Research Issues in South Asia.

Kuenza, Karma, Yeshi Dorji and Dorji Wangda. Landslides in Bhutan. Department of Geology and Mines. Ministry of Trade and Industry. Thimphu. Bhutan.

Ministry of Agriculture and Forests. 2009. RNR Statistics 2009. Thimphu, Bhutan.

Ministry of Education. 2003. National Educational Assessment in Bhutan; A Benchmark Study of Students in Literacy and Numeracy at Class VI. Bhutan Board of Examinations. Thimphu, Bhutan.

__. 2004.Education Sector Strategy. Realizing Vision 2020 Policy and Strategy. Thimphu, Bhutan.

__. 2006a.A Study of Enrolment and Retention Strategies in Bhutan. Thimphu, Bhutan.

__. 2006b.Quality of Education (Standards). Presentation to CCM. Thimphu, Bhutan.

__. 2010.Annual Education Statistics 2010. Thimphu, Bhutan.

Ministry of Foreign Affairs of Denmark. 2008. Climate Change Screening of Danish Development Assistance with Bhutan, Danish International Development Assistance (Danida).

Ministry of Health. 2007. Heath Response to Climate Change and Climate Variability. A Project Proposal to UNDP/Global Environment Facility. Thimphu, Bhutan.

__. Various years. Annual Health Bulletin. Thimphu, Bhutan.

__. 2000.National Health Survey. 2000. National Nutrition, Infant and Young child Feeding Survey, Nutrition Programme. Department of Public Health.

Ministry of Home and Cultural Affairs. 2006. National Disaster Risk Management Framework - Reducing Disaster Risks for a Safe and Happy Bhutan, Royal Government of Bhutan, Thimphu, Bhutan.

__. 2006. Strengthening Disaster Risk Management Capacities in Bhutan: Programme of the Royal Government of Bhutan. Royal Government of Bhutan, Thimphu, Bhutan, 2006.

__. 2010. National Disaster Risk Management Framework: Reducing Disaster Risks for a Safe and Happy Bhutan.

__. 2011.Disaster Management Division Report 2010-2011. Thimphu, Bhutan.

Ministry of Labour and Human Resources. 2010. Labour Force Survey Report 2010. Thimphu, Bhutan.

Ministry of Works and Human Settlement. 2008. Bhutan National Urbanization Strategy. Thimphu, Bhutan.

National Environment Commission. 2000a. Background Paper for National Technology Needs Assessment for Bhutan. Thimphu, Bhutan.

__.2000b. Climate Change Adaptation Technology Needs Assessment for Agriculture Sector. Thimphu, Bhutan.

__.2000c. Initial National Communication under the United Nations Framework Convention on Climate Change. Thimphu, Bhutan. Thimphu, Bhutan.

__.2006. Bhutan National Adaptation Programme of Action to Climate Change. Thimphu, Bhutan. Thimphu, Bhutan.

__.2009. Strategizing Climate Change for Bhutan. Thimphu, Bhutan.

__.2011a. Bhutan National Adaptation Programme of Action (draft). Thimphu, Bhutan.

__. 2011b. "Second National Communication from Bhutan to UNFCCC (draft)." Thimphu, Bhutan.

National Statistics Bureau. Various Years.. Statistical Yearbooks of Bhutan. Thimphu, Bhutan.

__. 2005a. Population Projections Bhutan 2005-2030. Thimphu, Bhutan.

__. 2005b. Socioeconomic and Demographic Indicators 2005. Thimphu, Bhutan.

__.2007a. Bhutan Living Standard Survey 2007. Thimphu, Bhutan.

__. 2007b. Poverty Analysis Report 2007. Thimphu, Bhutan.

__.2008. *Dzongkhag* Population Projections 2006-2015. Thimphu, Bhutan.

__.2009. National Accounts Statistics. Thimphu, Bhutan.

__. 2010a. Bhutan Multiple Indicator Survey 2010. Thimphu, Bhutan.

__. 2010b. Small Area Estimation of Poverty in Rural Bhutan 2010. Thimphu, Bhutan.

Office of the Census Commissioner. 2005. Results of Population and Housing Census of Bhutan 2005. Thimphu, Bhutan.

__. 2006.Population and Housing Census of Bhutan 2005. Thimphu, Bhutan.

Schwank, O., A. Bruederle, N. North. 2010. Global Climate Financing Mechanisms and Mountain Systems. Nepal: ICIMOD.

