Bhutan National Adaptation Programme of Action

National Environment Commission
Royal Government of Bhutan

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ROYAL GOVERNMENT OF BHUTAN
NATIONAL ENVIRONMENT COMMISSION SECRETARIAT

Foreword

The kingdom of Bhutan today has 72.5% of its total land area under forest cover, much of which is primary forest. The kingdom's rich forest cover and its high GHG sequestration potential and its wealth of floral and faunal biodiversity are the results of His Majesty King Jigme Singye Wangchuck's enlightened policy on nature conservation. It is our hope that under his Majesty's dynamic leadership, Bhutan will continue to benefit from this rich forest cover and be spared of the devastating consequences of climate change. This document is a humble tribute to His Majesty's farsighted and visionary leadership in guiding Bhutan's environmental policy.

Climate change and global warming are significant challenges that the world, particularly the developing and least developed countries, face this century. Although LDCs like Bhutan contribute the least to global warming, they will nonetheless be seriously affected by the impacts of climate change.

As a small developing nation located in the fragile eastern Himalayan ecosystem, it is important to realize that climate change is not just an environmental problem but a serious challenge to sustainable development and the livelihood of the Bhutanese people. Bhutan's National Environment Strategy "The Middle Path" highlights hydropower development, industrial growth and intensification of agriculture as the three major avenues for sustainable development in Bhutan. However, these three sectors are also climate sensitive and most vulnerable to the adverse effects of climate change. 79% of Bhutan's population, who are subsistence farmers, will be directly affected by temperature changes and unpredictable monsoon patterns caused by climate change. Our roads and other important infrastructure will suffer more damages from landslides and flashfloods caused by climate change. Furthermore, the rapid melting of glaciers, besides affecting the base flow of our rivers, will also dramatically increase the risk of glacial lake outburst floods. With the Bhutanese economy so dependent on hydropower generation and agriculture, one can then imagine the consequences of climate change on the nation. Bhutan's extensive forest cover, rich biodiversity and clean water resources that are major tourist attractions will also be affected by climate change.

Therefore it is vital to put in place policies and measures to meet the unique challenges brought about by climate change. For countries like Bhutan, the most viable solution to address the adverse impacts of climate change is to develop sound coping mechanisms. The Formulation of Bhutan's "National Adaptation Programme of Actions (NAPA)" is an effort to look at such coping mechanisms in a scientific manner. The NAPA findings are aimed at addressing the immediate threats of climate change by putting in place long-term preventive measures.

I would like to acknowledge the contribution of the multi-sectoral Taskforce in the preparation of this document. In spite of their limited experience and knowledge, they have done a very commendable job. On behalf of the Royal Government of Bhutan, I would also like to thank the UNDP/GEF for providing the financial resources to complete Bhutan's NAPA.

Tashi Delek

Nado Rinchhen
Deputy Minister

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Acknowledgements

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Acronyms

BCP : Biodiversity Conservation Programme
BPMAS : Bhutan Poverty Monitoring and Assessment System
BPRSP : Bhutan Poverty Reduction Strategy Paper
CBD : Convention on Biological Diversity
CBS : Center for Bhutan Studies
CSO : Central Statistical Office
DOE : Department of Energy
DYT : *Dzongkhag* Yargye Tshogchung/District Development Committee
EA : Environmental Assessment
EAA : Environment Assessment Act
EFRC : Environmental Friendly Road Construction
EIA : Environmental Impact Assessment
GDP : Gross Domestic Product
GEF : Global Environment Facility
GIS : Geographical Information System
GNH : Gross National Happiness
GNP : Gross National Product
GLOFs : Glacial Lake Outburst Floods
GYT : *Geog* Yargye Tshogchung/Block Development Committee
HIES : Household Income and Expenditure Survey
HMSD : Hydro Meteorological Services Division
ICIMOD : International Center for Integrated Mountain Development
LDC : Least Developed Country
LUSS : Land Use and Statistics Section
MEA : Multilateral Environment Agreements
MOA : Ministry of Agriculture
MOHCA : Ministry of Home and Cultural Affairs
MTI : Ministry of Trade and Industry
MDGs : Millennium Development Goals
NBAP : National Biodiversity Action Plan
NCCC : National Climate Change Committee
NES : National Environment Strategy
NEPA : National Environment Protection Act
PCS : Planning Commission Secretariat
PPD : Planning and Policy Division
PMU : Poverty Monitoring Unit
PRSP : Poverty Reduction Strategy Paper
PVI : Poverty Vulnerability Indicators
RGoB : Royal Government of Bhutan
RNR : Renewable Natural Resource
RWHT : Rainwater Harvesting Techniques
SAARC : South Asian Association of Regional Cooperation
SDA : Sustainable Development Agreement
SDS : Sustainable Development Secretariat
UNCSD : United Nations Commission on Sustainable Development
UNCCD : United Nations Convention to Combat Desertification
UNDP : United Nations Development Programme
UNFCCC : United Nations Framework Convention on Climate Change
UNFCC : United Nations Forum on Climate Change
WFP : World Food Program
WSSD : World Summit on Sustainable Development

Executive Summary

The Bhutan NAPA preparation has been a timely opportunity to look at the country's climate change related vulnerabilities in its unique geographical setting. The peaceful Kingdom nestled among the highest mountainous regions of the globe has enjoyed political peace, stability and development progress for the last 100 years, but the process objectively showed how highly vulnerable the country is to effects of climate change given its fragile mountain eco-systems, high dependency on monsoon rains, and the ever present threats of Glacier Lake Outburst Floods (GLOFs) from its northern mountain ranges.

The process for the first time involved looking at effects of climate change as a threat mainly to the largely agrarian population that still depends on subsistence agriculture for their daily livelihood. Given past trends, the threat from GLOFs is now more than ever imminent due to evidence of temperature increases from the global warming; the incessant and frequent flooding and flash floods, especially in the summer of 2004 was a stark reminder of the deadly effects of climate change and environmental degradation- as witnessed especially in the eastern regions of the country.

The fact that Bhutan's economy is highly dependant on hydropower resources, constituting over 12% of the GDP, is alarming given the risks from adverse impacts of climate change to the hydropower infrastructure. What was evident from the process was that not only human lives and livelihoods are at risk but the very backbone of the nation's economy is at the mercy of climate change hazards. Thus important adaptation activities to GLOF threats are lowering level of dangerous lakes upstream, mapping of hazard zones, and watershed management in critical areas. It was also evident that all future hydropower plants – being capital intensive- should be installed only after careful assessment of their optimal capacity. Studies show substantial seasonal changes in water flow levels for extended periods of the year that do not fully utilize plant capacities; further such plants need to take into account the effects of climate change, global warming and GLOF that could pose high risks to the infrastructure.

The NAPA process not only adhered closely to the guidelines given by the LDC Expert Group (ref. Annotated Guidelines for NAPA preparation), it was conducted in a transparent manner. The process began with the assessment of vulnerabilities due to climate change across all development sectors represented by the five main working groups (Agriculture and Livestock, Forestry and Biodiversity, Health, Water Resources and Energy, and Natural Disasters and Infrastructure). A total of over 30 task force members participated vigorously at each stage of the process. After hazards and vulnerabilities were identified, the groups then worked on key adaptation strategies that would best address those vulnerabilities.

The NAPA Task Force group met over 15 sessions in the course of one and half years. The process began in early June of 2004, followed by 4 regional consultations at the grassroot level. The regional consultations allowed for exchange of information on climate change hazards and created an opportunity for the taskforce team to learn of specific local hazards and adaptation techniques that could be incorporated into the proposed projects at a later stage in the NAPA process. These invaluable stakeholder consultations at grassroot level helped identify the best possible adaptation activities that would address the countries most vulnerable communities which could further help increase their adaptive capacities.

A list of 55 projects were initially proposed that was narrowed down to 20 proposals; with an agreed list of criteria that best suited Bhutan's unique conditions- the proposals were further selected in accordance to (costs, human lives and health, arable land and water supply, and effects on essential infrastructure and monuments). A scoring on each of the above criteria led to a selection of top 9 prioritized projects as shown below:

1. Disaster Management Strategy (Pilot Implementation of Food Security and Emergency Medicine)
2. Artificial Lowering of Thorthomi Glacier Lake
3. Weather Forecasting System to Serve Farmers and Agriculture
4. Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)
5. Flood Protection of Downstream Industrial and Agricultural Area
6. Rainwater Harvesting
7. GLOF Hazard Zoning (Pilot Scheme – Chamkar Chu Basin)
8. Installation of Early Warning System on Pho Chu Basin
9. Promote Community-based Forest Fire Management and Prevention

The concerned sectors and the Department of Aid and Debt Management (DADM) will be the main custodians of the Bhutan NAPA program and will foresee its implementation with input from various stakeholders in the government and the local communities. The Bhutan NAPA is conceived as a living document, with transparent methods that can be updated from time to time once the prioritized projects are implemented.

While Bhutan does not have abject poverty, studies by the National Statistical Bureau estimates show over 30% of the rural communities live below the poverty line (Poverty Analysis Report Bhutan 2004). The adaptation activities will directly affect these vulnerable communities, thus it is critical that these projects be implemented without delay. Given the fragile and steep mountainous ecosystem, small land holdings, GLOF threats, and unpredictable monsoon rains, the RGOB's impressive advancement and

gains made in the last 40 years in rural development: health care and nutrition, increased life expectancy, primary education, improvements in agriculture and livestock productions, roads and communication infrastructure, can fast deteriorate if we do not learn to adapt to imminent threats from climate change.

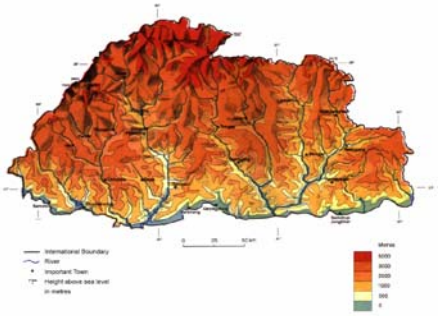
1.0 Introduction and Setting

1.1 Background.

Bhutan is a small mountainous country situated on the southern slopes of the eastern Himalayas. The country's area of 38,394sq.km. contains some of the most formidable regions in the world- mostly rugged and mountainous with elevations ranging from about 100m in the foothills to over 7500m towards the north.

72.5% of the total land area is forested, much of which is primary forests. Protected Areas make up 28% of the total land area with another 9% designated as Biological Corridors. Only 7.8% of Bhutan's land area is used for agriculture[1] . The country is home to almost 7000 species of vascular plants, 46 species of rhododendrons, 400 lichen species, 360 species of orchids, 201 mammal species and 700 bird species. The eastern Himalayas of which Bhutan is part of has been identified as an international global hotspot for biodiversity conservation. The Kingdom of Bhutan today plays a vital role in protecting some of the world's most endangered species such as elephants, tigers, snow leopards and golden langurs.

Bhutan's population has increased dramatically from an estimated 452,000 in 1984 to over 600,000 in 1996[2] . The current population of Bhutan is estimated to be around 7,50,000. Although the population density at 12 persons per square km. is the lowest in south Asia, the growth rate of 2.5-3% is among the highest in the world. Recent improvements in health care have reduced child mortality rate by over 50% and average life expectancy has increased by over 20 years in the last decade. Since the country has a young population with 39.1% of the population estimated to be below the age of 15, the kingdom's population is expected to double in the next 23 years[3] .



1.2 Economic Situation

Agriculture is the dominant sector in Bhutan providing livelihood, income and employment to 79% of the population. The majority of the farmers are subsistence farmers with average land holdings ranging from 1-4 acres[4] .

Bhutan's main export earnings are from hydropower generation. While it is estimated that the country has the potential to generate up to 30,000MW of electricity,

[1] Statistical Yearbook of Bhutan 2004, National Statistical Bureau
[2] Statistical Yearbook of Bhutan 2004, National Statistical Bureau
[3] Planning Commission RGOB Vision 2020- A Vision for Prosperity, Peace and Happiness
[4] RNR Statistics 2000 Vol 1. MOA

barely 3% of this potential has been harnessed so far. Much of the electricity is exported to India to generate income to finance development activities in the other sectors. In the 8th Plan period, earnings from hydropower constituted 45% of the country's revenue. Hydropower continues to play a dominant role in the current 9th Five Year Plan where it has been described as the main engine of growth. While it is the backbone of the Bhutanese economy, it is highly vulnerable to the adverse effects of climate change.

1.3 Vulnerability to Climate Change

The farming community is the most vulnerable group as farm productions are highly dependent on climate change, especially with the unpredictable and increased variability in the timing of the monsoons. In addition, the rugged and steep terrain makes it difficult to both expand productions and market any surplus that may be produced. The main cash crops of the farmers (rice, potatoes, chilies, apples and oranges) are all highly sensitive to water and temperature variations. Dry land crops such as wheat, buckwheat, maize and barley are the major food source for the farmers; both for family consumption and for his livestock. Dry land crops are however entirely dependant on rainfall thus making it even more vulnerable to climate risks.

1.4 Key Environmental Stresses & Vulnerabilities

The environment in Bhutan is one of most pristine in Asia with clean air, water and primeval forest. However, with high growth rates in population, unchecked rural to urban migration, increased population density in the towns and cities, rapid increases in imports of cars, and rising demand for fuel wood, roads and building construction, the future suggests many negative effects on environmental assets, which can further expose the population to climate change vulnerabilities.

Of particular importance is the use and management of watersheds, change in land use patterns from agriculture and forestry to industry, roads, townships, mines and quarries - that not only affect hydropower generation, but lead to environmental degradation. A preliminary analysis shows a total of 24,808.4 acres[6] of land has been used for various development purposes including transmission lines and government institutions.

Air quality – considered among the best in the region - is becoming a cause for concern in view of the accelerated growth in the industrial sector in the last 5 year period. Moreover, records show an annual increase of 11-17% in the number of cars in the period 1985-2003.

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[5] 9th Plan Main Document 2002-2007, Planning Commission, RGOB

[6] NEC, Brief Report on State of the Environment, May 2004

Box 1. GLOF and its Threats

Glacial Lakes

All the major rivers in Bhutan (Mo Chu, Pho Chu, Mangde Chu, Chamkhar Chu, Kuri Chu and Pa Chu) originate from glaciers and glacial lakes of the higher Himalayas. There are an estimated 2,674 glacial lakes in Bhutan out of which 562 are associated with glaciers[7]. The latest study shows 24 glacial lakes to be potentially dangerous. Not until the 1994 Glacial Lake Outburst Floods (GLOF) was this danger taken seriously.

GLOFs

GLOFs occurred in 1957, 1960, 1968, 1994 with varying intensity and damage to life and property in the lower valleys.

1994 GLOF

This was the most devastating GLOF in living memory. On 7th October 1994 the Luge Tsho in eastern Lunana burst and caused massive flooding, loss of life and extensive damage to property along the Punakha- Wangdi valley. The Dzongchu or small Dzong in Punakha was partly destroyed when the Pho Chu and Mochu rivers joined course above the Dzong. A total 91 households were affected by the flood in the Lunana Region. The GLOF washed away 5 water mills, damaged 816 acres of dry land and 965 acres of pasture land, and carried away 16 yaks and about 16 tons of food grains.

POTENTIAL DANGERS

A recent study[8] warns that the Raphstreng and Thorthormi glaciers and lakes could become dangerous in about a decade (2010) unless mitigation measures are taken. The worst case scenario being that a combined GLOF of these two lakes could result in a flow of over 53 million cubic meters of water- that is more than twice the volume of the 1994 GLOF. This could have with unimaginable consequences downstream.

