



**NATIONAL REPORT ON BHUTAN  
FOR WORLD CONFERENCE ON DISASTER REDUCTION  
(KOBE, JAPAN 18-22 JANUARY 2005)**

Department of Local Governance  
Ministry of Home and Cultural Affairs  
Thimphu, Bhutan

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## ACRONYMS, ABBREVIATIONS & BHUTANESE TERMS

CITES	Convention on International Trade on Endangered Species
DFID	Department for International Development
DGM	Department of Geology and Mines
DMP	Disaster Management Plan
DYT	Dzongkhag Yargye Tshogdue
ECOP	Environmental Code of Practice
EFRC	Environmental Friendly Road Construction
GHG	Greenhouse gas
GIS	Geographical Information System
GLOF	Glacial Lake Outburst Flood
GNH	Gross National Happiness
GPS	Global Positioning System
GYT	Gewog Yargye Tshogchung
HKH	Hindu Kush Himalayan
ICIMOD	International Center for Integrated Mountain Development
JGE	Joint Group of Experts
LDCs	Least Developed Countries
NAPA	National Adaptation Program of Action
NEC	National Environment Commission
NEIC	National Earthquake Information Centre
NESB	National Environment Strategy of Bhutan
NSB	National Statistical Bureau
RAP	Rural Access Project
SQCA	Standards and Quality Control Authority
UNDP	United Nations Development Programme
UNFCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UTEP	University of Texas at El Paso
WFP	World Food Programme
WMO	World Metrological Organization

### BHUTANESE TERMS

<i>Dzong</i>	Fortress or Monastery
<i>Dzongchung</i>	small Dzong
<i>Dzongkhag</i>	District
<i>Dzongkhag Yargye Tshogdue</i>	District Development Committee
<i>Geog</i>	Administrative Block under District
<i>Gewog Yargye Tshogchung</i>	Block Development Committee

## **1. PRELUDE**

This 'National Report' on Disaster Management in Bhutan is prepared for submission to the World conference on Disaster Reduction in Kobe, Japan from 18-22<sup>nd</sup> January 2005. The Report is an outcome of the national level consultative meeting held on 6<sup>th</sup> December 2004 with all the relevant sectors in Disaster Management in Bhutan. The consultative meeting was organized by the Ministry of Home and Cultural Affairs to inform the various agencies and organizations about the World Conference on Disaster Reduction and to gather information on the disaster management initiatives undertaken in different sectors. Apart from the national level consultative meeting, many departmental consultations were also held with each concerned agency in collecting more information and other facts and figures.

This National Report is the first comprehensive report of its kind on the status of disaster management in Bhutan.

## **2. COUNTRY PROFILE**

Bhutan is a small mountainous country, landlocked between India and China situated on the southern slopes of eastern Himalayas between latitudes 26.7° -28.4° North and longitudes 88.7°-92.2° East. With an area of 38,394 square kilometers (National Statistical Bureau 2004) and a population estimated at 7, 34,340 (NSB 2004). The majority of Bhutanese people follow Mahayana Buddhism. Bhutan is a typical agrarian society with more than 85 % (National Environment Strategy of Bhutan 1998) of Bhutanese people engaged in agriculture with limited arable land, and relies on an integrated system of crops, livestock and small-scale forest management. The country currently meets 65 % of its food needs through domestic output.

Bhutan has been declared as one of the ten biodiversity 'hotspots' in the world due to very high biodiversity concentration in its forests which covers 72.5 % (NESB 1998) of the total surface area of Bhutan. So far 770 species of birds and 116 mammals (NEC) have been recorded in Bhutan. In its effort to preserve the fragile mountain ecosystem the government has identified nine protected areas in the form of wildlife sanctuaries, national parks and a natural reserve occupying 26.3 % of total land area, which represents different types of ecosystem. These protected areas are connected by a biological corridor, which occupies another 9.3 % of total land area.

The self imposed isolation for years has helped Bhutan to maintain and preserve our pristine environment and rich cultural heritage. Bhutan has been able to preserve the varied forests, flora and fauna, natural resources and its pristine air and water resources and keep them largely intact. However, during the second half of the 20<sup>th</sup> century Bhutan saw unparalleled progress and development with the opening of its door to the outside world in 1961. The major challenge here is to strike a balance that enables Bhutan to optimize the gains and minimize the adverse impacts of globalization. The dominant sectors of the Bhutanese economy include Hydropower generation, Construction Industry and Financial Services.

Bhutan's development philosophy has been constantly marked by a fair balance between preserving its cultural heritage and natural environment and pressing forward with economic development. The

unique development approach “**Gross National Happiness (GNH)**” that Bhutan follows, focuses on peoples’ cultural, spiritual and emotional needs, which are far beyond mere economic indicators of the well being of every Bhutanese.

A long term development strategy is set out in the policy document “**Bhutan 2020: A Vision for Peace, Prosperity and Happiness, 1999**” with the main principles of self reliance, sustainability, preservation of cultural heritage, balanced and equitable development, improving quality of life, human resource development, environmental conservation and strengthening national security.

### **3. DISASTERS IN BHUTAN**

Bhutan is prone to disasters like floods, flashfloods, forest fires, draught and earthquakes of which landslides and flashfloods is a recurrent phenomenon causing extensive damages to infrastructures and properties every year. This is because of the rugged and fragile geophysical structures, complex geological setting, vulnerable ecosystem, variable climatic conditions and active tectonic processes taking place in the Himalayas. The problem is further aggravated by the socio-economic and changing demographic patterns that are steadily increasing the impact of disasters.