Planning Commission. 1999. Bhutan 2020: A Vision for Peace, Prosperity and Happiness. Thimphu, Bhutan.

__.2007. Bhutan Millennium Development Goals – Needs Assessment and Costing Report. Thimphu, Bhutan.

Pathak, Dinesh, Ananta P Gajurel and Pradeep K Mool. Climate Change Impacts on Hazards in the Eastern Himalayas. ICIMOD.

Rahman, Atiq and DL Mallick. Undated. Climate Change Impacts on Cities of Developing Countries: A Case Study on Dhaka. Bangladesh Centre for Advanced Studies. Dhaka, Bangladesh.

Royal Government of Bhutan. 2007. Labour and Employment Act of Bhutan.

Royal Government of Bhutan. 2004. Poverty Reduction Strategy Paper. Thimphu, Bhutan.

Royal Government of Bhutan. 2005. Bhutan's National Capacity Self-Assessment for Global Environmental Management and Action Plan. Thimphu, Bhutan.

Royal Society for the Protection of Nature.

Bibliography

2006a. Health and Climate Change: An exploratory study on climate change and diseases sensitive to climate change. Thimphu, Bhutan.

__. 2006b. Buddhism and the Environment. Thimphu, Bhutan.

Tshering, Dago and Gyambo Sithey. 2008. Capacity Strengthening in the Least Developed Countries (LDCs) for Adaptation to Climate Change; Climate Change and Health in Bhutan. Royal Society for Protection of Nature. Thimphu. Bhutan.

Schipper, Lisa F., Maria Paz Cigarán and Merylyn McKenzie Hedger. 2008. Adaptation to Climate Change: The new challenge for development in the developing world. UNDP, New York.

Selby, David. 2008. The Need for Climate Change in Education. University of Plymouth. United Kingdom.

Swedish International Development Cooperation Agency. 2009. Making Climate Your Business: Private sector adaptation in South East Asia. Synthesis Report, Bridging The Gap: A Role for Business in Climate Change Adaptation.

T. Namgyel, 2003. UNFCCC Expert Workshop on Local Coping Strategies and Technologies for Adaptation to Climate Change. Country Presentation on Bhutan. 12-13 October 2003, New Delhi

United Nations Development Programme. 2007. Human Development Report 2007/2008. Fighting Climate Change: Human Solidarity in a Divided World, Palgrave Macmillan, New York.

__. 2008. Climate Change at UNDP: Scaling Up to Meet the Challenge. UNDP, New York.

__. 2009. Human Development Report 2009. Overcoming Barriers: Human Mobility and Development. Palgrave McMillan, New York.

__. 2009. Estimating Sub-National Human Development Indices in the Presence of Limited Information: The Case of Bhutan. Regional Centre for Asia Pacific, Colombo Office.

__. 2010a. Gender, Climate Change and Community-based Adaptation: A guidebook for designing and implementing community-based adaptation programmes and projects. New York, UNDP.

__. 2010b. Human Development in a Changing Climate: A Framework for Climate Finance.

__. 2010c. Human Development Report 2010. The Real Wealth of Nations. Pathways to Human Development. Palgrave McMillan, New York.

__. 2010d. The Technology Needs Assessment Handbook. UNDP, New York.

United Nations Environment Program (UNEP). 2001. Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods: Monitoring and Early Warning Systems in the Hindu Kush –Himalayan Region. Kathmandu. Nepal.

United Nations Educational, Scientific and Cultural Organization Institute for Statistics. 2010. Database on school enrolment. Paris.

United Nations Framework Convention on Climate Change. 2007. Climate Change Impacts, Vulnerabilities and Adaptation in Developing Countries. Climate Change Secretariat, Bonn.

United Nations General Assembly. 2011. "Happiness: towards a holistic approach to development." Resolution A/RES/65/309. New York, United States.

Ura, Karma. 2009. A Proposal for GNH Value Education in Schools. Thimphu. Bhutan.

World Bank. 2008. Biodiversity,Climate Change and Adaptation: Nature-Based Solutions from the World Bank Portfolio. Washington, DC.

World Wildlife Fund. 2009. The Cost of Climate Change: The story of Thorthomi Glacial Lake in Bhutan. Thimphu, Bhutan..