[7] ICIMOD (2001), Bhutan. Inventory of Glaciers, Glacial Lakes, and Glacial Lake Outburst Floods. Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region

[8] Dept. of Geology and Mines with Institute of Geology, University of Vienna, Austria, August 2002.

Box 2. Flash floods & landslides, and their impacts

Flash Floods & Landslides

Records show that from 27th July to 3rd August 2000, the southern regions of Bhutan received maximum rainfall that was unprecedented in the recorded history of hydrology in Bhutan (The Hydrology Unit of the Department of Power[9]). The maximum rainfall in a 24 hour period was 449mm in Phuentsholing, 500mm in Tala and 520 mm in Gedu. The highway to the country's capital city of Thimphu was closed for almost a month and the worst flood took place in and around Phuentsholing. Flash floods ravaged the deeply eroded gullies, gorges and steep terrain of Phuntsholing, Pasakha, Samtse and Kalikhola areas. Both the Toorsa and Dhotikhola rivers changed their course causing loss of life, and damage to both industrial areas and residential homes.

Hydropower Stations at Risk

The landslide on the Tsatichu (August 2003) river created a dam forming a lake that could pose dangers downstream to the Kurichu Hydropower station. While there was no imminent danger from the lake, it was a stark reminder of the how vulnerable the nation's hydropower facilities are.

Eastern Floods (July-August 2004)

While the western region had lesser total rainfall, the eastern Dzongkhags of Trashigang, Trashiyangtse and Samdrupjongkhar experienced increased volume of rainfall resulting in major flooding and damages[10] . A total of 9 lives were lost (in landslides and related accidents), 29 houses were completely washed away, 26 houses collapsed and 107 houses were partially damaged. A total of 161 acres of wetland and 503 acres of dry land was washed away. 350mt. of maize, 126mt. of paddy, 2000 orange trees and 2mt. of potatoes were lost affecting about 1437 households. 39 irrigation channels were damaged and 22 bridges were damaged or washed away.

[9] Report on the Dutekhola and Pasakha (Barschhu) Floods in Phuentsholing, September 2000.

[10] Report on the Assessment of Monsoon Related Damages in the Six Eastern Dzongkhags. Compiled by the Ministry of Agriculture- 12 August 2004.

2.0 Framework for Adaptation Programme

2.1 Climate - Current Situation

Climate data and information on Bhutan is scanty, sparse and not well documented. The first meteorological weather stations were installed by the Department of Agriculture in 1973 in a few selected locations across the country[11]. The Department of Energy under the Ministry of Trade and Industry has today improved the capacity to collect and monitor hydro-meteorological data.

The climate in Bhutan varies substantially from one region to another due to dramatic changes in topography. The country has three climatic zones: 1) the southern plains with a typical subtropical climate with high humidity and heavy rainfall 2) the central belt of flat valleys characterized by cool winters and hot summers with moderate rainfall and 3) the high valleys with cold winters and cool summers. Annual rainfall on average varies from 1,020mm to 1,520mm. The land over 5000m is permanently covered with snow and glaciers.

The complex climate variations in Bhutan are also mainly due to its situation at the periphery of the tropical circulation in the north and periphery of the Asian monsoon circulation in the south. Thus the country is influenced at once by both the extra-tropical and monsoon systems (Hydromet Division, MTI/RGOB).

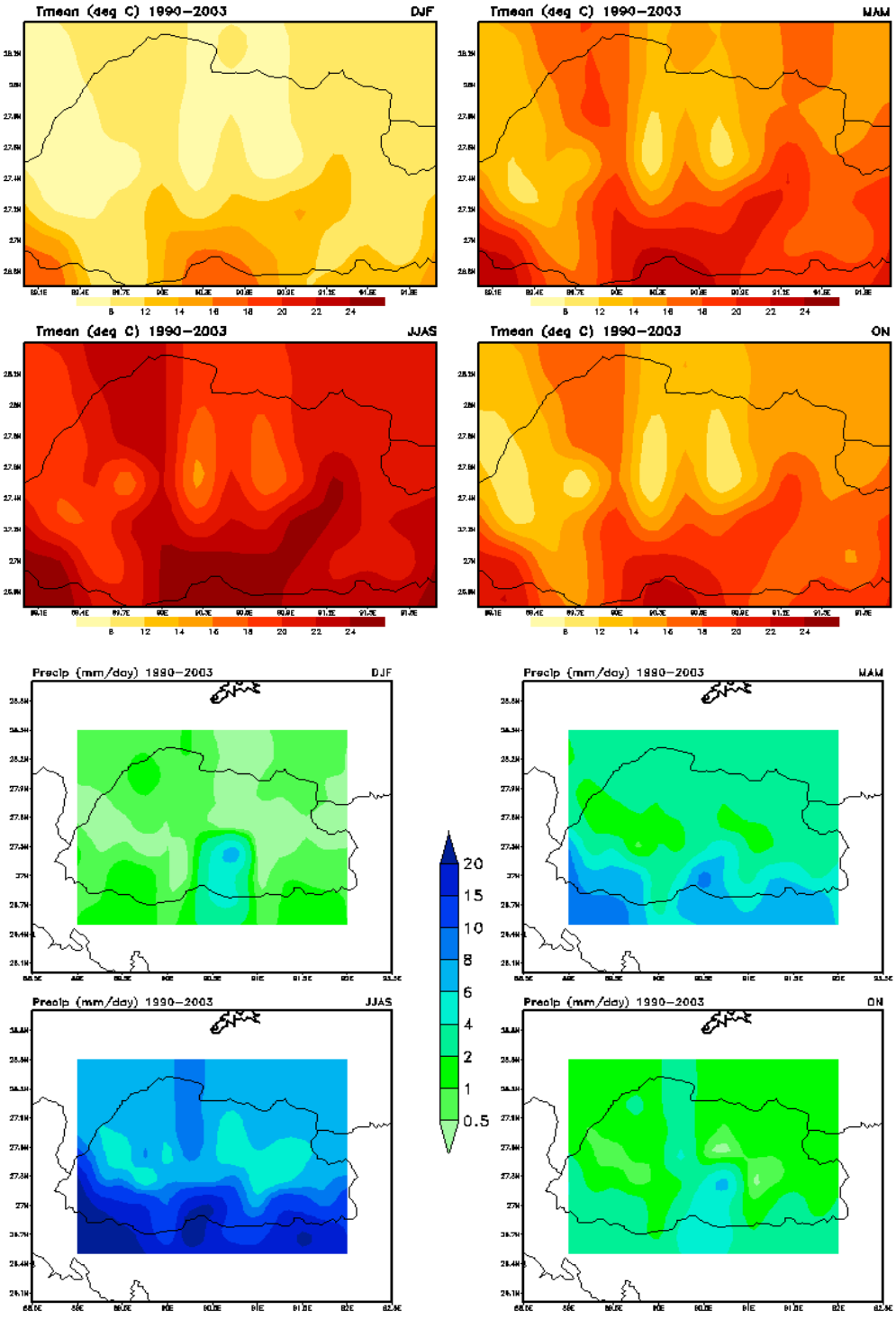
The summer monsoon lasts from late June through late September with heavy rains from the southwest. The rain bearing clouds that originate from the Bay of Bengal travel north towards the Bhutan Himalayas. When they are blocked from traveling further by the high Himalayas, they bring heavy rainfall causing devastating flash floods and land slides in the region.

A study of temperature and rainfall from 44 meteorological stations across Bhutan during the period 1990-1999 shows that the highest temperature recorded was 37.2 degrees celsius at Phuentsholing while the lowest temperature recorded was –8.2 degrees celsius at Drukgyel Dzong[12]. Figure 1. below shows the variation of average annual temperatures across the four agro-ecological zones. While there is an inverse correlation between altitude and average temperatures, observations in Paro and Mongar indicate little differences due to local variations from the orientations of the valleys and mountain ranges. The annual observation of monthly precipitation show a unimodal nature with the maximum in July and the minimum in January; Around 70% of the precipitation in Bhutan is generated by the monsoon while pre-monsoon activities generate about 20%.

[11] Group Training Course in Meteorology, Country Report, prepared by Sonam Dorji, JE. HMSD, DOE 2004

[12] Climatic characteristics of temperature and precipitation of Bhutan, Dewan Abdul Quadir, Md. Et al. SAARC Meteorological Research Center (SMRC), Dhaka, Bangladesh

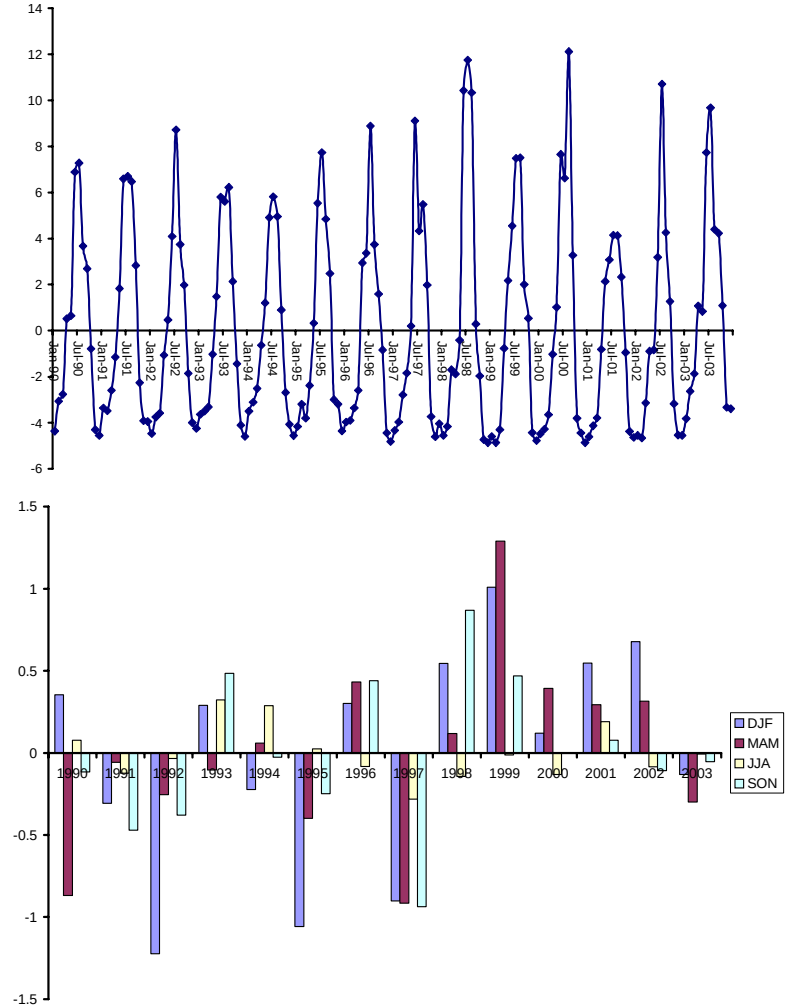
Figure 1. Seasonal Annual Average Temperature (degrees Celsius) and Precip (mm/day)



2.2 Climate Trend

Given the scarce resources, proper equipment, lack of capacity and trained manpower, projecting climate change in a meaningful and systematic manner is an extremely difficult task. Reliable data exists for only about 10-12 years beyond which observations are not reliable enough to make any firm conclusions as climate predictions would need at least a few decades of observations. However, the analysis of available meteorological data for the past 13 years indicates an increasing trend in precipitation variability during the past 13 years across the country (Figure 2). Note that the temperature over the past 5 years has been above the 1990-2003 mean values, which is a good indication that Bhutan could also be confronted with global warming.

Figure 2. Anomaly of monthly average precipitation and mean temperature from the 1990-2003 mean



2.3 Vulnerability of Key Sectors

The NAPA Taskforce comprising of the five working groups reported on key vulnerabilities due to climate change within their respective sectors.

The sector vulnerability assessment findings as shown in the following tables are the final results of group meetings, field consultation workshops, discussions amongst the NAPA Taskforce members and all concerned stakeholders.

Sector	Vulnerabilities
Forestry & Bio-diversity	• Drought in combination with increased lightning risks triggering forest fires • Change in phenological characters of plants/ Loss of endemic species • Change in migratory pattern of the trans boundary wildlife, (All resulting in loss/degradation of forest ecosystem and reduction of alpine range lands. Furthermore, possible increase of vector-borne disease in wildlife due to warming)
Agriculture	• Crop yield instability. Loss of production and quality (due to variable rainfall, temperature, etc.). Decreased water availability for crop production. Increased risk of extinction of already threatened crop species (traditional crop varieties) • Loss of soil fertility due to erosion of top soil and runoff. Loss of fields due to flash floods, land slides and rill & gully formations. Soil nutrient loss through seepage • Crop yield loss (flowers & fruit drop) to hailstorms. Deteriorated produce quality (fruit & vegetables) by untimely incessant heavy rains and hailstorms • Delayed sowing (late rainfall). Damage to crops by sudden early (paddy) and late spring (potato) frost (ref. seasons shifting) • Outbreak of pests and diseases in the fields and during storage where they were previously unknown • Damages to road infrastructures (food security) – see also Natural Disaster & Infrastructure sector.
Natural Disaster & Infrastructure	• Debris-covered glaciers forming huge moraine dam lakes that ultimately lead to GLOFs (i.e. flash floods and landslides, heavy siltation of the rivers, and other geotechnical hazards) **GLOF will affect 'essential' infrastructure):** - **Hydropower** systems (generation plants, transmission and distribution infrastructure) – the main export product, and furthermore: - Industrial estates/infrastructures - Human settlements: urban, sub-urban and rural settlements. - Historical and cultural monuments: *dzongs*, monasteries, *chortens*, etc. - Public utilities: roads, bridges and communications. ***** Receding debris-free glaciers lead to reduction of water resources (possible shortages/variations) – see also Water Resources sector
Water Resources (& Energy)	• Temporal & spatial variation in flow, affecting notably electricity production/exports due to disruption of average flows for optimum hydropower generation • Increased sedimentation of rivers, water reservoirs and distribution network, affecting notably irrigation schemes' productivity/ agricultural crop yields • Reduced ability of catchment areas to retain water/increased runoffs with enhanced soil erosion (deterioration of environment) • Deterioration of (drinking) water quality (see also Health sector)
Health	• Loss of life from frequent flash floods, GLOF and landslides (recent Trashigang floods and landslides) • Spread of vector-borne tropical disease (malaria, dengue) into more areas (higher elevations) with warming climate • Loss of safe (drinking) water resources increasing water borne diseases.

Thus, a total number of 17 'main vulnerabilities' were identified, although not all equally related with climate (change).

2.4 Methodology used to Develop NAPA

The methodology used to develop Bhutan's NAPA was a widely consultative process both at the national and regional levels. Both senior and mid level RGoB officers representing a wide range of stakeholders - agriculture, forestry, livestock, environment, roads, health, geology and mines, finance, planning, home affairs - took part in the numerous workshops and training sessions and in developing project options and ideas for NAPA. The NAPA Task Force with representation from the five key sectors played the integral role in develop ping the NAPA document.

The cross-sectoral multidisciplinary team deliberated at each step of the NAPA formulation process; beginning at the training workshops to the national and regional consultations, and finally during the prioritization or ranking of project options to develop the project profiles.

In addition four regional consultations were held in Phuentsholing, Lobeysa, Bumthang and Trashigang Dzongkhags. At these workshops, sector heads from the 20 Dzongkhags including village heads or *Gups*, and *Chimis* or peoples representatives deliberated on the climate change vulnerabilities and adaptation issues presented by the task force members.