During the damage assessment of the 2004 Monsoon in the six eastern Dzongkhags which was carried out by the Ministry of Agriculture, it was found that a total of 9 lives were lost, 29 houses were completely washed away and 26 houses had collapsed, 107 houses were partially damaged and a total of 664 acres of wet and dry land were washed away. Hundreds of tonnes of maize, paddy and potatoes were lost and about 2000 orange trees had been washed away affecting about 1437 households. Taking into consideration the small population size and limited arable land it is a great loss.

Mountains in Bhutan are home to a large and varied biodiversity of flora and fauna, they are a source of livelihood for the people and a major source of fresh water for irrigation, drinking and other domestic uses as well as for generation of hydropower which is one of the major sources of revenue for the government. All the rivers in Bhutan are fed by melting of glaciers. It is now observed that mountains are being threatened as soil erosion, landslides, floods, flashfloods and rock fall increase in frequency and intensity. The increase in population and other demographic changes put pressure on the limited arable land and people are forced to expand the agricultural fields and community settlements, which further de-stabilize the slopes.

Global warming is causing the glaciers to retreat at a much faster rate, which when combined with torrential rains in the monsoon season gives rise to major floods and flashfloods due to GLOF as in the case of recent GLOF disaster in October 1994 due to partial burst of Lugi Tsho in eastern Lunana. There will also be increased debris flow of glaciers as it gets warmer and ultimately there is a huge risk of dramatic loss of glacier-fed water produced by calamitous events. Glaciers and glacial lakes in Bhutan are an important resource as well as a source of major hazard if there is no proper logistics and capacity for organized response to natural disasters.

Bhutan also falls under one of the most seismically active zones in the world primarily attributable to the continent-continent collision of the Eurasian-Indian plates. There does not exist any

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comprehensive seismic zonation of Bhutan but its proximity to neighboring Assam which falls under seismic zone V indicates that majority of Bhutan falls under seismic zone IV or V. In contrast to western and central portion of the Himalayas, the seismotectonics of the Bhutan Himalayas are virtually unknown. During the past 100 years the Himalayan region has experienced 4 major earthquakes measuring  $M > 8$  on the Richter scale. Recent studies have indicated that the Himalayan region is due for such a major event endangering the lives of millions of people (Seismicity of the Bhutan Region (1937-2000), DGM). Although there exists a very high risk of earthquake occurrence in Bhutan there is no systematic disaster management system in place. There are also no comprehensive and official records of past earthquakes and damages caused in Bhutan.

The lack of proper disaster management system and coordination among different agencies and the lack of technical manpower and other resources combined with difficult geo-physical situation have been some of the obstacles in coping with disasters in Bhutan.

#### **4. NATIONAL POLICIES AND DISASTER MANAGEMENT IN BHUTAN**

In Bhutan there does not exist any law, statutes or any other legal frame work to deal with different types of disasters. There was no centralized disaster risk management mechanism in Bhutan. Though the country is not free from disasters the magnitude of the problem has not been serious enough to draw serious concern with regard to emergency preparedness and disaster management. This is however changing and the Royal Government has already taken policy measures in dealing with national disasters.

The Ministry of Home and Cultural Affairs, as the focal agency pertaining to disaster management in Bhutan, coordinates with other Ministries and Departments such as the Department of Geology and Mines, National Environment Commission, Department of Energy, Department of Roads, Standards & Quality Control Authority, Department of Urban Development, Ministry of Health, Department of Urban development and Engineering Services and Ministry of Agriculture. All these different organizations deal with issues pertaining to disaster management as regular activities. There are also Disaster Relief Committee being established in some Dzongkhags, which will, with the help of Local government (GYT and DYT) respond to disasters as well as inform the Central Government of any disasters occurring in the different Dzongkhags and Geogs.

Thus, although there is a lack of comprehensive disaster management system in Bhutan there are some key elements of disaster management scattered among different sectors and organizations in Bhutan. The present system of disaster management has been quite effective even without any legislation on disaster management in Bhutan. Whatever disasters have occurred in Bhutan so far, such as floods, flashfloods, forest fire, diseases and pest outbreak those affected have been able to receive prompt relief and response from the central government, districts, local agencies and military personnel. This may be attributed to the effective governance existing in the country both at the national and Dzongkhag levels.

However, there is a need to have a formally recognized national framework to encapsulate and legalize disaster management in Bhutan. There should also be a systematic coordination among different stakeholders and the roles and responsibilities of each agency should be clearly spelt out.

The international organizations such as UNDP, WFP and UNICEF also have plans and programs to assist the government in disaster management. Recently the UNDP is assisting the Royal Government with a Thimphu valley earthquake risk management project.

As mentioned earlier, Bhutan has been able to respond to past disasters quite effectively with its limited technical, financial and human resources. But the scales of disasters were not enormous enough to test the capacity of disaster management in Bhutan. Realizing that the present capacity to respond to disaster is inadequate in case of large-scale disaster, Bhutan is proposing to have a National Strategy on disaster management. With a strong commitment of the Royal Government in disaster management, Bhutan hopes to put in place an efficient and effective disaster management mechanism.

Under organizational restructuring of the government some changes were made. A new department, Department of Local Governance, was established in the Ministry of Home and Cultural Affairs. Among others, one of the main functions of the department is to coordinate the functions of Dzongkhag Administrations and to monitor their activities. The Department of Local Governance shall therefore also directly co-ordinate disaster management in all 20 Dzongkhags. In order to respond to such crises appropriately and instantaneously it shall develop clear objectives, strategies and activities in conformity with international guidelines.