Statistical Annex

Table 1 Human development index and components by Dzongkhags

Dzongkhags	Gross domestic product per capita, Nu. 2007	Combined gross enrolment ratio (%) 2005	Adult literacy rate (% aged 15 and above) 2005	Life expectancy at birth (years) 2005	Income index	Education index	Life expectancy index	Human development index	HDI Rank
Thimphu	109749	78.8	68.9	64.2	0.806	0.722	0.654	0.727	1
Bumthang	63024.6	72.7	58.6	69.8	0.742	0.633	0.747	0.707	2
Haa	52821.6	72	54.5	69	0.722	0.603	0.733	0.686	3
Paro	76656	77.4	58.1	62.9	0.765	0.645	0.631	0.681	4
Pemagatshel	39005.4	76.5	48.5	70.8	0.687	0.578	0.764	0.676	5
Trongsa	52390.5	62.7	50.4	70.2	0.721	0.545	0.753	0.673	6
Chhukha	60458.4	65	59	64.5	0.738	0.61	0.657	0.668	7
Tsirang	52760	55.4	49.3	69.3	0.722	0.513	0.738	0.658	8
Wangdue	55613.6	59	45.2	69.5	0.728	0.498	0.741	0.656	9
Zhemgang	35679.7	63.4	47.2	69.9	0.677	0.526	0.749	0.651	10
Punakha	57276.4	71.4	52.8	62.8	0.731	0.59	0.629	0.65	11
Trashigang	39744.5	62.7	46.4	69.4	0.689	0.519	0.739	0.649	12
Lhuentse	31881.8	58.3	45.2	70	0.664	0.496	0.75	0.637	13
Gasa	66247.7	43.8	39.2	69.3	0.748	0.408	0.739	0.631	14
Mongar	36316.1	57.5	41.5	69.4	0.679	0.468	0.74	0.629	15
Sarpang	44774.1	54.1	51.9	63.9	0.703	0.527	0.648	0.626	16
Trashiyangtse	47258.2	5859	4955	62.7	0.709	0.509	0.629	0.616	17
Samdrup Jongkhar	0.044	12642	11994	63.1	0.692	0.503	0.635	0.61	18
Dagana	40278.3	44	44	63.3	0.691	0.44	0.638	0.589	19
Samtse	34242.7	44.4	44.5	63.2	0.672	0.445	0.637	0.585	20

Source: UNDP, Estimating sub-national HDI in the presence of limited information; the Case of Bhutan 2009

Table 1.b Bhutan human development index over time

	2005	2006	2007	2008	2009	2010
Life expectancy at birth (years)	64.8	65.3	65.7	66	66.4	66.8
Adult literacy rate (% aged 15 and above)	52.8	52.8	52.8	52.8	52.8	52.8
Combined gross enrolment ratio for primary, secondary and tertiary education (%)	54.26	56.52	56.52	60.51	60.51	60.51
GDP per capita (2008 PPP US$)	3642	3792	4247	4759	5210	5532
Life expectancy index	0.663	0.672	0.678	0.683	0.690	0.697
Education index	0.533	0.540	0.540	0.554	0.554	0.554
GDP index	0.600	0.607	0.626	0.645	0.660	0.670
Human development index (HDI) value	0.599	0.606	0.615	0.627	0.635	0.640

Source: UNDP Human development indicators available at <http://hdr.undp.org/en/data/trends/>

Table 2 National-level education indicators

Indicator	2004	2007	2010
Gross Primary Enrollment Ratios (%)	84	106	117
Net Primary Enrolement Ratio (%)	..	83.7	93.7
Proportion of Pupils starting grade 1 who reach grade 5 (%)	94	92.4	93.6
Proportion of pupils starting grade 1 who reach grade 7 (%)	86	85.4	86.9
Ratio of girls to boys in primary schools (%)	95	99.5	99.4
Ratio of girls to boys in secondary schools (%)	96	97.2	103.5
Ratio of females to males in tertiary institutes (%)	53	54	60.8

Note: *Excludes students studying abroad, shedras, gomdeys, private learners*
Source: Annual Education Statistics, 2010

Table 3 Enrolment by level of schools and teacher pupil ratio, 2010

Level of school	Schools	Teachers	Students	Student: Teacher Ratio
Elementary Schools	362	2405	54,818	22.8
Lower Secondary Schools	90	1899	49,375	26
Middle Secondary Schools	52	1433	37,871	26.4
Higher Secondary Schools	43	1330	28,341	21.3
Total	547	7067	170,405	24.1