2.5 Relation of NAPA to Bhutan's Development Goals

The Bhutan NAPA framework with its plans and strategies was not developed in isolation. The adaptation responses are closely linked to the Royal Government's developmental policies, programs and activities as seen from the various country development goals and statements below:

National Vision
In 1999 Bhutan launched "Bhutan 2020- A Vision of Peace, Prosperity and Happiness" articulating the country's aspirations (that existed since 1987 when His Majesty the King Jigme Singye Wangchuk announced that "Gross National Happiness was more important than GNP.") for sustainable, and equitable economic growth and development without compromising the natural resource base for future generations.

Millennium Development Goals - (Progress Report 2002)
Bhutan places high priority on the MDG Goal to Eradicate Extreme Poverty and Hunger by Year 2015. With food poverty line of Nu. 740.36 per capita per month, it is estimated that 36.3 percent of the population are poor. The other millennium goals are:

- Achieve universal primary education;
- Promote gender equality and empower women;

- ❖ Reduce child mortality;
- ❖ Improve maternal health,
- ❖ Combat HIV/AIDS, Malaria and other diseases;
- ❖ Ensure Environmental Sustainability.

The poverty alleviation strategy of the RGOB is to first build infrastructure for access to the remote communities and villages. After roads have been constructed, then the other social facilities of schools, hospitals, power supply and communications, and agricultural stores (processing and marketing facilities) can be developed.

The *Bhutan Poverty Reduction Strategy Paper (BPRSP),* for poverty reduction through socio-economic and political empowerment of the poor. The BPRSP was developed with a wide range of stakeholder participation at national and district levels. The strategy identifies several cross-cutting issues relevant for NAPA including empowerment of the most vulnerable and remote sectors of society, by provision of access roads, electricity, free health care and education, and decision making powers at the village and block levels through a process of decentralization.

National Plans

Following the Earth Summit in Rio De Janeiro, Brazil, in 1992, Bhutan demonstrated its strong commitment to the preservation of the environment and climate change in particular when it ratified the UNFCCC in August 1995. The NEC became the focal point for climate change activities in the country and its high level commission members formed the National Climate Change Committee (NCCC). Bhutan has also ratified the Convention on Biological Diversity.

In 1998, the National Environment Strategy (NES) was formulated following consultations with all levels of society. The Environmental Assessment Act 2000 was passed in 2000. In addition Bhutan joined a unique partnership with the Netherlands, Costa Rica, and Benin to form the Sustainable Develop ment Agreement (SDA) - an unprecedented arrangement based on reci procity, equality and participation in contrast to the traditional one way donor-recipient relationship.

Regionally Bhutan is an active participant of the South Asia Cooperative Environment Program (SACEP) in promoting environmental causes in the region.

Bhutan has participated at the UN Commission on Sustainable Development (UNCSD) conferences. It also participates in other bilateral and multilateral fora of the United Nations Environment Program (UNEP), the Economic and Social Commission for Asia and the Pacific (ESCAP), World Bank, Asian Development Bank and the International Center for Integrated Mountain Development (ICIMOD). ICIMOD initiated a regional flood warning system that can be communicated and coordinated in real time during a recent meeting in May 2005. Bhutan participated in the World Summit on Sustainable Development (WSSD) in Johannesburg South Africa where the SDS presented a paper and held a side event to showcase the SDS program and explored further south-south relations amongst the SDA partner countries.

Based on the above RGOB policy framework and various national activities and consultations, the following development goals and objectives were selected to guide the NAPA process:

- Eradicate poverty, and achieve food security by increasing access to remote areas
- Safeguard hydropower generation as the backbone of the economy
- Promote gender equality and empower women (reduce gender disparity in tertiary education)
- Reduce child mortality
- Ensure environmental sustainability
- Minimize loss of life and livelihoods due to natural and climate related disaster

2.5.1 NAPA Vision

The Bhutan NAPA vision is to create awareness amongst all stakeholders of the inevitable effects of climate change and climate variability on their lives and to develop adequate capacity to respond to future climate change threats.

2.5.2 Objective

The objectives of the Bhutan NAPA are:

1. to identify urgent and immediate projects and activities that can help communities adapt to the adverse effects of climate change
2. to seek synergies and combinations with existing MEAs and developmental activities with an emphasis on the impacts of climate change
3. to integrate climate change risks into the national planning process

2.5.3 Strategies or Guiding Principles

With close adherence to the guidelines for the preparation of the NAPA (LDC Expert Group's Annotated Guidelines for NAPA preparation, 2002), the Bhutan NAPA process is guided by the following principles:

Multidisciplinary Approach
The use of a task force group representing the various sectors of the government ensures the ownership of the whole process in selection, prioritization and ranking of the projects and adaptation activities.

Participatory Approach
The regional consultations with representation from all the 20 districts of Bhutan allowed for communications between the NAPA task force members and the local public. This allowed for wider stakeholder views and further fine tuning of the project ideas and activities with participation from the grassroots level.

Complementary Approach
The information used to develop the NAPA is based on the national plans, programmes and policies of Bhutan. The process also compliments both national and international documents such as the Sustainable Development Agreement, Bhutan Poverty Reduction Strategy Paper, Biodiversity Conservation Programme, Biodiversity Strategy and Action Plan (CBD), and Initial National Communication.

Sustainable Development
The mainstreaming of NAPA into national plans and policies that support sustainable development goals is considered in the process - climate change factors are also addressed in the NES, EA Act 2000 and NBAP.

Gender Equality
The NAPA process promoted equal participation of both men and women right from the formation of the NAPA Taskforce. Gender equality was also emphasized during the regional consultations.

Country Driven Approach
In addition to having a multidisciplinary team representing the various sectors of the civil service, a wide stakeholder view and participation was encouraged with four regional consultations representing the four major agro ecological zones of the country.

Cost-effectiveness

The NAPA process takes into consideration implementation costs with experience from both past and on going projects; for example the proposals for an early warning system for the GLOF risks is both cost effective and fulfils the criteria for an urgent and immediate adaptation activity that has high life saving values.

Simplicity

The NAPA process aims to have an uncomplicated and efficient approach to addressing the most urgent and immediate needs of the vulnerable communities.

2.6 Potential Barriers to Implementation

Bhutan being a member of the LDCs, has very limited internal capacity to fund adaptation activities. Some of the major barriers to implementing NAPA activities are:

- Lack of sufficient national capacity in terms of human resources for sustainable development at the district and *geog l*evel
- More concerted efforts required across all sectors to heighten awareness of climate change issues especially in the districts and *geogs*. Much of the development efforts so far were geared at immediate infrastructure development needs to address basic standards of living where adaptations to climate change and its effects are fairly new concepts
- To adequately incorporate (and institutionalize) environmental criteria in the face of rapid development and urbanization
- Limited access to many of *geogs* and villages that are isolated and scattered limiting access to markets, information and awareness campaigns
- Limited analytical capability, especially for climate data to analyze threats, potential impacts and develop viable solutions
- Lack of sufficient donor partners to fund core environmental management activities

3.0 Identification of Key Adaptation Needs

In view of the historical information on climate related hazards, past adaptations to climate change and climate variability, and based on a summary of the various multi-sectorial workshops and the regional consultations across the kingdom, we can conclude that:

- The most likely adverse impacts of climate change in Bhutan are increased GLOF events and flooding, while increased rainfall in areas without proper drainage systems can cause soil instabilities leading to landslides and flashfloods

- The most vulnerable sectors are agriculture and hydropower as they both depend heavily on the monsoon and temperature change patterns. Since 70% or more of the Bhutanese depends on subsistence farming, crop failure and stress on livestock rearing will affect the most vulnerable communities in the rural areas

- The most vulnerable communities are likely to be the rural poor who depend directly on crops and livestock. They would be hardest hit from any climate change impact, while urban households especially those in the high-risk agro-ecological zones would also be impacted.

3.1 Potential Adaptation Options – Sector-wise

Based on the above overview and framework, the following are actual and proposed potential adaptation options that is further elaborated and explored into a manageable list of priority areas. The adaptation activities listed below are summarized from public consultations and the stakeholder workshops.

SECTOR	PROPOSED ADAPTATION ACTIVITIES
Human Health	• Increase number of/Protect existing water treatment plants to ensure safe drinking water • Regular cleaning and vaccination campaigns at sites where mosquito vector is abundant • Control of vector /water borne diseases • Monitor air and drinking water quality • Establishment of EMS
Water Resources & Renewable Energy	• Raise community awareness on sustainable use of water resources • Improve land use planning in degraded water catchment areas to promote afforestation; improve watershed management • Extend, improve and maintain water supply infrastructure • Provide technological and financial support to harness hydropower potential, including transmission and distribution • Conduct research for other renewable energy alternatives including solar power • Enhance the Power Master Plan • Optimization in design of installed capacity of existing as well future hydropower plants • Improve efficiency in irrigation • Assessment of GLOF threat in hydropower projects • Performance of religious rituals (indigenous methods for bringing about timely rain, adequate water for irrigation, ward off pests and diseases and usher good harvests)
Agriculture	• Develop and introduce resistant crop and livestock varieties with greater adaptations to limited arable land and extreme temperature and rainfall events • Promote agro-forestry or agro-silvo–pastoral systems to reduce soil erosion and run-off on steep slopes; also to mitigate heat stress and respiration problems • Improve food security for marginal farmers • Terracing and contour bunding • Convert wetland to dryland (from risks of: prolonged rain and flood) • Change cropping patterns • Create more off-farm or cash earning job opportunities (weaving, constructions, road labor, etc.) for farmers who are affected by crop loss due to climate change effects (early/late rains, pest damage, frosts, hail storms or droughts) • Improve or upgrade storage facilities to store and have access to food grains as an insurance against crop loss or damage or bad yields
Forests and Biodiversity	• Promote community-based forest management and afforestation projects in ways to conserve land, water resources and wood production • Develop a socio-economic system that ensures that society is in harmony with the natural environment

Natural Disaster and Infrastructure	Safeguard generation of hydropower with improved upstream watershed management in critical and high risk areas Installation of early warning systems; hazard mapping of key watershed areas; installation of hardware; real time monitoring (unmanned) with automatic data transmission Artificial lowering of lake levels (esp. Thorthormay Tsho) Implementation of Pho Chu Hazard Zonation Plan National database on landslide prone areas and intensity of land slides to assess the risk of landslides Reforestation of catchment areas and slope stabilization of landslide and flashfood prone areas Provide restrictions on collection of sand and boulders, and on overgrazing Soil conservation techniques River bank protection Re-location/ resettlement of affected towns Improve construction technology of building houses to withstand natural calamities
Associated Capacity Building Requirements	Build capacity to respond to future disasters and coping mechanisms; prepare national disaster management strategy; awareness creation; capacity building Build capacity in risk assessment from GLOF Capacity building on assessment and mitigation of landslides Build technical capacity and expertise for integrated assessment of climate change adaptations; including technical capacity to monitor climate, plan and implement adaptation activities, improve forecasts and inform policy makers Improve capacity to monitor and provide timely information from districts (20) and geogs (201). Integrating climate change concepts into the planning cycles, sector policies and project level activities.

A total number of 45 adaptation activities, including 6 on associated capacity building needs were listed. Not all of these relate clearly and unambiguously to climate change (or even climate variability) but are more focused on sustainable development. This long-list however offered sufficient opportunities for selection of the most climate-relevant activities.

The following step further fine-tuned the adaptation options addressing the various climate hazards impacting vulnerable and vital components of the Bhutanese society: agriculture and forestry-dependent livelihoods, essential infrastructures and heritage sites, the natural environment and ecology (see following table).

3.2 Adaptation Options – Climate Hazard-wise

Climate Hazard	Adaptation Options
GLOF (due to temperature rise)	• Installation of early warning systems with associated awareness raising • Artificial lowering of glacier lake levels (i.e. Thorthormi Tsho) • Implementation of Pho Chu Hazard Zonation Plan and other • Assessment of GLOF threats for hydropower projects
Landslide (due to weather pattern change – high rain intensity)	• Soil Conservation and Land Management - Ramjar, Chaskar, Arong, Moshi, Kencholing (erosion) • Application of EFRC – nationwide • National database on landslide prone areas and intensity of land slides to assess the risk of landslides. • River bank protection • Small stream catchment protection • Slope stabilization of areas with major landslide and flashflood problems
Flash flood (result of GLOF or due to weather pattern change – high rain intensity)	• Watershed Catchment Management integrated with Land Management/Soil Conservation • Weather and climate forecasting • Promote community-based forest management and afforestation projects in ways to conserve land, water resources and wood production (incl. tree species that are fast growing and more resistant to insect damages, diseases and phenomena like fires) • Protect water treatment plants to ensure safe drinking water
Drought (due to temperature rise and/or weather change pattern – longer intervals between rains)	• Optimize the installed power plants capacities. • Low river flow/Water shortage studies/Impact on hydropower generation, drinking and irrigation water supply, etc. • Weather and climate forecasting • R & D on water use efficiency, resistant crop varieties, water harvesting.

This framework of climate-induced hazards and (17) adaptation options or activities shown above, constitutes then the basis for the proposed projects—a 'shortlist' of 10-15 projects—to be assessed using a 'perceived cost-benefit' criteria to rank or prioritize as shown in the following chapters.

3.3 Shortlist of Proposed Adaptation Activities for NAPA Evaluation

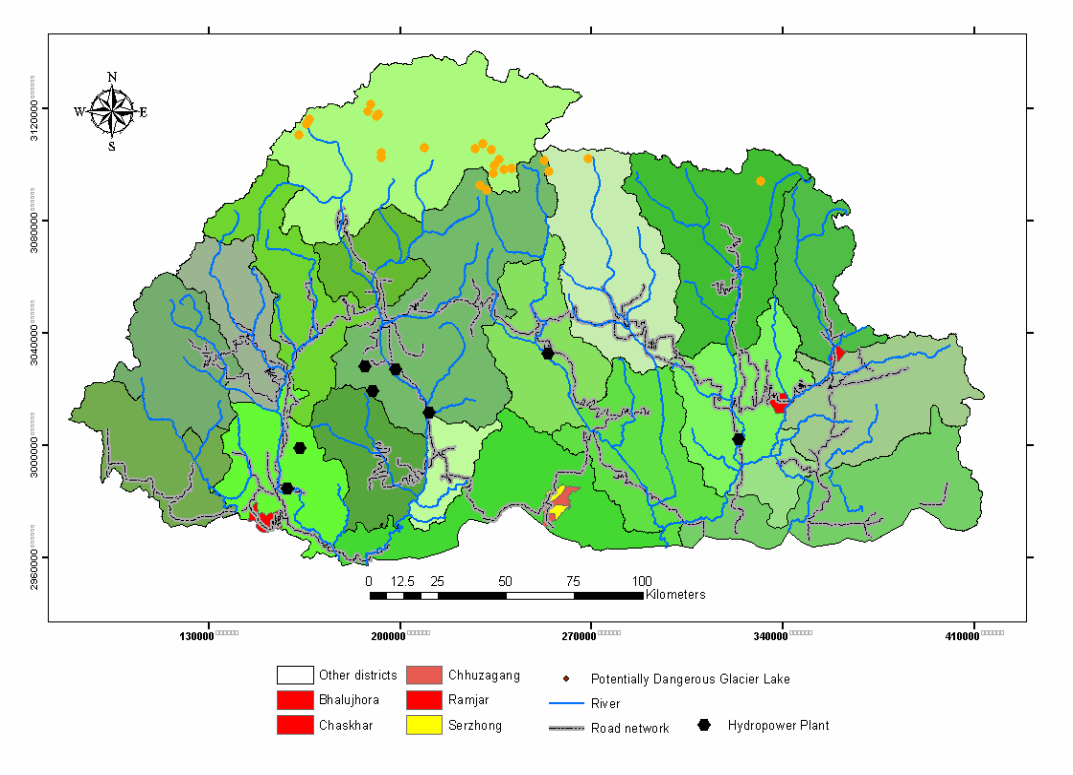
The selection and prioritization process of the multi-sector task force led to the following shortlist of 9 proposed NAPA activities (in random order) that is further prioritized in the next stage:

Title of Proposed Project	Main Objective	Main outputs
1- Disaster Management Strategy – planning for food security and emergency medicine to vulnerable communities	Implementation of Emergency Food Security & Medicine/First Aid components of National Disaster Management Strategies in some pilot districts (East Bhutan)	Rapid communication, immediate response & distribution networks for emergency needs in place; Lives saved; Awareness on relationship between bad land management and disasters,
2- Landslide Restoration & Flood Prevention (Pilot Schemes in Critical Areas)	Effectively intervene in major landslide and flood affected areas before these become dangerous for human livelihood	Proper land management practices developed, implemented and shared by communities in a series of pilot districts incl. Chaskhar & Latongla (Mongar), Ramjar (Trashiyangtse), Batasey and Tintaley (Sarbang), etc.
3- Rainwater Harvesting	Safeguard farmers from water shortages during dry periods and irregularities in the monsoon rainfall, thereby improving household food security and income of farmers living in vulnerable areas	Higher crop and animal productivity under rainfed agriculture; Safe drinking water and less health problems; Increase in rural income; Synergy with actions under the convention on desertification; Environmental benefits like reduced soil erosion, soil salinity and recharge ground water.
4- Weather Forecasting System to Serve Farmers and Agriculture	Provide (i) weather and seasonal forecasts in support of production decisions of farmers, (ii) agro-meteorological early warning system against inclement weather, (iii) special advisories at different production stages	Optimally distributed network of synoptic stations; More accurate weather forecasts up to 15 days based on operational meso-scale LAM model optimized for Bhutan; associated extension services
5- Artificial Lowering of Thorthormi Lake	GLOF prevention: Lower water level of Thorthormi lake by excavating artificial channel-widening of existing outlet channel	Required civil works built; Water level monitored; staff trained to undertake similar projects elsewhere
6- Installation of Early Warning System on the Pho-chu River Basin	Warning of Punakha valley Settlement/ Essential Infrastructure in case of actual GLOF	Technical Early Warning System in place & operated; Hazard Zonation; Awareness across the valley
7- Promote Community-based Forest Fire Management and Prevention	Conserve land, water resources and wood production (incl. tree species that are fast growing and more resistant to insect damages, diseases and phenomena like fires)	Village level forest fire management institutionalized and implemented; Forest fire equipment well established and managed; Reduced incidence of fires; in Mongar and perhaps Wangdi-phodrang districts
8- GLOF Hazard Zoning (Pilot Scheme - Chamkhar Chu Basin)	Awareness raising for GLOF risks and possible preventative measures	High quality hazard zonation map delineating areas with high risk etc. areas; materials for public information; tools for the decision makers on spatial planning, building permits, etc.
9- Flood Protection of Downstream Industrial and Agricultural Area	Effectively intervene in major landslide and flood affected areas before these become dangerous for human livelihood	Proper land management practices developed, implemented and shared by Local Authorities and Investors in Pasakha (Chukha) Industrial and Gelephu Agricultural Area.

All the above proposed projects with the exception of one (no. 4) are location-specific. In addition to the climate-related problems that the interventions will address, they act as 'pilot' projects that can be duplicated elsewhere in Bhutan.

Proposal no. 4 addresses a requirement of national importance as regards climate and climate change, notably the need to significantly improve the weather recording database and 'medium-term & localized' forecasting capabilities.

The following map shows the approximate locations of the proposed adaptation activities or interventions in relation to the country's main river basins (5), main climatic zones (3) and potentially dangerous glacial lakes (24).



4.0 Criteria for Selection of Priority NAPA Projects

The task force considered the application of Bhutan's (internationally popular) concept of "Gross National Happiness" (GNH) as a main criterion for prioritization of NAPA activities/projects, but decided that it would be preferable to break down the single 'indicator' into several components that would be closer to internationally accepted criteria used to appraise project proposals. The task force then took the criteria recommended by the LDC Expert Group (ref. Annotated Guidelines for NAPA preparation, and Decision 28/CP.7—para. 15 and 16) as the starting point for the determination of suitable criteria.

The task force team used a three step selection approach as shown below, and was cautious to choose criteria that best suits Bhutan while limiting it to a manageable number so as to maintain a reasonable degree of transparency in the decision-making process.

4.1 Methodology used for Selection of Criteria

In the next NAPA process the task force agreed to apply an adapted Multi-Criteria Analysis (MCA) technique in order to reach consensus on the selection of the top priority NAPA projects.

Firstly, four general criteria were used to select priority adaptation activities from a long list of potential activities (Section 3.1 above) they are:

1. convincing threats of climate and climate change; level or degree of adverse effects of climate change
2. demonstrates fiscal responsibility (or cost effectiveness)
3. level of risk (by not choosing to adapt that is doing nothing entails a certain amount of risk)
4. complements country goals (such as: overcoming poverty, enhancing adaptive capacity, or other environmental agreements)

For each of the ideas put forward the group rated it against each of the four criteria above- and using a consensus approach omitting project ideas that failed to satisfy one or more of the above criteria. In other words, the above criteria was used as a first step- to narrow down the total list of project ideas from an initial list of 53 adaptation activities (the total from five sectors—see Section 3.1) to a manageable list of 9 activities (Section 3.3).

In the second step, the task force then discussed the criteria listed below, with an indicative 'hierarchy' of importance of the criteria (in descending order of

'priority' as shown below):

1. Loss of life and livelihood
2. Human health
3. Food security and agriculture
4. Water availability, quality and accessibility
5. Impact on vulnerable groups
6. Essential 'Infrastructure', including also Cultural Heritage (Dzongs, etc.)
7. Cost of the Project
8. Biological diversity
9. Land use management and forestry
10. Other environnemental issues (natural attractions, forest, land erosion, slope stability etc.).

The task force concluded that this total number of criteria (10) was not really manageable. Moreover, it was practically impossible to define measurable indicators for several of these criteria. Even where measurable indicators can be defined, it would be difficult—at the current stage of development of research and monitoring capacity in Bhutan—to come up with *quantitative* indicators. The criteria would have to be expressed in *'comparative' or 'relative' qualitative terms*, rather than in figures or numbers—with the exception of costs.

4.2 Criteria for Assessing the Proposed Activities

After elaborate discussion, the task force agreed to apply the following four (4) criteria—three (3) representing 'benefits' of the adaptation project intervention and one (1) representing the 'cost' of the project:

- Human life and health saved by the intervention (benefit-1);
- Arable land with associated water supply (for Agriculture/Livestock) and productive forest (for Forestry/Forest products collection) saved by the intervention (benefit-2);
- Essential infrastructure, i.e. existing and projected hydropower plants, communication systems, industrial complexes, cultural and religious sties, and main tourist attractions (benefit-3);
- Estimated cost (cost—which can be considered a *'negative'* benefit).

The task force felt that the first criterion listed—*Human life and health saved by the intervention (benefit-1)*—reflected the high values attached to life and health with direct effects on human beings; it called for inter alia emergency aid such as food and medicine (related with a national disaster management strategy, so far non-existent in Bhutan).

The second criterion listed—*Arable land with associated water supply (for Agriculture/Livestock) and productive forest (for Forestry/Forest products collection) saved by the intervention (benefit-2)*—would adequately reflect the impact on vulnerable groups that are largely dependent on agriculture and forest products; this group suffer mostly from land degradation, flash floods and landslides that urgently need improved, integrated land use management ensuring food security and an acceptable level of cash income.

The third criterion listed—*Essential infrastructure, i.e. existing and projected hydropower plants, bridges in national roads system, industrial complexes, religious and cultural heritage and main tourist attractions, etc. (benefit-3)*—
is mostly concerned with national economic interests of the country; the criteria addresses safeguarding the pillars of economic development, hydropower exports (the main foreign exchange earner), national road communications, and the cultural heritage which is gaining foreign exchange income through international tourism.

The fourth criterion adopted—*estimated project costs*—represents the concerns of the country's (Ministry of Finance) national budget – a scarce resource that must be used judiciously for interventions with optimal impact.

The task force concluded that it was not necessary, for this exercise, to incorporate a separate criterion for protection of the environment and biodiversity, because current legislation and regulations—and in particular their enforcement—was stringent enough to adequately discourage *undesired* economic developments especially for the agricultural/livestock sector.

4.3 Methodology used in scoring of Projects

Each of the proposed adaptation activities was given a score on a scale of 1 to 5 as concerns each of the (3) Benefit criteria. A score of 5 means that the project concerned is expected to bring along most 'savings' of Human life, Arable land or Essential infrastructure respectively; a score of 1 indicates the least 'savings'. This scoring of the individual projects was regarded in a comparative manner. With exception perhaps of the Cost criterion, the other three (Benefit) criteria could be established only in a 'relative' manner based on personal/professional judgment by the task force members. The initial group scores of the 3 sub groups of the task force are shown in Appendix (Tables 1, 2, 3) and final results of the group scores against each project is shown in the appendix Table 4.

4.4 Standardization of Scores for Each of Criteria

The scores in 4.3 above were standardized- that is the scores of the different criteria are all brought on a common scale between 0 and 1 (or 0% and 100%). Doing this allows the addition of the scores on the (4) criteria across each of the projects. The formula used in the standardization process is as follows:
(X1-L)/(H-L), where X1 is the given score for a criteria, L is the lowest score in the column, and H is the highest score. The result of the standardized scores are shown in the Appendix (Table 5.), where a uniform weight or an equal weight of 1 is given for each criteria.

4.5 Weighting of the Criteria

Depending on the magnitude of weights given to each criteria- in relation to each other, project rankings showed various results. After elaborate consultation, the task force team eventually decided to test the (3) following weighting options (see table below):

- Equal weights of all (4) criteria;
- Equal weights for Cost on one side and the sum of the rest of the benefits;
- Weighting poverty highly via Benefit #2

After elaborate consultation, the task force team eventually came to 'consensus' values for the weights as presented in the row # 2 of the table below.

The various results from differing weights are shown in the Appendix. (Equal, Cost, Poverty,) Tables No.

	CRITERIA (4) >>	**COST**	**BENEFIT-1**	**BENEFIT-2**	**BENEFIT-3**
#	***Options for Weighting of Criteria***	**Estimated Project Cost**	**Human Life & Health saved**	**Arable land & Water supply saved**	**Essential Infra & Monuments saved**
1	*All equal (relative)*	1 *(0.25)*	1 *(0.25)*	1 *0.25*	1 *0.25*
2	***Task force decision***	**3 *(0.20)***	**5 *(0.33)***	**4 *(0.27)***	**3 *(0.20)***
3	*Cost = Sum of Benefits*	3 *(0.50)*	1 *(0.17)*	1 *(0.17)*	1 *(0.17)*
4	*Main weight on Saving of Arable land etc. for Vulnerable communities*	1 *(0.13)*	1 *(0.13)*	5 *(0.63)*	1 *(0.13)*

The Task force further felt that a relatively greater weight should be attached to proposed adaptation projects with a "national outreach" and a relatively lower weight to those with a purely "local impact". This was done by keeping the Weighed sum of the (5) "Regional" projects unchanged, and giving a *15% greater weight* to the (3) "*National*" projects and a *15% lower weight* to the (1) "*Local"* project (than to the "Regional" projects. This changes the ranking somewhat, but not dramatically—see the table 6 (Appendix I)

5.0 List of Priority NAPA Projects

The final result after ranking of the projects is given in the table below. The result is the outcome of exercises in i) group scorings on the four criteria, (ii) the relative weight given to each of these criteria, and (iii) the relative weight given to projects with a "national", a "regional" or a "local" impact led to the final result of top ten recommended project proposals.

5.1 Ranking of Proposed Activities

Using the group "consensus" weight on the selected criteria, the project proposals ranked in the following order:

RANK	NAME OF PROPOSED PROJECT
1	Disaster Management Strategy – planning for food security and emergency medicine to vulnerable communities
2	Artificial Lowering of Thorthomi Lake
3	Weather Forecasting System to Serve Farmers and Agriculture
4	Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)
5	Flood Protection of Downstream Industrial and Agricultural Areas
6	Rainwater Harvesting
7	GLOF Hazard Zoning (Pilot Scheme – Chamkhar Chu Basin)
8	Installation of Early Warning System on Pho Chu Basin
9	Promote Community-based Forest Fire Management and Prevention

The more detailed project profiles are contained in the following section 5.4, where the nine (9) highest priority adaptation activities have been elaborated further into project profiles.

5.2 Sensitivity of Ranking Order

After the group reached a consensus on the top 9 projects, it was interesting to test ranking of projects with different criteria weights:

a) Attaching most weight to costs, with 3 times more weight than each of the other benefits shows the following ranking order:

#	NAME OF PROPOSED PROJECT	RANKING when "COST" most important		Accumulated Cost Top 5	Estimated Cost *US $*
		Initial	Adjusted (Nat / Reg / Loc)		
1=	Disaster Management Strategy (Planning for Food Security and Emergency Medicine to Vulnerable Communities)	**1**	**1**	**$ 619,110**	**$ 619,110**
2=	Artificial Lowering of Thorthomi Lake	9	9		$ 3,188,942
3=	Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)	**3/4**	**3**	**$ 1,513,289**	**$ 894,179**
4=	Weather Forecasting System to Serve Farmers and Agriculture	**3/4**	**2**	**$ 1,933,289**	**$ 420,000**
5=	Flood Protection of Downstream Industrial and Agricultural Area	**2**	**4**	**$ 2,386,777**	**$ 453,488**
6=	Rainwater Harvesting	7	**5/6**	**$ 3,281,777**	**$ 895,000**
7=	GLOF Hazard Zoning (Pilot Scheme - Chamkar Chu Basin)	**5**	**5/6**	**$ 3,502,679**	**$ 232,493**
8=	Installation of Early Warning System on the Phu-chu River Basin	**6**	7		$ 400,000
9=	Promote Community-based Forest Fire Management and Prevention	8	8	3514270	$ 423,000
			Estimated cost Top 6:	**$ 3,514,270**	

In this case, the Top 6 projects' package add up to an estimated Cost total of **$ 3,514,270**.

b) If however most weight was attached to the criterion "**Arable land & Water supply saved"** (benefit-2) i.e. a weight 3 times as high as that given to Cost and the two other benefits—which would favor 'vulnerable' or "poor" communities, then the ranking would be as shown in the following table.

#	NAME OF PROPOSED PROJECT	RANKING when "POOR" most important		Accumulated Cost Top 5	Estimated Cost *US $*
		Initial	Adjusted (Nat / Reg / Loc)		
1=	Disaster Management Strategy (Planning for Food Security and Emergency Medicine to Vulnerable Communities)	**1**	**1**	**$ 619,110**	**$ 619,110**
2=	Artificial Lowering of Thorthomi Lake	**2**	**2**	**$ 3,308,052**	**$ 3,188,942**
3=	Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)	**3**	**3**	**$ 4,702,231**	**$ 894,179**
4=	Weather Forecasting System to Serve Farmers and Agriculture	**4**	**4**	**$ 5,122,231**	**$ 420,000**
5=	Flood Protection of Downstream Industrial and Agricultural Area	**5**	7		$ 453,488
6=	Rainwater Harvesting	**6**	**5**	**$ 6,017,231**	**$ 895,000**
7=	GLOF Hazard Zoning (Pilot Scheme - Chamkar Chu Basin)	8	8		$ 232,493
8=	Installation of Early Warning System on the Phu-chu River Basin	9	9		$ 400,000
9=	Promote Community-based Forest Fire Management and Prevention	7	**6**	**$ 6,440,231**	**$ 423,000**
			Estimated cost Top 6:	**$ 6,440,231**	**6440231**

In this case, the Top 6 projects' package would add up to an estimated Cost total of **$ 6,440,231.**

5.3 Implementation Strategy

The National Environment Commission (NEC) will facilitate in the launching of the NAPAs, guiding and coordinating the executing/implementing sector agencies (Ministries) in what are mostly 'integrated' adaptation projects requiring several agencies to closely cooperate. However, the NEC will not be the main custodian of the NAPA projects- as the concerned sector agents will take on board as part of their planned development activities in consultation with the Department of Aid and Debt Management.