## **5. SECTORAL INITIATIVE FOR DISASTER MANAGEMENT**

### **5.1 DEPARTMENT OF LOCAL GOVERNANCE**

The Department of Local Governance under the Ministry of Home and Cultural Affairs is identified as the focal agency in disaster management in Bhutan. It shall co-ordinate all the disaster management activities in the country with other relevant sectors. The Department shall undertake the following functions:

1. It shall plan and coordinate responses to disaster in any part of the country in cooperation with concerned sectors.
2. It shall be the agency to co-ordinate all external assistance/ Collaboration in disaster management including trainings and formulation of projects.
3. It shall develop RAPID REACTION STRATEGIES for all types of disasters in collaboration with respective sectors without requiring separate establishments.
4. It shall develop annual budgets in the centre and also ensure procurement of essential equipment and other logistical needs
5. It shall raise public awareness, caution and preparedness with special focus on the vulnerable groups.



6. It shall include civil society in all its disaster management plans and strategies.
7. All Dzongkhag disaster management committees shall report directly to the Department of Local Governance, which in turn shall inform all participating agencies.
8. A fund raised through a) government allocation, b) public contribution, c) External support and other sources shall be named "**His Majesty's Relief Fund**".
9. There shall be a disaster reduction / prevention and management committee in the centre with members from relevant sectors.

## **5.2 DEPARTMENT OF GEOLOGY AND MINES (DGM)**

The main roles of the Department of Geology and Mines under the Ministry of Trade and Industry include geological mapping, exploring mineral resources, providing engineering geological services, ensuring environment friendly exploitation of economic mineral resources, and carrying out scientific studies and monitoring of natural hazards like GLACIAL LAKE OUTBURST FLOOD (GLOF), earthquakes and landslides which are prevalent in the Himalayan environment. The Department also acts as crucial link between Bhutan and the geological organizations of other countries for exchange of information and technology.

The risk of GLOF has been a major threat in Bhutan. The glaciers in Bhutan are important water resources for hydro power generation, drinking, irrigation and other domestic uses but they are also a potential source of geo-hazards such as rock fall, landslides and flashflood if preventive and mitigation measure are not in place. According to the recent study carried out by the DGM in collaboration with International Center for Integrated Mountain Development (ICIMOD), Nepal, there are 667 Glaciers and 2674 glacial lakes in Bhutan alone out of which 24 glacial lakes are potentially dangerous. The study was done to monitor the GLOF events and hazards using GIS and satellite imagery and also to establish early warning system to reduce GLOF hazards on lives and properties.

There is no documented evidence of past GLOF incidents in Bhutan except for the GLOF incident on 7<sup>th</sup> October 1994 from the partial burst of Luggi Tsho in eastern Lunana. This flood caused extensive damage to properties along Punakha-Wangdi valley. The *Dzongchung* or small Dzong was partly destroyed.

The study by the DGM along with the Institute of Geology, University of Vienna, Austria warned of possible hazard potential of combination of Raphstreng and Thorthormi Tsho which could result in more than two times the volume of 1994 Luggi Tsho outburst. If this is true then the consequences can be very devastating.

Some elderly people still remember the flooding from GLOF in 1957, which affected Punakha-Wangdi valley destroying part of the Punakha Dzong that was caused by the outburst of Tarina Tsho in Western Lunana.

The Himalayan region has been categorized as one of the seismically active zones in the world. During the past 100 years the region has witnessed four great earthquakes with  $M > 8$  that devastated the region bringing huge losses and misery to millions of people. The Bhutan region on the other hand never experienced any major events.

## **DISASTER MANAGEMENT INITIATIVES UNDERTAKEN BY DGM**

Due to the enormous threat posed by the glaciers and glacial lakes in Bhutan, the DGM with organizations in other countries have so far carried out numerous studies to monitor the developments in the glacial lakes. They have also provided some mitigation measures to minimize the impacts of possible GLOF.

In 1967, identification of potentially dangerous glacial lakes in Lunana region was carried out. The Geological Survey of India carried out Aerial reconnaissance survey of the Lunana region. The Joint DGM and GSI conducted the Lunana expedition in 1986. The expedition to Lunana by Indo-Bhutanese team to identify the causes and effects of 1994 GLOF was conducted in 1995. The multi-disciplinary team from National Environment Commission, DGM, Department of Roads and Bhutan Survey conducted an expedition to Roduphu glacial lake. The mitigation measures for Raphstreng Tsho were carried out in collaboration with the Government of India from 1996-1998. The Joint Japan-Bhutan project for Hazard Risk Assessment for GLOF was done in 1998. The Risk Assessment of Upe Tsho and Tsokar Tsho at the source of Chamkhar chhu in Bumthang was conducted by the DGM in 1999. Finally in 1999-2001 a Joint Bhutan-Austria Project for the risk assessment of glaciers and glacial lakes was completed.

Austrian Government also assisted Bhutan in monitoring and GLOF hazard analysis of Lunana for down stream effects of Phochu.

Apart from the many expeditions made to GLOF sources the DGM also monitor the developments in glaciers and glacial lakes through the use of satellite images, time series data and hardcopy maps. The DGM has also done a comprehensive Hazard Assessment of the Lunana glacial lakes and prepared a Hazard Zonation Plan for these lakes in order to reduce the possible impacts on lives and properties in the event of a GLOF.