Note: *Excludes students studying abroad, shedras, gomdeys, private learners*
Source: Annual Education Statistics, 2010

Table 4 Enrolment rates by education level, 2006 - 2010

Enrolment rates	2006	2007	2008	2009	2010
Net enrolment rate primary education (PP-VI)	79	84	88	92	94
Gross enrolment rate primary education (PP-VI)	102	106	112	116	118
Net enrolment rate Basic education (PP-X)	75	78	85	88	91
Gross enrolment rate Basic education (PP-X)	85	88	96	100	104

Source: Annual Education Statistics, 2010

Table 5 Education achievements and infrastructure at Dzongkhag level

	Adult literacy rate (%) 2007			Enrolment (%), March 2010			Number of schools by type, 2010					
Dzongkhag	Male	Female	Total	Boys	Girls	Total	Community Primary	Primary	Lower secondary	Middle secondary	Higher Secondary	Private
Bumthang	76.9	50.5	63.2	2,079	2,174	4,253	12	1	2	2	1	1
Chhukha	67.3	48.1	57.6	8,247	8,315	16,562	18	5	7	4	3	2
Dagana	64.9	43.2	53.6	3,596	3,363	6,959	14	1	4	3	1	0
Gasa	51.3	29.3	40.3	333	337	670	2	1	0	1	0	0
Haa	74.6	55.3	65.1	1,531	1,549	3,080	2	3	3	0	1	0
Lhuentse	60.6	41.8	50.4	2,026	1,968	3,994	13	9	2	2	1	0
Mongar	56.6	37.7	46.4	5,087	4,877	9,964	31	6	8	2	2	1
Paro	60.6	46.1	52.7	5,244	5,434	10,678	3	3	7	3	2	4
Pemagatshel	58.6	37.1	47.6	3,313	3,000	6,313	18	4	6	1	2	0
Punakha	62.0	44.2	52.9	3,646	3,902	7,548	9	3	4	4	1	1
Samdrupjongkhar	65.4	44.2	54.8	4,555	4,384	8,939	11	5	4	5	1	1
Samtse	61.1	37.9	49.6	7,618	7,121	14,739	9	1	4	4	2	0
Sarpang	72.4	47.3	59.5	5,487	5,425	10,912	12	0	5	2	2	2
Thimphu	81.3	63.1	72.0	12,494	13,188	25,682	5	7	8	6	2	13
Trashigang	55.2	39.8	47.3	6,544	6,227	12,771	35	12	8	5	3	0
Trashiyangtse	55.5	38.7	47.3	2,587	2,526	5,113	20	3	5	1	1	0
Trongsa	70.4	56.2	63.0	1,742	1,744	3,486	15	4	3	1	1	0
Tsirang	65.6	43.3	54.0	2,834	2,678	5,512	7	3	2	1	1	0
Wangdue	63.1	40.1	51.3	3,663	3,997	7,660	15	6	3	1	2	0
Zhemgang	60.9	42.2	51.2	2,817	2,753	5,570	15	9	3	3	1	1
Bhutan	65.7	45.9	55.5	85,443	84,962	170,405	266	86	88	51	30	26

Source: Bhutan Living Standard Survey, 2007; Annual Education Statistics, 2010

Table 6 Literacy rate by sex, age group and area, 2007

Age Group	Urban			Rural			Bhutan		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
6 – 9	77.1	76.8	77	57.5	54	55.8	62.7	59.9	61.3
10 – 14	97.7	89.6	93.4	88.1	83	85.5	90.5	84.8	87.6
15 – 19	96.5	86.5	90.5	84.6	74.8	79.6	87.3	78.2	82.5
20 – 24	86.5	76.2	80.5	73.6	55	63.8	77.4	62.2	69.1
25 – 29	87.2	63.4	74.8	64.3	38.3	50.2	73	47.4	59.3
30 – 34	81.9	50.3	66.4	56.9	23.7	38.6	66	32	47.9
35 – 39	80.4	40.7	62.4	49	15.1	31.1	60.4	22.7	41.4
40 – 44	77.6	39.7	60.3	42.7	9.9	24.9	52.6	16.5	33.8
45 – 49	74.9	30.5	56.4	42.6	5.8	22.9	50.5	10	29.8
50 – 54	78.2	19.8	54.1	39.4	5.1	22	47.3	7.3	27.7
55 +	57.3	9.5	34.6	27.9	2.6	15.8	31	3.3	17.8
All Ages (Standard Errors)	84 (0.8)	64.9 (0.8)	74.2 (0.7)	59.3 (0.6)	39.2 (0.6)	49.0 (0.6)	65.7 (0.6)	45.9 (0.6)	55.5 (0.5)