The NEC will from time to time monitor the "adaptations to climate change" components within the projects to make sure that key NAPA objectives are not ignored.

For example, the National Disaster Management Strategy 'pilot' implementation in food security and emergency medicine/first aid distribution will require the close cooperation of the Ministries of Home and Cultural Affairs (responsible for the National Disaster Management Strategy), Ministry of Agriculture (responsible for Food Security) and the Ministry of Health (responsible for Emergency Medicine/first aid System). Likewise, in the other priority adaptation projects, two to four different sector agencies, including the cross-cutting Water Resources "Sector", need to closely work together. While the required coordination of a project is done by the Project Coordination Committees, the NEC's professional representative within this body can ensure that the NAPA objectives are well implemented.

The NAPA projects' list of priorities—due to the methodology used for the ranking—has been established in a 'transparent' way. The ranking is 'adjustable' to some extent as is shown in the section 5.2 on 'Sensitivity of ranking order', allowing for emphasis on certain aspects, e.g. targeting vulnerable communities.

Thus, the present NAPA, conceived within the framework of the RGOB's sustainable development (5-Year) planning, can serve as an important tool to attract foreign assistance not only from UNFCCC sources such as LDC Fund etc. but also from e.g. bi-lateral donors favoring assistance for CC-related projects for vulnerable communities.

This NAPA is intended to be applied as a 'living' document—the NEC is dedicated to review the NAPA periodically after actual implementation of the first priority projects within the context of the Royal Government's FYP (5-Year Plan) cycle.

5.4 Project Profiles

From the 9 selected projects, the top six priority activities were developed into brief project profiles with emphasis on project rationale or justification, objectives, inputs, short-term outputs, potential long-term outcomes, institutional arrangements, risks and barriers, monitoring and evaluation, and a budget proposal.

Disaster management strategy-
planning for food security
and emergency medicine to vulnerable communities.

1. Disaster management strategy- planning for food security and emergency medicine to vulnerable communities.

Rationale

In times of disasters due to landslides, flood, drought and other forms of natural disaster- it is not only human lives that are endangered as an immediate impact of the hazard, but more often how well relief efforts are coordinated that determine the success or failures in managing disasters.

A well managed relief strategy will not only require a rapid response team in health services with the capacity to institute effective Emergency Medicine and First Aid, but also a well planned food reserve and distribution network to operate efficiently for at least six months.

For example the climate related disasters of the six eastern Dzongkhags in 2004 witnessed major loss of lives, damage to properties and houses, loss of over 660 acres of agriculture land, and loss of standing crops for over 1430 households. Infrastructure such as irrigation channels, power transmission facilities, bridges, farm and feeder roads were significantly damaged**.**

In order to cope with such vulnerabilities from climate change impacts, it is imperative to establish both a network of food reserve stocks in key areas of eastern Bhutan with an efficient distribution system to cover a minimum of six months period; and an emergency medicine and first aid to cater to the vulnerable groups.

Description

Objectives: The objective of the project is to plan and implement components of the national disaster management strategy as concerns emergency food security, medicines and first aid in few pilot districts in eastern Bhutan.

Activities

- Mapping of vulnerable areas of potential land slide and floods in the vicinity of settlements
- Identification of potential areas for resettlement of villages
- Put in place a National Disaster Management Strategy
- Formulation of National Emergency Medical Services Strategy at National as well as Dzongkhag level
- Consolidating and strengthening institutional arrangements at national and local levels

– for example creation of rapid response for food distribution and medical teams at all levels

- Training of Emergency Medical Teams (EMTs) in country
- Procurement of equipment – ambulance, communication sets, equipment, First Aid Kits, EMT Uniform, teaching materials
- Introduction of EMS in pre-service curriculum at Royal Institute of Health Sciences (RIHS)

Inputs: Inputs include technical and financial assistance, equipments and institutional support.

Short term outputs

- Information on cause-effect relation on physical changes caused by various factors such as population pressure, deforestation, over-grazing, intentional forest fires and poor land management is available
- A national disaster management strategy policy and strategy in place. Immediate response to any disasters
- Many lives saved due to immediate medical intervention
- Enough human resource trained in managing disasters

Long term out puts

- A rapid food distribution system to cover a minimum of six months period in any given situation in place facilitated through a network of food reserve stocks in different parts of the country
- Clear policy directives and institution of functional support and management structures established
- Well-defined operational plans and systematic implementation strategies established
- The health sector emergency plan closely linked with the other national disaster plans which will/may be put into operation by the Royal Government

- Functional Trauma centers strengthened and established
- Health Department in collaboration with the Dzongkhag health sectors ensures a heightened level of preparations in order to respond optimally for any

disaster situation

- Adequate community understanding and participation sought so that there is critical support in terms of providing physical support and blood donations
- Institutional arrangements at national and local levels in place for rapid response for food distribution and medical services in case of natural disasters through climate change

Implementation

Institutional arrangements: The project will be implemented by the Ministry of Home and Cultural Affairs in partnership with Ministry of Agriculture, Ministry of Health and other stakeholders such as the Ministry of Works and Human Settlement, Dzongkhag (Local) Administrations and relevant communities.

Risks and barriers: There are no major risks foreseen in the implementation of the project.

Monitoring and evaluation: Monitoring and evaluation of the project will be carried out as per the normal RGOB procedure.

Financial resources: The project cost is estimated at US$ 0.62 million.

Budget breakdown

Activities	Year 1	Year 2	Year3
A. Food security			
Survey and data collection for the study on cause and effect of physical changes caused by various factors such as population pressure, deforestation, over-grazing, intentional forest fires and poor land management	$ 23,255.00	-	-
Draft report and workshops on the above study, publication	-	$ 18,600.00	-
Formulation of a national disaster management strategy and policy (workshops and seminars)	-	$ 14,000.00	-
Institutional support to MoHCA and MoA for emergency disaster management	-	-	$ 23,255.00
Subtotal	**$ 23,255.00**	**$ 32,600.00**	**$ 23,255.00**

B. Emergency medical			
Formulation of National Emergency Medical Services Strategy - consultative workshop	$10,000.00	$ 10,000.00	-
Training of Emergency Medical Teams (EMTs) in country	$ 30,000.00	$ 30,000.00	-
Training of Medical Doctors & Nurses on Trauma Management incountry	$ 20,000.00	$ 20,000.00	-
Training of Trainers (TOT) on EMS	$ 30,000.00	$ 30,000.00	-
Observation Tours to other centers in the region	$ 25,000.00	$ 25,000.00	-
Strengthening the 3 Trauma Centres	$ 60,000.00	$ 60,000.00	-
Training of Ambulance drivers on basic first aid	$ 5,000.00	$ 5,000.00	-
Strengthen the medical rehabilitation center at Gidakom	$ 30,000.00	$ 30,000.00	-
Procurement of logistics – ambulance, communication sets, equipment, EMT & First Aid Kits, EMT Uniform, teaching materials,	$ 60,000.00	$ 60,000.00	-
Sub-total	**$ 270,000.00**	**$ 270,000.00**	
Total (A+B)			**USD 619,110.00**

Artificial Lowering of Thorthormi Glacier Lake

2. Artificial Lowering of Thorthormi Glacier Lake

Rationale

Based on the detailed assessment[13]of hazard potential of Raphstreng and Thorthormi glaciers and its lakes, it was found that there is the probability of a worse case scenario in the near future of a Glacial Lake Outburst Floods or GLOF – possibly occurring in the next ten years originating in the Thorthormi area, unless urgent mitigation measures are taken. Near the terminus of the Thorthormi glacier several interconnected surpraglacial lakes have been observed; due to fast melting these lakes are expanding rapidly and it is assumed that soon these lakes will form one large proglacial lake. The worst case scenario being that a combined GLOF of these lakes could result in a flow of over 53 million cubic meters of water- that is more than twice the volume of the 1994 Luggye GLOF event with unimaginable consequences down stream. Thus to reduce the risk of a future GLOF originating at the Thorthormi lake, it is seen that means of artificial lowering should be explored.

Description

Objective: The main objective is to lower the water level of the Thorthormi Lake by excavating an artificial channel- widening of the existing outlet channel.

Activities: The activities will include the following:

- Plan of field work and logistics
- Finalization of the design of spillway channel
- Stability assessment of the spillway channel
- Coordination with Dzongkhag and *geog* officials
- Recruitment of labour (20 working groups of 14 workers each)
- Establish water diversions, by building coffer dam, to allow dry working conditions for building of outlet channel
- Stabilization of channel side slopes
- Handing over to local officials for monitoring and maintenance

Inputs: The main inputs include human labour, financial resources, excavating tools and equipment, cable car, computers and accessories.

Short-term outputs: These will include the following:

- Water diversions built and functioning
- Outlet channel built
- Lowered water levels of Thorthormi and adjoining lakes

[13] Brauner et al (2003), Technical GLOF Mitigation Measures Thorthormi Outlet, Dept. of Geological Science, University of Vienna, Austria, October 2003.

- Staff trained to monitor and maintain the artificial lowering systems

Potential long term outputs: These will include the following:

- GLOF threat from Thorthormi and adjacent lakes reduced below danger levels
- Knowledge and experience in artificial lowering of lakes that can be useful for lowering of water levels in other potentially dangerous lakes across Bhutan

Implementation

Institutional arrangements: The main institution for the implementation of this project will be the Department of Geology and Mines in coordination with Ministry of Agriculture, and Department of Local Governance (Disaster Management Office); also the involvement of the districts of Gasa and Punakha, and the local communities of the Lunana area.

Risks and barriers: The main risks are: actual depth of lakes and surface slope are not known- only assumptions made; climate and altitude (above 4000m.a.s.l) make for harsh working conditions; optimal period of working is only about 6 months in a year (May-June- mid October); logistics, 6-7 days trekking from nearest road, all materials and equipment must by manually carried to lake site; possible lack of full local participation from the *geogs* for supply of adequate manpower; timely completion of planned work.

Monitoring and evaluation: Monitoring will be done by the Department of Geology and Mines. Tthe project steering committee will evaluate performances on a quarterly basis via meetings on progress and expenditures.

Financial resources: Funds for the project are estimated at US$ 3.19 million.

Budget breakdown

Activities	Year 1	Year 2	Year 3	Year 4
Labour Cost	$412558.00	$412558.00	$412558.00	$412558.00
Transportation costs (Yak and horses)	$57720.00	$36632.00	$36632.00	$36632.00
Helicopter transport of PE pipes	$97674.00			
PE low pressure pipes	$25116.00			
Medical equipment	$5813.00	$1162.00	$1162.00	$1162.00
Provision	$34883.00	$34383.00	$34383.00	$34383.00
Technical equipment	$93023.00	$23255.00	$23255.00	$23255.00
Rental charges for storage place in project site and at Thimphu, insurance for transportation of equipments	$23255.00	$23255.00	$23255.00	$23255.00
Improvement in trekking route	$4651.0000	$2325.00	$2325.00	$2325.00
Contingencies (Assumed based on information from Raphstreng Lake mitigation and Austrian expeditions (20%)	$15093.00	$106813.00	$106813.00	$106813.00
Capacity building		50,000.00		
Total Cost of the Project	**$769,790.00**	**$690,384.00**	**$640,384.00**	**$640,384.00**

Weather Forecasting System to serve Farmers and Agriculture

3. Weather Forecasting System to serve Farmers and Agriculture

Rationale

Agriculture depends on the mean climate of a particular region. Each production unit of agriculture has its own climate requirement for growth and development; and any large-scale deviation exerts a negative influence. Extreme climate conditions also negatively impact agricultural production through the development of pests and diseases. Although natural disasters resulting from climatic extremes cannot be averted, their destructive impacts in terms of losses in production and productivity can be greatly minimized. Planning and management for adaptation, prevention and mitigation of extreme events are crucial for the safety and well-being of the vulnerable communities who live in disaster-prone areas.

Accurate and timely information on extreme meteorological events is critical to farmers in maximizing their production by making appropriate decisions in their production environment, setting up protective mechanisms and scheduling inputs and activities effectively. The successful development of Bhutan's agricultural economy is, therefore highly dependent on the use of climatic and synoptic weather information, particularly on adverse meteorological factors. Such information can be used in the development of proactive and responsive adaptation strategies that can minimize the adverse impacts of extreme climate conditions.

Agriculture in Bhutan is completely dependent on the prevailing weather conditions determined largely by the influences of high Himalayas and the South-west Monsoon circulation. Notwithstanding the magnitude and spatial characteristics of the system, even a slight deviation in the monsoon onset and retreat can result in significant changes in agricultural productivity. Without the capacity to monitor and understand the dynamics of these weather manifestations, efforts to modernize and sustain agriculture for national food security and as a rural economic sector will not bring about expected returns. Delayed monsoon may result in agricultural drought while an early one may hinder production activities and favor development of pests and diseases. For example temperature extremes, especially at the beginning of the growing season, may destroy the production of an apple orchard for the whole year.

A weather detection, monitoring and early warning system can provide reliable and timely information to the farmers to deal with weather and climatic variability and changes. Seasonal forecasts can support long-range, strategic decisions; while weather forecasts can support short-term, tactical decisions in

the agricultural production operations. Special weather forecasts provide the input to assist farmers in making decisions on planting/sowing, application of crop protection chemicals, forestry and forest fire operations, product transportation, and post-harvest operations.

Bhutan, to date, does not have a proper weather or climate forecasting capability. The global forecasts provided by outside systems do not serve the needs of agriculture development in Bhutan as they cannot resolve the geophysical complexity associated with the rugged terrain. Building up the communication and computing resources together with the development of technological competence of meteorological technicians and professionals will enable Bhutan to operationalize its own forecasting and early warning system that accounts for its complex forcing systems. The forecasts will be more accurate with more frequent updates at higher spatial and temporal resolutions. In addition, the weather forecast can be customized to produce agrometeorological data for the Ministry of Agriculture and its stakeholders.

Description

Objectives: The objectives of the proposed adaptation project are:

- To set up a weather forecasting office (WFO) with necessary equipment and manpower to provide weather and seasonal forecasts for supporting production decisions of the farmers
- To provide an agrometeorological early warning system against inclement weather conditions and provide special advisories at different production stages

Activities: The activities to be conducted will include the following**:**

1. Institutional setup with necessary mandate and program policy and development support
2. Procurement of tools and equipments to fulfill the communication and computing resource needs
3. Set up one automated and telemetered synoptic station in each Dzongkhag
4. Link up to the Global Telecommunication System (GTS) of the WMO to receive regular synoptic data.
5. Install a limited area weather model, such as WRF or MM5 to operationalize a computer-based weather forecasting system.
6. Set up a data assimilation system to ingest observational and satellite data to improve the accuracy of model data.
7. Establish Internet link to the global model data providers for initial and boundary conditions input to the mesoscale LAM model configured for Bhutan's conditions

8. Set up a data processing and dissemination system
9. Train technicians and professionals in data compilation, processing and preparing weather forecasts
10. Train professionals in running and maintenance of the forecast models, post-processing and development of information products/packages
11. Train farmers and extension workers in the proper use of the information products and advisories
12. Forecast verification in association with other WFOs in the region

Inputs: The main inputs include: professional expertise (TA), enabling policy environment, computer hardware and software, synoptic stations, dedicated internet access, training, human resources, finances, administrative and management support. Information and data input includes global/regional forecast and analysis data, satellite data, GTS data, local synoptic data.