With regard to earthquake threat in Bhutan, the DGM is working closely with the University of Texas at El Paso and University of Colorado to understand the earthquake and tectonic characteristic of Bhutan Himalayas. The collaborative Project between DGM and UTEP resulted in training of one Bhutanese student in the field of earthquake and exploration geophysics and another one in research on neo-tectonics of Bhutan region. The collaborative work between DGM and UTEP installed 5 temporary seismic network stations for one-year period in January 2001 to understand the Seismicity of the country for the very first time. The preliminary results showed that over a six month period the network recorded over 1600 tremors of which 642 were regional/local events.

The collaborative work between the DGM and the University of Colorado at Boulder involved in understanding the tectonic and earthquake hazards using the GPS technology capable of measuring deformation rate up to +/- 3mm. This deformation rate is the key to the size and damages of earthquake in Bhutan. Numerous GPS points were measured during Oct-Nov 2003 along Thimphu-Phuentsholing highway, Punakha-Laya, and Bumthang-Zhemgang highway. Besides, two permanent GPS stations were installed at Royal Bhutan Institute of Technology in Phuentsholing and Thimphu to determine the convergence rate.

Efforts shall be made to collaborate with ICIMOD, Katmandu and other institutions that are involved in monitoring seismic activities and behaviour in the Himalayas.

### **5.3 NATIONAL ENVIRONMENT COMMISSION**

National Environment Commission in Bhutan is one important agency which looks after the overall legislation and legal framework on environment sectors in Bhutan to ensure that the socio-economic development is consistent with the 'middle path' of sustainable development. They have published the Environment Assessment Act in 2000 and there are many other publications such as Environment Code of Practices and sectoral guidelines on environment which cover a broad spectrum of developmental activities like roads and highways, hydropower plants and transmission lines and other infrastructure constructions. Besides, the NEC also conducts research, monitoring and awareness on environment. It is also a focal point on various International conventions to which Bhutan is signatory.

Realizing the damage that can be caused by unplanned and uncontrolled development the Royal Government of Bhutan has taken the "middle path" of sustainable development, in order to raise the living standards of the present population without compromising the country's cultural integrity, historical heritage or the quality of life for future generations. Due to the strong exemplary environment practices in the nation, environment degradation is not a major contributing factor to disasters in the country although at some point of time the pressure of economic development may prove too great to maintain the fragile ecological balance. In early 1974 the National Assembly passed a strong resolution mandating the country to maintain at least 60 percent of its total area under forest cover for all times to come.

At the international level Bhutan is signatory to many regional and international conventions on environment such as the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention on Biological Diversity (UNCBD), Convention on International Trade on Endangered Species (CITES), World heritage Convention and Basal Convention.

With regard to climate change, Bhutan stands out as one of the very few countries in the world with greenhouse gas sequestration capacity which can be credited to its vast forest cover, limited industrialization and use of clean energy sources. But global warming and climate change due to increased GHG production from human activities around the world makes Bhutan vulnerable as climate change may disrupt the delicate balance of the mountain ecosystem.

## **DISASTER MANAGEMENT INITIATIVES UNDERTAKEN BY NEC**

The NEC has come up with many sectoral guidelines on environment assessment, air and water quality standards and other Environment Codes of Practice which take care of major environment degradation at the project implementation level. However the impacts of climate change will be felt in Bhutan due to increased Green House Gases (GHG) generation around the world. The financial and technological constraints in Bhutan are a major obstacle to prepare itself against the consequences of climate change.

Although global warming and climate change will affect all the countries, the least developed countries will be affected the most due to lack of financial and technical resources to adapt to climate change. As a means to help the LDCs adapt to climate change the Conference of Parties to the UNFCCC started to help the LDCs prepare its National Adaptation Program of Action (NAPA) in its Seventh session in 2001.

The NEC is currently working on NAPA Project which is funded by the Global Environment Facility through UNDP. The Project will basically try to identify all the vulnerable sectors such as agriculture, health, infrastructure, water and forest and try to prioritize them in terms of risks associated due to climate change. By mid 2005 NAPA Project will come up with different project proposals for the sectors which are highly vulnerable to the climate change as adaptive measures.

### **5.4 DEPARTMENT OF ENERGY**

The Department of Energy within the Ministry of Trade & Industry is responsible for the power sector policy, planning & regulation. In addition, the Department is also responsible for generation, distribution, transmission, investigation and implementation of various projects. The hydropower sector is the engine of socio-economic growth in Bhutan. As of now, Bhutan exports about 75% of its electricity to India. Bhutan is endowed with a large hydropower potential of over 30,000 MW.

There are three major hydroelectric Projects in Bhutan:

#### **1. Tala Hydroelectric Project**

This project is scheduled for completion in the year 2005/2006 with an installed capacity of 1020 MW and an annual generation of 4865 Million Units. The project is financed by the Government of India with a financing mix of bilateral assistance and soft loan. This project is the largest high-head (860m) power plant being constructed in the region.

#### **2. Kurichu Hydroelectric Project**

This project was completed by 2002 with an installed capacity of 60 MW and an annual generation of 400 Million Units. It has started supplying power to six Dzongkhags in eastern Bhutan and two Dzongkhags in south-central Bhutan. Surplus power is being exported to India through the 132 kV Gelephu-Salakati line. The project is financed by a combination of bilateral assistance and soft loan from the Government of India.

### **3. Basochu Hydropower Project**

This project has an installed capacity of 22.2 MW with an annual generation of 105 Million Units. This project has helped to augment the generation supply in western Bhutan as well as improve the reliability of power supply in the region. The Austrian Government under a financing mix of bilateral assistance and soft loan finances the project.