Source: Bhutan Living Standard Survey, 2007

Table 7 Enrolment, Repetition Rate & Dropout Rate (PP-X) 2005-2010

Enrolment	2005	2006	2007	2008	2009	2010
Enrolment	133,288	138,422	143,378	146,955	152,447	157,091
Promotees	113,948	118,262	134,545	127,606	132,777	136,678
Repeaters	9,266	8,743	8,833	8,833	9,343	8,856
Repetition Rate (%)	7.2	6.6	6.4	6.0	6.1	5.6
Dropouts	5,557	4,055	4,989	4,064	2,901	2,674
Dropout Rate (%)	4.2	3.0	3.6	2.8	1.9	1.7

Source: Annual Education Statistics, 2010

Table 8 School survival rates by grades (%)

Survival rates	Boys	Girls	Total
Survival rate at grade 7 (class VI)	82	91	87
Survival rate at grade 10 (class X)	80	84	80
Primary cycle completion rate	92	100	98
Transition rate (Primary to lower secondary)	93	95	94

Source: Annual Education Statistics, 2010

Table 9 National-level Health indicators

Indicators	2010	Source
Deliveries attended by health professional	69.5	MoH
Immunization Coverage	94.4	EPI Survey 2008
Access to safe drinking water	88	MoH
Access to safe excreta disposal	93	MoH
Malaria Incidence per 10,000 population at risk	7	MoH
Tuberculosis Prevalence rate per 10,000 population	19	MoH
Diarrhoea Incidence per 10,000 under 5 children	2428	MoH
Pneumonia incidence per 10,000 under 5 children	1135	MoH
Intestinal Worms incidence per 10,000 population	141	MoH
Conjunctivitis Incidence per 10,000 population	948	MoH
Diabetes Incidence per 10,000 population	47	MoH
Cancer Incidence per 10,000 population	15	MoH
Alcohol Liver Disease Incidence per 10,000 Population	28	MoH
Hypertension Incidence per 10,000 population	343	MoH
Skin Infections per 10,000 population	1323	MoH

Source: Annual Health Bulletin, 2010; PHCB, 2005; Annual Health Bulletin, 2011

Table 10 National-level health trends

Indicators	2000	2005	2010
Infant Mortality Rate (per 1000 live births)	60.5	40.1	47.0
Under 5 Mortality Rate (per 1000 live births)	84.0	61.5	69.0
Life expectancy at birth (years), Male	..	65.7	68.4
Life expectancy at birth (years), Female	..	66.9	69.4
Life expectancy at birth (years), Total	..	66.3	68.9

Source: National Statistics Bureau, Thimphu, Bhutan

Table 11 Health facility by Dzongkhag, 2010

Dzongkhag	Hospital	BHU I	BHU II	Ind. Unit	ORC with shed	ORC without shed
Bumthang	1	0	4	2	13	1
Chukha	3	1	8	2	27	20
Dagana	1	2	6	3	12	4
Gasa	0	1	3	1	9	4
Haa	1	1	3	1	7	8
Lhuntse	1	0	11	1	33	0
Mongar	1	1	23	4	51	6
Paro	1	0	3	1	20	7
Pemagatshel	1	1	11	2	29	4
Punakha	1	0	6	1	9	0
Samdrupjongkhar	2	2	6	3	31	5
Samtse	3	0	9	2	14	4
Sarpang	2	0	10	1	8	3
Thimphu	5*	1	8**	0	5	11
Trashigang	3	2	17	4	53	4
Trashiyangtse	1	0	7	1	23	0
Trongsa	1	0	6	2	19	0
Tsirang	1	0	4	1	11	2
Wangdue Phodrang	1	1	9	2	17	6
Zhemgang	1	2	12	3	27	11
Total	31	15	166	37	418	100

* Indigenous hospital included under hospital
** Satellite Clinic included under BHU II
Source: Annual Health Bulletin, 2011