Outputs: These include:

- An independent weather forecasting office (WFO) established
- An optimally distributed network of synoptic stations
- An operational mesoscale LAM model optimized for Bhutan
- More accurate weather forecasts upto 15 days
- Seasonal forecasts for the next three months
- Forecast guidance materials
- Regular agrometeorological advisories
- Special advisories
- Internet resources including manuals, guidelines, maps, etc

Long-term outputs: These include, among others

- Higher agricultural productivity
- Better working conditions
- Enhanced food security and standard of living
- Better use of natural resources
- Reduced damage to the environment

Implementation

Institutional arrangements: The Ministry of Agriculture shall implement the project with the establishment of a new WFO under it. The synoptic stations in the Dzongkhags will report at three hourly intervals. The information will be uplinked to the GTS and downlink synoptic observations from others by the central data communication system located at the WFO in Thimphu. The model forecast will run once a day assimilating the latest analysis and forecast boundary conditions. The forecasts and advisories will be available within three hours of the completion of model run.

Risks and barriers: The main barriers include the following**:**

- No government approval to establish the weather forecast office
- Failure in data uplinks and downlinks
- Internet connection breakdown
- Instrument and equipment breakdown
- Insufficient, inadequate or no provision for training of the technicians and scientists
- Failure to appreciate the economic value of weather services by the Government, research & development workers, and the farmers
- Failure to educate the beneficiaries on the prudent use of weather information and advisories

Monitoring and evaluation: Monitoring and evaluation will be done by the MOA via its established procedures:

- Annual progress report and half-yearly financial report
- Technical and forecast verification report
- Survey report of the target beneficiaries
- Socio-economic impact assessment

Financial resources: The project is estimated to cost US$ 0.420 million.

Budget breakdown (USD)

Activities	**Year 1**	**Year 2**	**Year 3**
Installation of 20 synoptic stations	200,000.00	-	-
Set up operational weather model	50,000.00	10,000.00	15,000.00
Information post processing	5,000.00	5,000.00	5,000.00
Development of Advisories	5,000.00	5,000.00	5,000.00
Information Dissemination	5,000.00	5,000.00	5,000.00
Short-term training	50,000.00	10,000.00	10,000.00
Workshops and seminars	10,000.00	10,000.00	10,000.00
TOTAL PROJECT COST	**325,000.00**	**45,000.00**	**50,000.00**

Landslide Management and Flood Prevention (Pilot Schemes in Critical Areas)

4. Landslide Management and Flood Prevention (Pilot Schemes in Critical Areas).

Rationale

Bhutan is prone to landslides, flood, drought and other forms of natural disasters which cause loss of human life as well as property and damage to the natural environment. The mountain terrain and the scattered settlements make delivery of services difficult. Incidences of natural disasters and effects from impacts of climate change pose challenges to proper land management. The recent fast paced development of the country combined with the various incidences of climate change has made many areas in Bhutan prone to disasters from landslides, mudslides and flooding.

The last decade witnessed the beginning of major landslides and floods owing to increased rainfall and untimely arrival of monsoon. Entire communities are at risk from landslides in Chaskhar (Mongar) and Ramjar (Trashiyangtse) owing to increased frequency and intensity of rainfall. In addition, every year during the monsoon season landslides cause damage to the major highways of the country (especially the Thimphu-Phuntsholing & Riju- Ranjung roads) disrupting communications, travel, trade and causing substantial economic loss to the country.

The proposed activities are in areas where there is an urgent needs to intervene and these activities could be replicated in other areas in the country incorporating the lessons learnt from these pilot sites.

Description

Objectives: The objectives of the project are to predict and effectively intervene in major landslide affected areas of Bhutan. Key areas to focus are: landslide prone areas of Chaskar (Mongar) and Ramjar (Trashiyangtse), and the critical road links from Phuentsholing- Thimphu, and Riju- Rangjung highways.

Activities: The activities include**:**

- Mapping of vulnerable areas in terms of potential landslide and floods
- Assessment of spatial distribution of landslide in the selected areas
- Identification of potential areas for resettlement for vulnerable communities
- Development of metrological data center
- Assessment of strength parameter of geological materials
- Explore early warning technologies for occurrence of landslide
- Initiate long term collaborative scientific cause-effect study to generate

information necessary in preparing long term strategies to cope with disasters related to river inundation, floods and landslides

- Implement landslide prevention activities such as cross drainage, plantations and intermediate river training as well as bank and bed protection
- Institutional capacity strengthening (GIS, geotechnical lab tests, data acquisition and analysis)

Inputs: The inputs include technical and financial assistance, office and field equipments, professional consultants and institutional support.

Short term outputs:

- Information on various causes such as: climate change, population pressure, deforestation, over-grazing, intentional forest fires and poor land management
- Forecasting and early warning system put in place
- Staff trained to operate and maintain early warning system for landslides
- Inventory of landslides
- Landslide hazard zonation and landslide susceptibility maps for the study areas produced
- Guidelines published on the best practice in the rural access planning and engineering with respect to landslide and slope susceptibility
- Local land degradation minimized.

Potential long term outcomes: This will include:

- Proper land management practices developed validated and shared through out the country
- Local land degradation minimized
- Erosion control
- Safe and convenient mode of communication/transportation facilities
- Increased safety for communication/transportation facilities
- Development of framework for disaster management system

Implementation

Institutional arrangements: The project sub-component on Community Protection will be implemented by the Ministry of Agriculture in consultation with the Ministry of Home and Cultural Affairs in partnership withstakeholders such as Ministry of Works and Human Settlement, Dzongkhag (local) administrations and the relevant communities while the other sub-component on Highway/Road Protection will be implemented by the Department of Roads in collaboration with the Department of Geology and Mines, the Department of Energy and the local communities.

Risks and Barriers:

- Lack of interest to participate by the rural communities
- Lack of inputs by various stakeholders not forthcoming

Monitoring and evaluation: Monitoring and evaluation of the project will be carried out as per the normal RGOB procedure. It will include submission of quarterly progress and financial reports.

Financial resources. The project cost is estimated at US $ 0.894 million

Budget breakdown.

Activities	Year 1 (Part I)	Year 1 (Part II)	Year 2
A. Community Protection			
Survey and data collection for the study on cause and effect of physical changes and development of recommendations for Chaskar and Ramjar area.	23,255.00	-	-
Development of cross drainage and landslide preventive measures (Chaskhar)	-	23,255.00	-
Development of adequate drainage and plantations (Ramjar)	-	11,628.00	23,255.00
Subtotal	23,255.00	34,883.00	23,255.00
B. Highway/Road Protection			
Assessment of landslide	4,651.00		-
Establishing early warning system	3,48,837.00		46,511.00
Strengthening the Geotechnical Unit through procurement of laboratory equipments	69,767.00		5,814.00
Capacity building Train staff to man the systems and in all the project activities	69,767.00		23,255.00
Professional Service			
Landslide control Works	23,255.00		11,628.00
Project Management Office Equipment Project operation Consultative workshop	1,39,534.00		69,767.00
Subtotal	6,55,811.00		1,56,975.00
Total (A+B)	894,179.00		

Flood Protection of Downstream Industrial and Agricultural Area

5. Flood Protection of Downstream Industrial and Agricultural Area

Rationale

Bhutan is prone to landslides, flood, drought and other forms of natural disasters which cause loss of human life as well as damage to property and the environment. The mountain terrain and the scattered settlements make delivery of services difficult. Incidences of natural disasters and effects from impacts of climate change pose challenges to proper land management. The recent fast paced development of the country combined with the various incidences of climate-related events has made many areas in Bhutan prone to disasters from landslides and mudslides.

The last decade witnessed the beginning of major landslides and floods owing to increasing rainfall and untimely arrival of monsoon. Entire communities are at risk in the industrial areas in Pasakha (Chhukha) from landslide and flash floods owing to heavy rainfall and high rates of siltation ; while monsoon flash floods over the years had caused recurrent damage to fertile agricultural land in the Taklai river basin (two Geogs of Chuzagang and Sershong of Sarpang districts). It is estimated that about 1300 ha of cultivable fertile land in the above two geogs could be saved if flood damages could be controlled to allow for a sustained irrigation scheme.

The proposed activities are in areas where there is an urgent need to intervene and these activities could be replicated in other areas in the country incorporating the lessons learnt from these pilot sites.

Description

Objectives: The objectives of the project are to effectively intervene in major landslide and flood affected areas of the country (Pasakha Industrial areas, and the fertile agricultural land of the Taklai river basin) before the areas become both dangerous for human livelihood and infertile for crop productions.

Activities: The activities include**:**

- Mapping of vulnerable areas in term of potential landslide and floods in the vicinity of settlements
- Identification of potential areas for resettlement in case of such requirements
- Initiate long term collaborative scientific cause-effect study to generate information necessary in preparing long term strategies to cope with disasters related to river inundation, floods and land slides
- Implement landslide prevention activities such as cross drainage,

plantations and intermediate river training as well as bank and bed protection in critical areas (Taklai river basin and Pasakha)
- Conduct a detailed study of hydrology and surface water of the Taklai river to determine periodic discharge and flood prediction

Inputs: The inputs include technical and financial assistance, equipments and institutional support.

Short term outputs
- Information on cause-effect relation on physical changes caused by various factors such as climate change, population pressure, deforestation, over-grazing, intentional forest fires and poor land management
- Intermediate disaster preventive steps: area maps that show vulnerable sites and places suitable for resettlement
- Safer areas downstream for both industrial property and protection of agri-cultural land.

Potential long term outcomes: This will include:
- Proper land management practices developed, validated and shared through out the country.
- Improved and reliable irrigation canals that can keep large areas of agricultural land fertile and thus increase food production
- Better knowledge of surface discharge of the Taklai river – that can help in flood predictions and other river training works

Implementation
Institutional arrangements: The project will be implemented by the Ministry of Agriculture (Taklai River Basin) in consultation with the Ministry of Home and Cultural Affairs and Ministry of Trade and Industry (Pasakha- Singye and barsa Rivers) in partnership with stakeholders such as the Ministry of Works and Human Settlement, Dzongkhag (Local) Administrations and relevant communities.

Risks and Barriers: There are no risks foreseen in implementation of the project.

Monitoring and evaluation: Monitoring and evaluation of the project will be carried out as per the normal RGOB procedure. It will include submission of quarterly progress and financial reports.

Financial resources. The project cost is estimated at (US $ 0.45 million)

Budget breakdown.

Activities	**Year 1, I**	**Year 1, II**	**Year 2**
Survey and data collection for the study on cause and effect of physical changes and framing of recommendations (All Sites)	$34,883		
Procurement of river training and bed and bank protection machineries (Pasakha, Taklai)	$116,280		$116,280
Development of permanent diversion headwork for high level intake (Taklai)	$58,140	$58,140	
Study hydrology and surface water of the Taklai river to determine periodic discharge and flood prediction.	$23,255	$23,255	$23,255
Total	**$232,558**	**$81395**	**$139,535**

Rainwater Harvesting

6. Rainwater Harvesting

Rationale

Drought and dry spells are common in the mountainous areas of Bhutan where people depend primarily on rain fed subsistence agriculture. It was, therefore clear that a simple and affordable rainwater harvesting system combined with an integrated approach to improving agricultural production would significantly improve the lives of local farmers. Most farmers have traditionally relied on unfavorably distributed seasonal rainfall. About three-quarter of the rain falls between June and September each year, often in the form of heavy downpours. Due to the rugged terrain and the geological conditions it is both difficult and expensive to divert water from other watersheds. There is water shortage during the most critical part of crop growth and development, particularly during spring when sowing and planting activities are performed. Early or late monsoon can also disrupt the normal schedule of work and progression in the physiological development of plants. Under abnormal weather conditions, water stored during periods of excess availability can safeguard farmers from crop failures, loss of animal productivity and have safe drinking water.

The RWHTs is associated with the process of supplementing domestic/household water requirement through collecting rainwater, treatment and storage as part of a wider drinking water supply program. The purpose in the present context is to ensure that farmers have sufficient water to maintain agricultural production in times of water shortages due to seasonal and inter-annual climate variability or longer-term impact of climate change. Rainwater harvesting may also help control erosion and flooding during periods of excessive rainfall.
There are various technologies adopted successfully in various parts of the world, like:

- Micro-catchment runoff farming water harvesting systems
- Macro-catchment runoff farming water harvesting systems
- Floodwater harvesting runoff farming (also called large catchment water harvesting or spate irrigation)

Some of these techniques and their localized variants are practiced by farmers in Bhutan. However, the scientific rationale and necessary details are often overlooked to effectively realize the potential benefits of these technologies. This proposal is an attempt to bridge the existing gaps and provide an adaptation option to water deficits caused by variability and change in the climate system.

Description

Objectives: To safeguard farmers from water shortages during dry periods and irregularities in the monsoon rainfall, thereby improving household food security and income of farmers living in vulnerable areas.

Activities: The proposal has the following activities:

- Small scale irrigation development based on RWHTs
- Strengthen farmers involvement and research and extension services
- Vulnerability assessment
- Land survey
- Rural credit
- Project management
- Identification of areas vulnerable to dry spells and erratic monsoon rainfall
- Arial surveys and evaluation of remote sensing images/photographs to determine areas suitable for water harvesting
- Assessment of available and proven Rainwater Harvesting Technologies (RWHTs) for adoption
- Technological adaptation to fit the needs and requirements specific to each vulnerable locations
- Research new designs and package improved technologies (studying and modeling runoff behavior)
- Establish farmers' capacity to mobilize local resources for technology adoption and actual application
- Demonstration of emerging technologies like supplemental water system, dual purpose system, combined system, modeling
- Training farmers in the maintenance of their investments in RWHTs, and effective utilization of harvested rainwater
- Economic analysis of rain water harvesting techniques

Inputs: The main inputs are technical expertise; RWHT incorporated structures, farmer's participation, training, research and development, land, labor, finances and credit facilities. Inputs in the technology design include: topography of the area; soil type, texture, water holding capacity, soil depth, infiltration characteristics, hydraulic conductivity; climate data (at least 15 years), evaporation, transpiration; crop, its root depth, growing season, and critical growth stages.

Output: These will include:

- Increased awareness and knowledge of RWHTs among farmers
- Higher crop and animal productivity under rainfed agriculture
- Safe drinking water and less health problems

- Increase in rural income
- Improved national food security status
- Synergy with actions under the UNCCD
- Environmental benefits such as reduced soil erosion, soil salinity and recharge ground water

Implementation

Institutional arrangements: Implemented by research and development agencies of the MoA in collaboration with farmers, dzongkhag administrations outside technical assistance. Investment in rain-fed areas, policy reform, and transfer of technology such as water harvesting runoff farming require stronger partnerships between agricultural researchers and other agents of change, including:

- local organizations,
- farmers,
- community leaders,
- NGOs,
- national policymakers and
- donors.