In these power projects, the government is spending huge resources and the Department of Energy is well aware of the threat posed by GLOF and floods. In order to cope with disasters such as GLOF and floods, the Department of Energy has taken some important measures on flood and GLOF monitoring and early warning system.

### **DISASTER MANAGEMENT INITIATIVES UNDERTAKEN BY THE DEPARTMENT OF ENERGY.**

The Hydromet Services Division under the Department of Energy is responsible for Planning and Design of Hydro-met Network for collection of Hydromet data required for hydropower planning, flood and weather forecasting as well as for energy generation scheduling. They collect the Hydromet data and disseminate to the end users such as the hydropower plants and other agencies. They are also actively involved in flood warning and flood prevention measures.

Presently the Hydromet Services Division has 10 Hydrological stations and 33 rainfall stations spread across the country. They also have one station in Thangza to monitor the glacial lakes.

The Hydromet Services Division of the DoE in collaboration with International Center for Integrated Mountain development (ICIMOD) and World Metrological Organization (WMO) held a meeting in Thimphu to establish a flood information network in the HKH (Hindu Kush Himalayan) region. It was felt that a regional information network among countries like India, Nepal, Bhutan, Pakistan and China would help them to be in a better position to manage floods.

A high level technical delegation from Bhutan and India discussed on 2<sup>nd</sup> August 2004 to form a joint group of experts (JGE) to tackle flood management issues that affect the Indian states of Assam and Bengal every monsoon. The meeting drew up TOR to discuss the probable causes and effects of recurring floods and erosion in the southern foothills of Bhutan and adjoining plains in India. The TOR also states that recommendations and appropriate solutions should be identified which is acceptable to both the countries.

## **5.5 MINISTRY OF AGRICULTURE**

The Ministry of Agriculture plays an important role in increasing food production, raising rural income and improving the livelihood of the nation's large rural population while

preserving the pristine natural environment and conserving the rich natural resources of land, water, forests, flora and fauna for future generations. The Ministry also provides crops, livestock and forestry services to the people.

The Water and Agriculture sectors are the most sensitive to climate change impacts due to increase in volume of floods and surface runoff. The occurrence of forest fire is also a frequent phenomenon in Bhutan where hundreds of hectares of forested lands are destroyed and many wild animals killed. Agriculture, on which 85 % of the population depends, is likely to suffer major losses due to high temperature, severe draught and changes in climatic patterns. At other times it is the outbreak of pests and diseases. Given the small land holdings of most farmers in Bhutan and their total dependence on agricultural products, any damage to their crops will make life difficult for them. The high biodiversity concentration in Bhutan is also threatened by the synergistic effects of climate change and habitat fragmentation due to rapid urbanization.

Just in the 2004 Monsoon 350 metric tonnes of maize, 126 metric tonnes of paddy and 21 metric tonnes of potatoes were lost in the 6 eastern Dzongkhags of Bhutan due to floods, flashflood and landslides although emergency situation such as out break of diseases or severe food shortages did not occur in any of the affected areas. The vulnerable people in Duksum were evacuated to a safer site and the Royal Government provided food and other essentials.

Agriculture related disasters are usually confined to local levels and nation wide disasters have not yet occurred in Bhutan.

#### **DISASTER MANAGEMENT INITIATIVES UNDERTAKEN BY THE MINISTRY OF AGRICULTURE.**

When there is an outbreak of pests and diseases in the agricultural fields, the Department of Agriculture provides technical expertise and provides measures to control the outbreak. If the situation becomes worse and if there is severe food shortages then the Department also provides direct food aid to the affected group of people for a limited duration as a temporary measure. The Dzongkhags also provide small amounts of free inputs such as seeds and fertilizers to the affected farmers. To protect the livelihood of farmers the idea of crop insurance has been raised in the past but it has not materialized till date. This is an important concern which should be taken seriously.

During a forest fire, there is no comprehensive management plan to respond to fire disaster. The usual practice is that the community and government servants help to control the situation and try to save lives and properties at the most. The government also investigates the causes of fire and if anyone is convicted of intentionally setting the forest on fire he or she faces severe punishment.

The irrigation system in Bhutan is relatively small and they are not a major cause for

concern if managed properly. However during heavy rainfall and occurrence of small landslides the irrigation system tends to cause considerable damage. When irrigation system is damaged the farmers try to repair and maintain the irrigation channels using their own resources. If the damage is beyond their management capacity, the farmers report to the Dzongkhags through their respective DYT's. The Dzongkhags then depute engineers and local representatives to assess the damages and provides temporary irrigation measures for the rest of the season. The repairs of the damaged irrigation systems are usually carried out in the following year after obtaining supplementary budget. The Department has also adopted the National Irrigation Policy where the farmers are responsible for repairs and maintenance of irrigation channels.

The riverbank protection works are also initiated by the department to protect lives, properties and farmlands during high water level and heavy rainfall. The normal protection measures include construction of gabion walls.

## **5.6 STANDARDS & QUALITY CONTROL AUTHORITY**

The Standards and Quality Control Authority under the Ministry of Works & Human Settlement was established in 2000 with the primary responsibility to develop standards and ensure quality in the public infrastructure projects. Derived from the broad government instructions, the SQCA has set its long-term vision as "Enabling development of technically superior quality public infrastructure, cost effective in its construction and engage the state of the art technology". The fact that major portion of Bhutan lies in one of the most seismically active zones in the world is imposing a major threat to Bhutan. In order for Bhutan to prevent and minimize the impacts of possible earthquakes, SQCA is executing a project to assess the vulnerability of buildings in the country and to come up with retrofiting recommendations.