Table 12 Health personnel by type and number of hospitals

Health personnel	2005	2006	2007	2008	2009	2010
Hospitals	29	29	29	31	31	2010
Basic Health Units	176	176	178	178	181	181
Doctors	145	150	154	171	176	187
Nurses	538	587	559	567	556	556
Health Workers	171	229	232	425	505	535

Source: Statistical Yearbook 2010

Table 13 Estimated urban Population 2007-2010

Year	2007	2008	2009	2010	2011
Male	114,592	119,342	124,246	129,298	134,484
Female	98,978	103,410	107,986	112,703	117,554
Total	213,571	222,753	232,232	242,001	252,038

Source: Dzongkhag Population projections 2006-2015. NSB 2008

Table 14 Labour force participation rate, employed and unemployed, 2010

	Employed			Unemployed			Total Labourforce			Not in Labourforce			Labourforce participation rate (%)			Unemployment rate (%)			Employment rate (%)		
Sex	Male	Female	Total	Male	Fe-male	Total	Male	Female	Total	Male	Fe-male	Total	Male	Fe-male	Total	Male	Fe-male	Total	Male	Fe-male	Total
15-19	7,000	8,900	15,900	300	800	1,100	7,300	9,700	17,000	25,400	29,500	54,900	22.2	24.9	23.6	4.1	8.2	6.5	95.9	91.8	93.5
20-24	16,500	17,900	34,500	1,500	2,500	4,000	18,000	20,400	38,400	11,600	15,300	26,900	60.8	57.1	58.8	8.3	12.3	10.4	91.7	87.7	89.6
25-29	24,300	28,400	52,700	900	1,200	2,100	25,300	29,600	54,800	900	1,400	2,300	98.1	94.3	96	3.6	4.1	3.8	96.4	95.9	96.2
30-34	24,500	23,200	47,600	400	500	900	24,900	23,700	48,600	700	1,100	1,800	103.8	89.4	96.4	1.6	2.1	1.9	98.4	97.9	98.1
35-39	20,800	22,100	42,900	300	200	500	21,100	22,300	43,400	400	800	1,200	103.4	92.1	97.3	1.4	0.9	1.2	98.6	99.1	98.8
40-44	17,300	17,100	34,400	200	200	400	17,500	17,300	34,700	800	1,500	2,300	99.4	89.6	93.8	1.1	1.2	1.1	98.9	98.8	98.9
45-49	15,100	11,100	26,200	300	300	600	15,400	11,400	26,800	2,000	6,000	8,000	88	65.5	77	1.9	2.6	2.2	98.1	97.4	97.8
50-54	13,900	9,300	23,200	200	200	400	14,100	9,500	23,600	2,800	5,800	8,600	83.4	61.7	73.1	1.4	2.1	1.7	98.6	97.9	98.3
55-59	10,300	6,900	17,200	200	100	300	10,500	7,000	17,500	3,300	5,400	8,700	75	56	65.8	1.9	1.4	1.7	98.1	98.6	98.3
60-64	8,500	5,600	14,100	0	0	100	8,600	5,600	14,200	4,600	7,000	11,600	65.6	43.8	54.8	0	0	0.7	100	100	99.3
65+	7,500	4,600	12,100	300	300	700	7,900	4,900	12,800	12,000	13,800	25,800	39.9	26.5	33.5	3.8	6.1	5.5	96.2	93.9	94.5
Total	165,900	155,000	320,900	4,600	6,400	11,000	170,500	161,400	331,900	64,400	87,800	152,200	73.6	63.9	68.6	2.7	4	3.3	97.3	96	96.7

Source: Labour Force Survey 2010. MoLHR

Table 15 Inflation and gross domestic product, Bhutan 2007-2009

Indicators	2007	2008	2009
GDP at current prices (milln. Nu.)	49,456.5	54,712.9	61,223.5
GDP real growth (%)	17.9	4.7	6.7
Agriculture share to GDP (%)	18.6	12.1	18.2
Annual average inflation rate (%)	5.2	8.3	4.4