Risks and barriers: The main barriers include the following:

- Under extreme dry seasons, rain water harvesting may fail
- Government policy review in view of constructing contemporary irrigation channels vis-à-vis support to runoff farming systems.
- Labor shortage
- Non-participation from the beneficiaries
- Cooperation between farmers, the state and the scientific community
- Insufficient attention to social and economic aspects

Monitoring and evaluation: M& E will be done by the MOA via its normal methods of:

1. Progress reports
2. Technical and financial reports
3. Beneficiary interviews
4. Socio-economic impact survey

Financial resources: The project is estimated to cost US$ 0.895 million.

Budget breakdown

Activities	**YEAR 1**	**YEAR 2**	**YEAR 3**
Small scale irrigation development based on RWHTs	50,000.00	100,000.00	200,000.00
Strengthen farmers involvement and research and extension services	100,000.00	150,000.00	50,000.00
Vulnerability assessment	25,000.00	-	-
Land survey	25,000.00	10,000.00	-
Rural credit	-	-	150,000.00
Project management	10,000.00	10,000.00	15,000.00
TOTAL COST	**210,000.00**	**2,70,000.00**	**4,15,000.00**

GLOF Hazard Zoning (Pilot Scheme - Chamkhar Chu Basin)

7. GLOF Hazard Zoning (Pilot Scheme - Chamkhar Chu Basin)

Rationale

The Chamkhar Chu River has its source from the glaciers of Gangkar Punsum and the Monla Karchung ranges; a total of 557 glacial lakes have been identified in the Chamkhar Chu Sub-basin with a total glacial lake area of 21.03 sq.km. The whole of Bumthang district is drained by the Chamkhar Chu which flows south towards Zhemgang district to join the Mangdhe chu forming the mighty Manas river. The valley of Jakar today is a key tourist destination both for local Bhutanese as well as for foreign visitors and tourists. The local businesses, hotels, shops, and several cottage industries have steadily increased over the years making it a prosperous district. To the outside world Bumthang is one of the most important Buddhist pilgrimage destinations in the Himalayas as the valley boasts numerous historical monuments, temples, monasteries, and religious sites. Only recently plans have been approved for the town of Chamkhar to be shifted to Dekiling; as with many other areas in the valley this is being done without a proper consideration of GLOF threats. Hazard zonation at this critical stage in the valleys development would prove crucial in the long run, as the valley would be better prepared in the event of a GLOF.

Description

Objectives: The main objective of this project is to prepare a hazard zonation map for GLOF (from Khaktang to Chamkhar town) where the main settlements and developmental activities are taking place at present.

Activities: The following are the main activities to be undertaken:

- collection of different data set from the field (including data on the existing glaciers and glacial lakes at the headwater), which mainly involves extensive field works
- comparison of similar works in other regions where similar threat exist and adopt the best suited one for our area
- acquiring materials for remote sensing works in places of no accessible areas

Inputs: The main inputs in this project includes financial resources, research materials including equipments, human resources and office equipments (computers and accessories) and software for data analysis (like GIS and remote sensing related software).

Short term outputs: The main outputs include the following:

- adopting appropriate methodology for such works that best suits the area
- trained staff for handling the equipments and associated software
- creating awareness among the people who are settled along the course of this river
- High quality hazard zonation map delineating areas with high risk, medium risk and low risk area
- Material for public awareness campaign

Implementation

Institutional arrangements: The Department of Geology and Mines (DGM) the Ministry of Trade and Industry will be the implementing agent from the Royal Government of Bhutan's side. DGM will work in close consultation with the Ministry of Agriculture, Department of Energy, Department of Local Governanc e under Ministry of Home and Cultural Affairs and the respective districts.
The main focus will be given at the communities of the area and their participation will be an important part of this project.

Risks and barriers: The main risk will be the lack of local participation from the area.

Monitoring and evaluation: Monitoring will be done by the Department of Geology and Mines and the project steering committee will be formed which will evaluate the performance on either quarterly or 6 months basis through meetings.

Financial resources: The project is estimated to cost about USD 0.232 million

Budget breakdown

Activities	**Year 1**	**Year 2**
Field activities (Data Collection on Geotechnical, Geology, Geophysical, Topographical Survey, etc.)		38,749.99
Communication: vehicle hiring charges, telephone, internet and postal charges		27,272.72
Capacity Building (human resource development and infrastructure capacity development)	84,884.25	56,586.16
Workshops and meetings to review project progress and disseminate project outcomes including publication of final report	10,000.00	15,000.00
TOTAL		**USD 2,32,493.12**

Installation of Early Warning Systems on the Pho-chu River Basin

8. Installation of Early Warning Systems on the Pho-chu River Basin

Rationale

In living memory there have been several cases of GLOFs in Bhutan. The first studies on glaciers were done in 1960s. There are an estimated 2,674 glacial lakes in Bhutan out of which 562 are associated with glaciers[14] ; the latest studies show 24 glacial lakes to be potentially dangerous; not until 1994 GLOF was the dangers taken seriously; the main rivers in Bhutan: Mo Chu, Pho Chu, Mangde Chu, Chamkhar Chu, Kuri Chu and Pa Chu originate from the glaciers and glacial lakes of the Higher Himalayas. It is known that in the last few decades there has been a rapid retreat of glaciers creating many moraine dammed lakes that are increasing in size at a fast rate. Glaciers in Bhutan have been recorded to be retreating at about 20-30m a year mainly attributing to global warming trends.

The 1957 GLOF affected the Punakha-Wangdi valley which destroyed a section of the Punakha dzong; this was caused by the glacial lake outburst from the Tarina Tsho lake in western Lunana. The second flooding that lasted for 5 days- from the same lake in eastern Lunana region again destroyed parts of Punakha dzong. The most recent flood occurred on 7th October 1994 from the partial burst of the Luge Tsho in eastern Lunana; this flood caused loss of life and extensive damage to property along the Punakha- Wangdi valley; the Dzongchu or small dzong was partly destroyed when the Pho chu and Mochu (male and female) rivers joined course above the dzong. A total 91 households were affected by the flood in the Lunana Region. Records show: 12 houses being damaged, 5 water mills washed away and about 816 acres of dry land damaged or covered with silt and sand; 965 acres of pasture land was damaged and covered with sand and silt, 16 yaks were carried away and about 16 tonnes of food grains lost.

A recent study[15] warns of hazard potential of Raphstreng and Thorthormi glaciers and its lakes could become dangerous (as the Luggye 1994 GLOF) in about a decades time (around 2010), unless mitigation measures are taken.

Description

Objective: The main objective is to install a flood warning station on the Pho-chu river basin- specifically above Samdingkha (15-20 km above Punakha) so that Punakha can be warned within about ten minutes of a GLOF.

[14] ICIMOD (2001), Bhutan. Inventory of Glaciers, Glacial Lakes, and Glacial Lake Outburst Floods. Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region

[15] Dept. of Geology and Mines with Institute of Geology, University of Vienna, Austria, August 2002.

Activities: The activities will include the following:

- Compare similar work already done in comparative area or region (Nepal, South Tyrolean- Austrian/Swiss hazard zonation plans could be adapted to Bhutanese conditions
- Mapping the Pho-chu area according to geological, geotechnical and hydrogeological aspects and analyzing soil samples
- Measuring the area of investigation to calculate flood wave spreading, slope stability and river erosions
- Working out the sound plan- acoustic warning system according to natural sound level, morphology, damping and weather conditions
- Projecting the warning system which will include three components: releasing mechanism, connection to the acoustic warning device and determining the location for the acoustic warning devices
- Construction of a robust water level in the Pho-chu valley
- Constructing and commissioning the warning system

Inputs: The main inputs include human and financial resources, small equipment, vehicles, computers and accessories.

Short-term outputs: These will include the following:

- Brief comparative reports of similar systems established in Nepal, Swiss/Austrian situations
- Flood and hazard zonation maps of Pho-chu valley
- Early warning systems in place
- Staff trained to operate and maintain EW system
- Awareness campaign to residents of the valley on the workings of the EW system and their response and escape routes

Potential long term outputs: These will include the following:

- GLOF and disaster management plans developed
- An appropriate EW system in place that can be replicated for other valleys in Bhutan
- Development of the valley including hyrdropower development can efficiently use the results of this project (zonation plans, soils and slope studies etc.)

Implementation

Institutional arrangements: The main institution for the implementation of this project will be the Department of Geology and Mines in coordination with Ministry of Agriculture, and Department of Local Governance (Disaster Management Office); also the involvement of the districts of Punakha, Wangduephodrang and the local communities of the area.

Risks and barriers: The main risks are possible lack of local participation from the districts; malfunctioning of the sound system.

Monitoring and evaluation: Monitoring will be done by the Department of Geology and Mines; the project steering committee will evaluate performances on a quarterly basis via meetings on progress and expenditures.

Financial resources: Funds for the project are estimated at US$ 0.40 million.

Budget breakdown

Activities	**Year 1**	**Year 2**
Comparative studies to adopt right tool	30,000.00	
Mapping, data collection and planning for installation of Technical Early Warning System	5000.00	5000.00
Procurement & installation of Technical Early Warning System	200000.00	100000.00
Training on installation and maintenance of Technical Early Warning System	20000.00	
Workshop/Meeting to create awareness among stakeholders	5000.00	5000.00
Professional Services (for setup of the System)	30000.00	
Total Cost of the Project		**USD 0.40 million**

Promote community-based Forest Fire Management and Prevention

9. Promote community-based Forest Fire Management and Prevention

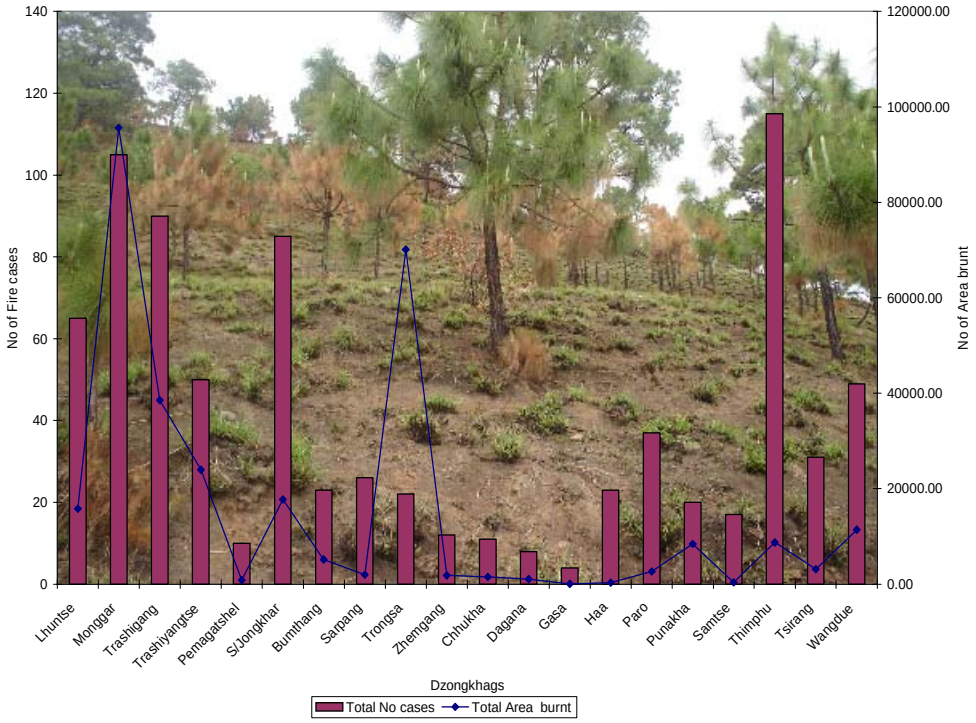
Rationale

Forest fire in Bhutan is commonly noticed and experienced below the altitude of 2500m with more intensity in dry zones especially in the Chirpine forest ecosystem which covers about 1,00,900 Ha. (*Dhital 1997:2*) and to a less extent in the temperate conifer forests. Forest fires are more frequent during winters, when long dry spells cause high day temperate, further exacerbated by strong winds and easy availability of dry fuel wood. With the change in the climate pattern - of late winters are cold and dry unlike in the past when winters used to be cold and wet covered with the snow and the chances of fire was less. Fire incidences in Bhutan usually coincide with the dry winter months which extend from November to May. The extent of the damage depends upon the frequency and intensity of fires and the type of forest, availability of fuel and local climatic factors.

Records reveal that most forest fires are anthropogenic in nature which are mostly caused as a result of fire spilling out of debris burning in orchards and cultivated fields, careless picnickers or campers, children playing with fires and smokers.

Further, records also reveal that fires are also deliberately set to improve grass growth in the natural pasture or to expand pasture areas. While in the Chir pine forest ecosystem, the fires are set to improve lemon grass growth for oil extraction and to protect agricultural crops from wild animals like wild boar, monkey and so on. The intensity of the damage varies from place to place depending upon topography, altitude, climate and type of forests and nature of human settlement. Uncontrolled forest fire, as a result of negligence and lack of effective collaboration with the stakeholders are being recognized as one of the main causes of resource degradation. The forest fire incidences and area affected over the span of 12 years is illustrated below

Forest Fire Incidences and Area brunt within 12 years from 1992-2004 period



In Bhutan, the prevention of forest fire has become an important and challenging program in forest fire prone areas. In order to combat forest fires effectively and enhance smooth implementation of forest fire related activities, forest fire protection and management activities were decentralized at the Dzongkhag level for implementation. Further to motivate and accommodate stakeholder interests, the Department of Forests developed a proposal for the institutionalization of Dzongkhag level forest fire Management committee and *Geog* level forest fire management committee. Terms of reference for the committees have been developed and the Ministry of Agriculture has approved the proposal for implementation.

Despite such arrangements, the nature and frequency of forest fires has not reduced over time and space. This was mainly due to limited budget to strengthen the human resources capacity to coordinate, disseminate forest fire awareness program and supply fire fighting equipment at the field level. Devastation of forests annually by fires may pose significant threat and effect on forest coverage if not addressed properly. With this proposal, it would further strengthen the human resource capacity of the Department of Forest in the management of forest fires.

Description

Objective: The main objective is to enhance the capacity of Department of Forests and rural people in the management of forest fire using appropriate tools and technology.

The main activities will include the following:

1 Awareness campaign in the forest fire prone Dzongkhag
2 Formation of village level forest fire management in the forest fire prone area
3 Supply of forest fire management tools and technology and physical protection equipment (occupational safety)
4 Dissemination of forest fire management information through different approaches
5 Strengthening capacity of Dzongkhag forestry sector through study tour visits and short training (aboard and in country).

Inputs: The input includes equipment, human, physical and financial resources.

Short term output:

⇒ The village level forest fire management institutionalized and implemented
⇒ Reduced incidence of wild fires
⇒ Forest fire equipment well established and managed properly
⇒ DoF capacity increased in management of fire

Potential long term outputs: The out of this project will contribute to the fulfillment of government policy objective to maintain 60% of the land under forest cover. With the experience gathered from implementing the project, it will enhance the DOF in developing a national forest fire management strategy.

Implementing arrangement: The project will be implemented by Social Forestry Division, DoF, Ministry of Agriculture in collaboration with the fire prone Dzongkhags, with involvement of rural people and other allied stake holders.

Risk and Barriers:

- Limited grazing options may lead to frequent forest fire outbreak
- Farmers dependent on income from lemon grass oil are likely to promote burning of the grass for healthier growth

Monitoring and Evaluation: The M and E will be done through the following

- Monthly and quarterly narrative report

- Financial reports
- Community feedbacks and case studies report

Further, the social forestry division from time to time will conduct monitoring activities.