### **DISASTER MANAGEMENT INITIATIVES BY SQCA**

The Standards & Quality Control Authority under the Ministry of Works and Human Settlement along with other stakeholders has initiated a short-term project "Thimphu Valley Earthquake Risk Management", which is supported by the UNDP.

The earthquakes do not kill people but the buildings and other infrastructures do in the event of an earthquake. The basic objective of the project is to assess the vulnerability of buildings in Thimphu Valley and propose recommendations and relevant retrofiting techniques for those buildings that are vulnerable.

The project includes the following major activities:

1. Development of an earthquake scenario for Thimphu valley using RADUIS Methodology which would assist to generate an earthquake risk management plan for Thimphu valley.

2. Vulnerability Assessment of 15 critical Buildings in Thimphu valley to formulate scheme for retrofitting and strengthening of critical buildings. Buildings have been selected based on their social importance, age, shape, size, purpose, alteration made etc.
3. Document Methodology and tools for rapid vulnerability assessment of some most prevalent building types to produce tools for conducting vulnerability assessment for large public buildings.
4. Build technical in-house capacity for earthquake vulnerability assessment and earthquake resistant construction relevant to Bhutan.
5. Produce awareness material on the project and earthquake resistant construction Technology and good practices.
6. Disseminate outputs related to the process and product of the project to strategic stakeholders at different points during the project. Similar projects will be carried out in the all the cities and towns in the country gradually.

## **5.7 DEPARTMENT OF ROADS**

The Department of Roads under the Ministry of Works & Human Settlement is responsible for planning, execution and management of all road infrastructures development in Bhutan. So far Bhutan has only 3900 Km of road network. All district headquarters and some geogs are accessible by road. However many other geogs and villages still rely on animal and head-load transport system.

There is an increasing need to expand road network in Bhutan to enhance the socio-economic status of the rural communities as well as upgrade the existing road network to cope with increasing vehicular traffic. The country's fragile terrain, high ridges and deep gorges, scattered settlement and low population density are some of the constraints which hinder the development of road network in Bhutan. Every monsoon, there are many landslides, roadblocks and flashfloods in most parts of the country. Roads and bridges have been washed away and some damaged due to landslides and flashfloods. The Royal Government also spends millions of Ngultrum in the monsoon damage restoration works such as rebuilding protection walls, culverts, and drainage system and in some cases realignment of the entire road.

During the damage assessment of the 2004 Monsoon carried out by the Ministry of Agriculture in the eastern Dzongkhags, it was found that a total of 22 bridges have been washed away or severely damaged. Some farm roads and feeder roads were also badly damaged requiring high repair cost.



## DISASTER MANAGEMENT INITIATIVES UNDERTAKEN BY THE DEPARTMENT OF ROADS

The Department of Roads has been exploring the possibilities of better road construction and road corridor planning techniques. Apart from the simple survey and construction of some permanent structures to mitigate the smaller landslides, DoR has adopted Environmentally Friendly Road Construction (EFRC) techniques which include detailed geological and environment assessment studies to reduce the negative impacts of road construction on society, economy and the environment.

The Environmentally Friendly Road Construction (EFRC) technique is, in principle, the translation of the environmental policy on road sector activities as governed by the *Environmental Assessment Act-2000* and the *Environmental Code of Practice-April 2000*. In simple terms, EFRC can be defined as the construction of roads in such a manner that the damages caused to the socio-economic development and the environment is minimized to the extent possible.

The EFRC technique was introduced in Bhutan in 1999 with construction of 122 km feeder roads in 4 eastern Dzongkhags of Zhemgang, Lhuntse, Trashigang and Tashiyangtse under the Rural Access Project (RAP). The Project is funded by the World Bank, SNV and the RGoB. As a prelude to the introduction of the EFRC technique, Environmental Code of Practice (ECOP) and Bio-engineering Manual were developed. The engineers from DoR were trained on planning, surveying and designing of roads, and several workshops and seminars were conducted to familiarize the concerned stake holders on the new technique of road construction.

The RAP, on a project level, has the mandate to develop the EFRC method and to build the requisite construction and maintenance capacity within DoR and other relevant agencies such as the Ministry of Agriculture, Forestry Development Corporation Limited and at the Dzongkhag and at the community level.

During a mid-term review (MTR) of the project, some of the major findings of the MTR team were that the EFRC technology was found well developed within the DoR and the project feels that DoR was competent enough to adopt the new technology. This could be replicated at the national level for all agencies involved in different types of road construction. The EFRC technique was also appreciated by all stakeholders including the private sectors and the project has shown encouraging results.

The following were identified as some of the main areas which require attention:

- Higher initial investment costs – Cost-estimates of a few roads which are under construction, have shown that the initial investment cost on road construction by EFRC method is 25 to 30% higher as compared to the conventional method. However, in the long run, the road constructed using EFRC techniques is envisaged to be more economical owing to low routine maintenance and recurrent costs as

disturbance to the geology and environment of the road alignment is minimized to the extent possible during the construction stage.

- Considerable time is required to carry out planning, geo-technical, social, environmental studies and survey and design.
- Limited availability of appropriate construction equipment and planning tools such as maps of desired scale, etc.