Source: Statistical Yearbook of Bhutan, 2010

Table 16 Households by source of fuel for cooking and lighting, 2007

Source		Gas	Electricity	Kerosene or Gas lamp	Wood	Kerosene	Candle	Others
Lighting	**Urban**	..	97.4	1.9	..	..	0.2	0.5
	Rural	..	56.1	37.3	..	..	0.7	5.8
	Bhutan	..	68.5	26.7	..	..	0.6	4.2
Cooking	**Urban**	44.8	50.1	..	2.3	1.5	..	1.4
	Rural	13	27.4	..	57.2	0.6	..	1.9
	Bhutan	22.6	34.2	..	40.7	0.9	..	1.7

Source: Bhutan Living Standard Survey, 2007

Table 17 Crop yield Bhutan, 2004-2006

Cereals	Yield (kg/acre)			% change 2004-2006
	2004	2005	2006	
Wheat	556.1	516.1	545.4	-1.9
Maize	1664.6	1238.7	1071.2	-35.6
Paddy	1150	1081.5	1104.6	-3.9
Buckwheat	400.5	432.6	432.2	7.9
Finger millet	324.1	417.9	440.6	35.9
All cereals	1,256.30	968.3	909.6	-27.6

Source: Estimated using RNR publication, MoA, Thimphu

Table 18 Minimum and maximum monthly temperatures in Thimphu, 2004-2006

	Minimum monthly average (celsius), Thimphu			Maximum monthly average (celsius), Thimphu		
Months	**1988**	**2000**	**2009**	**1988**	**2000**	**2009**
Jan	-3.8	-2.8	-1.4	16	16.5	23
Feb	0.7	-3.2	1.2	17.8	17.5	25
Mar	4.4	1.7	-1.9	18.6	22.5	24
Apr	7.6	7	8.8	21.5	23.5	28
May	12.4	10.8	8.9	24.4	27.5	28
Jun	14	15	14.2	25.3	27.5	30.5
Jul	17.1	15.6	16.1	25.6	27.5	31.5
Aug	16.6	14.7	15.7	24.4	27	31.5
Sep	14.6	11.6	13.5	24.4	26	30
Oct	6.9	6.2	8.8	24.5	22.5	28
Nov	0	3.5	2.1	19.5	17.5	23
Dec	0.7	0.6	0.6	16.9	17.5	20

Source: Meteorology Section, Hydromet Services Division, (semtokha), Thimphu

Table 19 Average annual rainfall 1996-2009, Semtokha and Thimphu (mm)

Location	1996-1999	2000-2004	2005-2009
Thimphu	642.6	680.82	507.54

Source: Meteorology Section, Hydromet Services Division, (semtokha), Thimphu 2009

Table 20 Households by distance from nearest motor road, dzongkhag 2005

Dzongkhag	Distance from nearest motor road								
	< 30 minutes	30 minutes - 1 hour	1 -2 hours	2 - 3 hours	3 - 4 hours	4 - 5 hours	5 - 6 hours	> 6 hours	All distance
Bumthang	2,528	219	38	14	18	20	1	32	2,870
Chhukha	11,116	771	396	323	292	308	281	995	14,482
Dagana	1,520	530	421	279	196	157	116	266	3,485
Gasa	134	29	19	14	2	8	18	503	727
Haa	1,847	92	89	9	4	5		244	2,290
Lhuentse	906	218	363	297	326	384	238	269	3,001
Mongar	2,891	645	563	718	773	297	111	1,350	7,348
Paro	5,910	613	242	261	36	9	1	46	7,118
Pemagatshel	1,126	197	201	185	238	230	156	604	2,937
Punakha	2,318	388	269	252	86	29	32	13	3,387
Samdrupjongkhar	3,754	342	355	452	547	448	709	1,756	8,363
Samtse	5,599	1,094	962	789	699	362	188	1,941	11,634
Sarpang	6,062	746	390	149	116	117	35	596	8,211
Thimphu	18,493	493	261	111	55	47	5	224	19,689
Trashigang	5,099	1,346	893	950	458	366	304	1,397	10,813
Trashiyangtse	1,506	440	480	566	289	173	127	183	3,764
Trongsa	1,642	317	200	210	79	105	66	120	2,739
Tsirang	1,872	399	317	498	287	169	54	55	3,651
Wangdue	3,814	596	620	350	300	158	174	215	6,227
Zhemgang	1,347	150	58	142	107	39	54	1,482	3,379
All Dzongkhags	79,484	9,625	7,137	6,569	4,908	3,431	2,670	12,291	126,115

Source: Population and Housing Census of Bhutan 2005. NSB