Financial resources: The project cost is estimated at USD 0.423 million

Budget Breakdown

Activity	**Year 1 $**	**Year 2 $**	**Year 3 $**
Awareness campaign amongst rural people	6,000.00	6,000.00	6,000.00
Institutionalization of Village level forest fire management in the fire prone area	6000.00	6000.00	5,000.00
Forest fire tools and technologies and occupational safety equipment	80,000.00	80,000.00	80,000.00
Capacity building through study tour in forest fire management (aboard and in country)	30,000.00	40,000.00	40,000.00
Use of tools and technology training workshop	6,000.00	6000.00	6000.00
Advertisement of Forest fire messages	3,000.00	3,000.00	3,000.00
Publication and case studies	4,000.00	3000.00	40000.00
Subtotal	**1,35,000.00**	**1,44,000.00**	**1,44,000.00**
Total			**4,23,000.00**

NAPA Preparation Process

6.0 NAPA Preparation Process

6.1 A Consultative Process

The Bhutan NAPA was developed using a widely consultative process both at the national and regional levels. Both senior and mid level RGOB officers representing a wide range of stakeholders – Agriculture, Forestry, Livestock, Environment, Roads, Health, Geology and Mines, Finance, Planning, Home Affairs took part in a series of workshops and training sessions on familiarization of NAPA procedures and concepts.

The NAPA task force- a multi-disciplinary team representing five main sectors from the RGOB namely Agriculture, Biodiversity and Forestry, Natural Disaster and Infrastructure, Health, and Water Resources, identified the key vulnerabilities of climate change and established the NAPA project options and ideas.

6.2 Regional Consultation (Workshops)

The regional consultations with representation from all the 20 districts of Bhutan allowed for communications between the NAPA task force members and the local public. This allowed for wider stakeholder views and further fine tuning of the project ideas and activities with participation from the grassroots level.

6.3 Country Drivenness

The Royal government has established a Disaster Management (DM) office within the Department of Local Governance in the Ministry of Home Affairs. This was in response to the increasing climate related disasters such as floods, landslides, disruption to communication facilities and road blockages, forest fires, droughts, pests and diseases (including locust attacks), failure in crops production and subsequent food shortages especially in the rural areas.

The DM office is in the process of formulating a disaster management strategy for the country, and subsequently will set up DM committees in all the 20 districts and establish a relief fund titled "His Majesty's Relief Fund." This office will also hold a series of awareness campaigns, publish guides and manuals for more efficient disaster management and relief efforts. These recent efforts highlight the royal government's initiative to tackle climate related disasters and calamities, and provide timely aid to those affected, especially the most vulnerable communities..

The NAPA efforts could not have come at a better time and will actually highlight and support the recent initiatives of the RGOB in seeking ways and means to adapt and respond to climate related disasters.

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6.4 Contribution to overall sustainable development goals

The national vision, as stated in Bhutan 2020- A Vision of Peace, Prosperity and Happiness, is for sustainable and equitable economic growth and development without compromising the natural resource base for future generations. In addition the BPRSP (Bhutan Poverty Reduction Strategy Paper) launched in 2000, and the Millennium Development Goals both emphasize some of the main aspirations of all Bhutanese- to eradicate extreme poverty and hunger by year 2015 by building infrastructure and access to remote communities and villages; to achieve universal primary education; reduce child mortality; improve maternal health and ensure environmental sustainability.

The NAPA project via its wide ranging consultations and efforts of the task force representing key sectors has assessed the main vulnerabilities (or effects of climate change) of eight sectors (Agriculture, Forestry, Livestock, Health, Trade and Industry, Biodiversity, Water, Roads and Infrastructure) resulting in 9 urgent and immediate adaptation projects. The implementation of these activities will efficiently address the above critical issues in the immediate future.

6.5 Government endorsement and commitment

The preparation of the NAPA document was initiated by the NEC (National Environment Commission), with the formation of a multi sectoral task force that has representations from eight sectors of the government, civil society, semi government agencies and private sector. The outcome seeks to address urgent and immediate needs of the country- especially in the remote vulnerable groups and areas affected or likely to be affected by climate change. The document is endorsed by the National Environment Commission which is also the National Climate Change Committee. The task force members who were responsible for the preparation of the document will further play a vital role in the implementation of the projects. Moreover, the projects will be subjected to the same rigorous methods of accountability and transparency in the areas of M&E, periodic reporting, accounts and auditing requirements.

6.6 Transparency

The NAPA document preparation has been conducted in a transparent manner right from the training phase to the consultative and endorsement phases. The multi sector task force is itself testimony to transparent process as they engaged many stakeholders in a participatory manner for all the consultations and workshops conducted around the country. Minutes and records of all the meetings held for the project are also kept on record.

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ANNEX I. Group Scoring, Standardization and Ranking of the Bhutan NAPA Project Proposals

Group Scoring, Standardization and Ranking of the Bhutan NAPA Project Proposals

Table 1: Initial criteria scores of Group 1

	CRITERIA (4) >>	COST	BENEFIT-1	BENEFIT-2	BENEFIT-3	*Group no. 1*	
#	OPTIONS or PROPOSED PROJECTS	Estimated Cost *US $*	Human Life & Health saved *SCALE 1-5*	Arable land & Water supply etc. saved *SCALE 1-5*	Essential Infra & Monuments etc. saved *SCALE 1-5*	*Standardized Sum - Equal weight all criteria*	*Rank #*
1	DMSI (FOOD/MED)	$ 619,110	5	3	2	*0.54*	*5/6*
2	LSR&FLPR	$ 894,179	4	5	4	*0.85*	*1*
3	RAINWHARV	$ 895,000	2	3	1	*0.18*	*9*
4	WEATHFOREC	$ 420,000	4	3	3	*0.56*	*3/4*
5	ARTLOWGLOF	$ 3,190,000	4	4	4	*0.54*	*5/6*
6	EWSGLOF	$ 400,000	4	3	2	*0.49*	*7*
7	FORFIREMAN	$ 423,000	2	3	4	*0.48*	*8*
8	GLOFHAZMAP	$ 232,493	5	3	2	*0.58*	*2*
9	FLPROTIAA	$ 453,488	4	3	3	*0.56*	*3/4*

DMSI (FOOD/MED) - **Disaser Management Strategy (Pilot Implementation of Food Security and Emergency Medicine.)**
LSR&FLPR - **Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)**
RAINWHARV - **Rainwater Harvesting**
WEATHFOREC - **Weather Forecasting System to Serve Farmers and Agriculture**
ARTLOWGLOF - **Artificial Lowering of Thorthomi Glacier Lake**
EWSGLOF - **Installation of Early Warning System on Pho Chu Basin**
FORFIREMAN - **Promote Community-based Forest Fire Management and Prevention**
GLOFHAZMAP - **GLOF Hazard Zoning (Pilot Scheme – Chamkar Chu Basin)**
FLPROTIAA - **Flood Protection of Downstream Industrial and Agricultural Area**

Table 2. Initial Criteria scores of Group 2

#	CRITERIA (4) >>	COST	BENEFIT-1	BENEFIT-2	BENEFIT-3	*Group no. 2*	
	OPTIONS or PROPOSED PROJECTS	**Estimated Cost** ***US $***	**Human Life & Health saved** ***SCALE 1-5***	**Arable land & Water supply etc. saved** ***SCALE 1-5***	**Essential Infra & Monuments etc. saved** ***SCALE 1-5***	***Standardized Sum - Equal weight all criteria***	***Rank #***
1	DMSI (FOOD/MED)	$ 619,110	**4**	**4**	**4**	***0.96***	***1***
2	LSR&FLPR	$ 894,179	**3**	**3**	**3**	***0.64***	***3***
3	RAINWHARV	$ 895,000	**4**	**3**	**1**	***0.60***	***4***
4	WEATHFOREC	$ 420,000	**4**	**3**	**1**	***0.65***	***2***
5	ARTLOWGLOF	$ 3,190,000	**2**	**3**	**3**	***0.33***	***9***
6	EWSGLOF	$ 400,000	**4**	**1**	**1**	***0.49***	***5***
7	FORFIREMAN	$ 423,000	**2**	**3**	**1**	***0.40***	***8***
8	GLOFHAZMAP	$ 232,493	**3**	**1**	**2**	***0.46***	***7***
9	FLPROTIAA	$ 453,488	**2**	**2**	**3**	***0.48***	***6***

Table 3. Initial Criteria scores of Group 3

#	CRITERIA (4) >>	COST	BENEFIT-1	BENEFIT-2	BENEFIT-3	*Group no. 3*	
	OPTIONS or PROPOSED PROJECTS	**Estimated Cost** *US $*	**Human Life & Health saved** *SCALE 1-5*	**Arable land & Water supply etc. saved** *SCALE 1-5*	**Essential Infra & Monuments etc. saved** *SCALE 1-5*	***Standardized Sum - Equal weight all criteria***	***Rank #***
1	DMSI (FOOD/MED)	$ 619,110	**5**	**4**	**3**	***0.83***	***2***
2	LSR&FLPR	$ 894,179	**4**	**3**	**1**	***0.43***	***6/7***
3	RAINWHARV	$ 895,000	**3**	**4**	**1**	***0.43***	***6/7***
4	WEATHFOREC	$ 420,000	**3**	**3**	**2**	***0.42***	***8/9***
5	ARTLOWGLOF	$ 3,190,000	**5**	**4**	**4**	***0.69***	***3***
6	EWSGLOF	$ 400,000	**5**	**2**	**3**	***0.61***	***4***
7	FORFIREMAN	$ 423,000	**3**	**3**	**2**	***0.42***	***8/9***
8	GLOFHAZMAP	$ 232,493	**5**	**4**	**4**	***0.94***	***1***
9	FLPROTIAA	$ 453,488	**4**	**2**	**5**	***0.60***	***5***

Table 4. Summarized (consensus) 'absolute' scores of the 3 sub-groups:

	CRITERIA (4) >>	COST	BENEFIT-1	BENEFIT-2	BENEFIT-3
#	*OPTIONS or PROPOSED PROJECTS*	ESTIMATED COST in US $	Human Life & Health saved SCALE 1-5	Arable land & Water supply etc. saved SCALE 1-5	Essential Infra & Monuments saved SCALE 1-5
1	DMSI (FOOD/MED)	$ 619,110	5	4	2
2	LSR&FLPR	$ 894,179	4	4	3
3	RAINWHARV	$ 895,000	4	3	1
4	WEATHFOREC	$ 420,000	4	3	2
5	ARTLOWGLOF	$ 3,190,000	5	4	5
6	EWSGLOF	$ 400,000	4	1	2
7	FORFIREMAN	$ 423,000	2	3	2
8	GLOFHAZMAP	$ 232,493	3	2	3
9	FLPROTIAA	$ 453,488	4	2	5

Table 5. The standardized scores of each criteria

	CRITERIA (4) >>	COST	BENEFIT-1	BENEFIT-2	BENEFIT-3
#	***OPTIONS or PROPOSED PROJECTS***	**STANDARDIZED SCORES**	**Human Life & Health saved STANDARDIZED SCORES**	**Arable land & Water supply etc. saved STANDARDIZED SCORES**	**Essential Infra & Monuments saved STANDARDIZED SCORES**
1	DMSI (FOOD/MED)	**0.71**	**1.00**	**0.75**	**0.25**
2	LSR&FLPR	**0.56**	**0.75**	**0.75**	**0.50**
3	RAINWHARV	**0.56**	**0.75**	**0.50**	**0.00**
4	WEATHFOREC	**0.81**	**0.75**	**0.50**	**0.25**
5	ARTLOWGLOF	**0.26**	**1.00**	**0.75**	**1.00**
6	EWSGLOF	**0.85**	**0.75**	**0.00**	**0.25**
7	FORFIREMAN	**0.81**	**0.25**	**0.50**	**0.25**
8	GLOFHAZMAP	**0.93**	**0.50**	**0.25**	**0.50**
9	FLPROTIAA	**1.00**	**0.75**	**0.25**	**1.00**

Table 6. Ranking of Projects after factoring in weights for "local, regional or national" outreach

#	OPTIONS or PROPOSED PROJECTS	National Regional or Local	Initial Ranking	Adjusted Ranking	TOP 6
1	DMSI (FOOD/MED)	**N**	**1**	**1**	**1**
2	LSR&FLPR	**R**	**3**	**3/4**	**3/4**
3	RAINWHARV	**N**	**6**	**6**	**6**
4	WEATHFOREC	**N**	**5**	**3/4**	**3/4**
5	ARTLOWGLOF	**R**	**2**	**2**	**2**
6	EWSGLOF	**R**	8	8	
7	FORFIREMAN	**R**	9	9	
8	GLOFHAZMAP	**R**	7	7	
9	FLPROTIAA	**L**	**4**	**5**	**5**

Table 7. Ranking of Projects with emphasis or more weights given to Cost factor

#	NAME OF PROPOSED PROJECT	RANKING when "COST" most important		Accumulated Cost Top 5	Estimated Cost *US $*
		Initial	Adjusted (Nat / Reg / Loc)		
1=	Disaster Management Strategy (Planning for Food Security and Emergency Medicine to Vulnerable Communities)	**1**	**1**	**$ 619,110**	**$ 619,110**
2=	Artificial Lowering of Thorthomi Lake	9	9		$ 3,188,942
3=	Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)	**3/4**	**3**	**$ 1,513,289**	**$ 894,179**
4=	Weather Forecasting System to Serve Farmers and Agriculture	**3/4**	**2**	**$ 1,933,289**	**$ 420,000**
5=	Flood Protection of Downstream Industrial and Agricultural Area	**2**	**4**	**$ 2,386,777**	**$ 453,488**
6=	Rainwater Harvesting	7	**5/6**	**$ 3,281,777**	**$ 895,000**
7=	GLOF Hazard Zoning (Pilot Scheme - Chamkar Chu Basin)	**5**	**5/6**	**$ 3,502,679**	**$ 232,493**
8=	Installation of Early Warning System on the Phu-chu River Basin	**6**	7		$ 400,000
9=	Promote Community-based Forest Fire Management and Prevention	8	8	3514270	$ 423,000
			Estimated cost Top 6:	**$ 3,514,270**	

Table 8. Ranking of Projects when more weights are given to the 'Vulner able' or "poor" Communities (Arable land & Water supply saved)

#	NAME OF PROPOSED PROJECT	RANKING when "POOR" most important		Accumulated Cost Top 5	Estimated Cost *US $*
		Initial	Adjusted (Nat / Reg / Loc)		
1=	Disaster Management Strategy (Planning for Food Security and Emergency Medicine to Vulnerable Communities)	**1**	**1**	**$ 619,110**	**$ 619,110**
2=	Artificial Lowering of Thorthomi Lake	**2**	**2**	**$ 3,308,052**	**$ 3,188,942**
3=	Landslide Management & Flood Prevention (Pilot Schemes in Critical Areas)	**3**	**3**	**$ 4,702,231**	**$ 894,179**
4=	Weather Forecasting System to Serve Farmers and Agriculture	**4**	**4**	**$ 5,122,231**	**$ 420,000**
5=	Flood Protection of Downstream Industrial and Agricultural Area	**5**	7		$ 453,488
6=	Rainwater Harvesting	**6**	**5**	**$ 6,017,231**	**$ 895,000**
7=	GLOF Hazard Zoning (Pilot Scheme - Chamkar Chu Basin)	8	8		$ 232,493
8=	Installation of Early Warning System on the Phu-chu River Basin	9	9		$ 400,000
9=	Promote Community-based Forest Fire Management and Prevention	7	**6**	**$ 6,440,231**	**$ 423,000**
			Estimated cost Top 6:	**$ 6,440,231**	