Apart from introducing the EFRC technique in road construction, a Landslide Risk Assessment Project was also carried out in Mongar-Trashigang road, Sunkosh-Dagana road and Chukha-Damchu road. This was a research project by the Scott Wilson Company and the project was funded by the Department of International Development (DFID), UK. The Project aimed at developing rapid, low-cost methods of landslide hazards and risk mapping based on the geological features, meteorological data and existing landslides of these three locations so that there will be better landslide management and road corridor planning in future. The main tools used in the project were GIS, Aerial photographs, seismic data, satellite images, land use maps and topography maps. The Project covered a total area of 80,000 hectares during which more than 500 landslide zones have been identified in these three pilot areas.

## **5.8 DEPARTMENT OF URBAN DEVELOPMENT AND ENGINEERING SERVICES**

Rapid developmental activities and urbanization within the last decade has led to an unprecedented boom and mushrooming of urban infrastructures, of which buildings, both commercial and residential, are the most prominent. Thus the need for a local authority to manage, regulate and monitor the otherwise chaotic and precarious approach to construction of such buildings was deemed indispensable. The urban centers usually consist of high population density and if disaster such as fire, earthquakes, floods and landslides occur, the number of casualties can be very high.

The Municipal Corporations thus established in the various cities and towns of the country now play a very instrumental and vital role in disaster prevention and to some extent disaster management. There are two major cities in Bhutan, Thimphu and Phuentsholing. There are also many other satellite towns coming up in many other parts of the country. The approach adopted by these municipalities presently, in disaster management is predominantly proactive in nature rather than reactive. Great care is taken to avoid disasters but very little effort is made to respond to disasters.

Prior to the establishment of these municipalities, buildings were constructed mostly at the whims and fancies of their owners. The engineering and technical aspects of the buildings were given negligible importance. The durability of the building and more importantly the

safety of the occupants are seriously jeopardized at the cost of economy and haste in construction.

### **DISASTER MANAGEMENT INITIATIVES UNDERTAKEN BY THE DEPARTMENT OF URBAN DEVELOPMENT AND ENGINEERING SERVICES.**

The municipalities are responsible for ensuring that the buildings meet the requirement for safety and strength so as to avoid catastrophic damage to lives and properties in the event of a disaster.

With the establishment of the municipal corporations, strict rules and systems for enforcing the application of the various relevant building design and construction codes were initiated. Seismic design codes are strictly adhered to while designing structures and special care and attention to details is given to structures having immense community services and utility such as Hospitals, fire stations, schools, radio and communication stations etc. Since Bhutan can be possibly considered to fall under either of the two most highly vulnerable seismic zones IV and V the municipalities adopt the Indian Standard (IS) code provision for Zone V while designing and assessing the buildings for approval.

Depending upon the soil condition and degree of vulnerability to certain kind of events (fire, landslides, flood, storm, earthquake etc...) the Thimphu City Corporation has been categorized into zones which determine the type and height of a building that can be built.

Anybody aspiring to construct a building should submit a complete set of drawings illustrating the type, the details of structural component, sewerage, plumbing and electrical wiring provision for the building, for scrutiny to the concerned section of the municipal corporation. The drawings have to comply with the technical norms and fulfill all the structural requirements to be approved for construction. A separate division known as the Building Inspection Division functions under the municipal corporations. This division performs both regular and surprise sporadic inspection to the construction sites to ensure that the buildings are being constructed as per the approved drawings and norms.

In its attempt to safeguard the community against the possibilities of fire hazards the municipal corporations plan and construct public foot path along the periphery and within the city to act as a fire line in an event of fire outbreak. However fire safety designs and practices are not incorporated in particular at present. The municipal corporation and the fire division of the police in association with few other organizations are in the process of developing fire code and guidelines for Bhutan.

Monsoons at times can be very heavy and since most of the settlements in the country are located along the river running through the valley, there is always the threat of flood and river water intrusion into the valley. The municipal corporations initiate construction of river training works along the rivers likely to flood during monsoon.

The Phuentsholing City Corporation (PCC) along with various organizations is devising a Disaster Management Plan (DMP) for the city so that if emergency situation arises it would be able to respond quickly and appropriately to minimize the loss of lives and properties. The proposed Disaster Management Plan includes 4 “R’s” principles. They are:

- Reduction of disaster through physical strengthening of structures and facilities
- Readiness in preparing arrangements to cope with disaster
- Response to deal with the consequences of disaster and
- Recovery from disasters to restore the city to its normal functioning.

## 6. CONCLUSION

There is an emerging threat from earthquake, GLOF and flashfloods and landslides. The increased generation of greenhouse gases in other countries is melting the glaciers on our mountains. There is a rising threat of GLOF and flashfloods especially as a result of global warming and climate change. At the same time tectonic movements appear to manifest greater calamities. The Royal government of Bhutan and the Government of India are investing huge amounts of money in conducting scientific expeditions in studying the glaciers and glacial lakes in Bhutan to find solutions to reduce the risks. In the event of GLOF major consequences are felt by our neighbors in the plains of India and Bangladesh.

There is a need for local, regional and international cooperation to work on disaster reduction. More often the disasters in one country have Their consequences in many other lower riparian countries. The recent earthquake in the islands of Sumatra has affected more than 9 countries with the devastating Tsunamis where the total death toll has exceeded 150,000, making it one of the worst disasters in the region. The poor and the least developed countries are the ones which are most vulnerable because there is no proper response mechanisms and resources to cope with disasters of such magnitude.

Governments have the responsibility to ensure that there are proper and adequate disaster management systems but the lack of financial and technical resources, awareness and capacity in the country’s major hurdles. However, Bhutan is committed to develop a National Strategy for disaster management and commensurate capacity to deal with disasters in the near future. Bhutan also commits itself to be part of the global community in disaster reduction and prevention, conscious of our moral responsibility as an upper riparian country.

## 7. APPENDICES

### Appendix I. Potentially dangerous glacial lakes in Bhutan

#### 1. Mo Chu sub-basin

Sl.No.	Lake No	Name of Lake	Latitude	Longitude	Altitude (masl)	Length (m)	Area (m2)
1	Mo_g1200	Kab	28°04'00.00	89°35'05.50	4280	285	52090.11
2	Mo_g1201		28°06'15.60	89°36'55.60	4080	325	30863.71
3	Mo_g1202		28°07'44.40	89°36'31.60	4380	325	34287.76
4	Mo_g1234	Setang Burgi	28°10'06.00	89°51'21.10	4480	795	232744.52
5	Mo_g1235		28°08'35.40	89°50'43.00	4960	565	150131.36

#### 2. Pho Chu Sub-basin

Sl.No	Lake No.	Name of Lake	Latitude	Longitude	Altitude (masl)	Length	Area (m2)
6	Pho_g184		27°56'48.53	89°55'14.03	5040	660	214078.18
7	Pho_g1148		27°58'09.42	89°56'16.69	4880	1285	454510.02
8	Pho_g1163		28°06'06.43	89°54'11.83	4280	1200	369572.13
9	Pho_g1164	Tarina	28°06'37.22	89°54'37.81	4320	1095	280550.42
10	Pho_g1235	Raphstreng	28°06'43.56	90°14'03.65	4360	550	145948.56
11	Pho_g1210	Luggye	28°05'00.34	90°18'28.58	4600	1980	769799.72
12	Pho_g1211		28°05'40.45	90°19'11.95	4710	650	141975.78
13	Pho_g1313		27°59'58.72	90°07'18.86	5030	205	222134.8

## 2. Mangde chu sub-basin

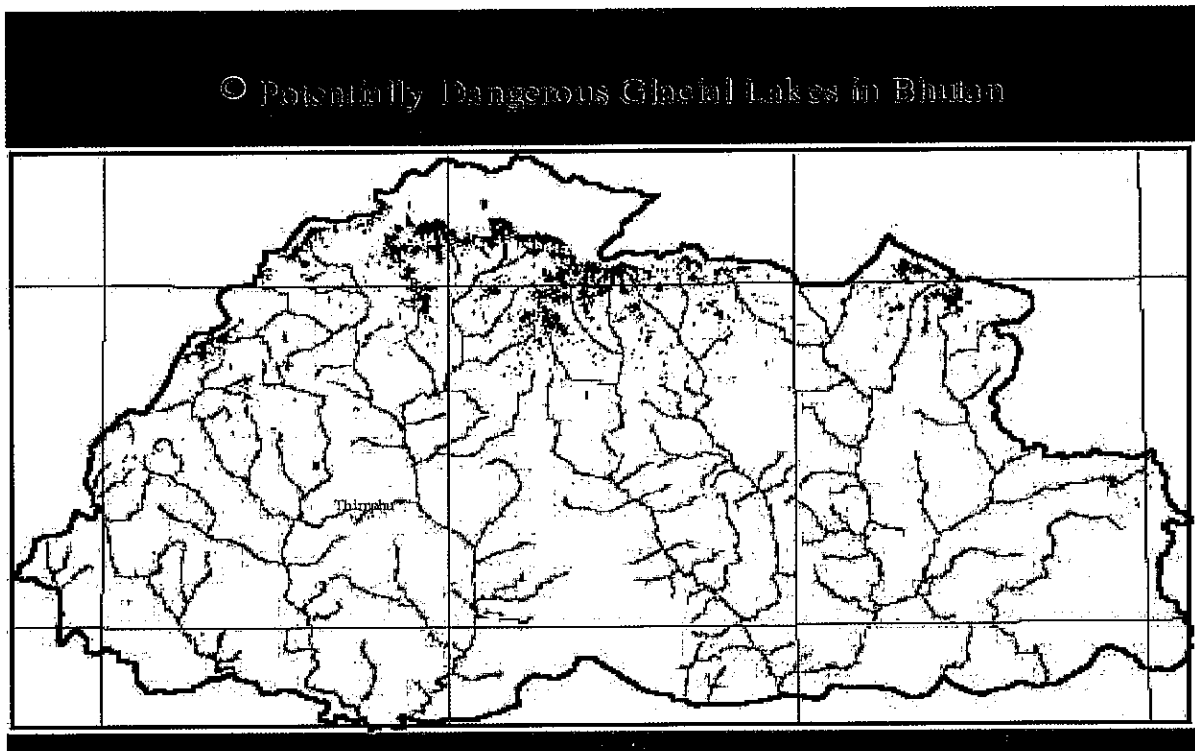
Sl. No	Lake No.	Name of Lake	Latitude	Longitude	Altitude (masl)	Length	Area(m2)
14	Mang_g199		27°54'22.13	90°16'45.88	4960	605	192607.29
15	Mang_g1106		27°53'19.45	90°17'33.94	5040	1480	868294.42
16	Mang_g1270		27°58'09.32	90°20'06.98	5280	850	239778.31
17	Mang_g1285		28°00'20.90	90°19'50.77	5390	795	341412.93
18	Mang_g1307		28°02'21.01	90°21'58.87	5240	1800	767429.06
19	Mang_g1310		27°58'49.87	90°23'05.53	5200	575	200746.06
20	Mang_g1385		27°58'58.53	90°26'21.90	5086	535	466125.34

## 4. Chamkha chu sub-basin

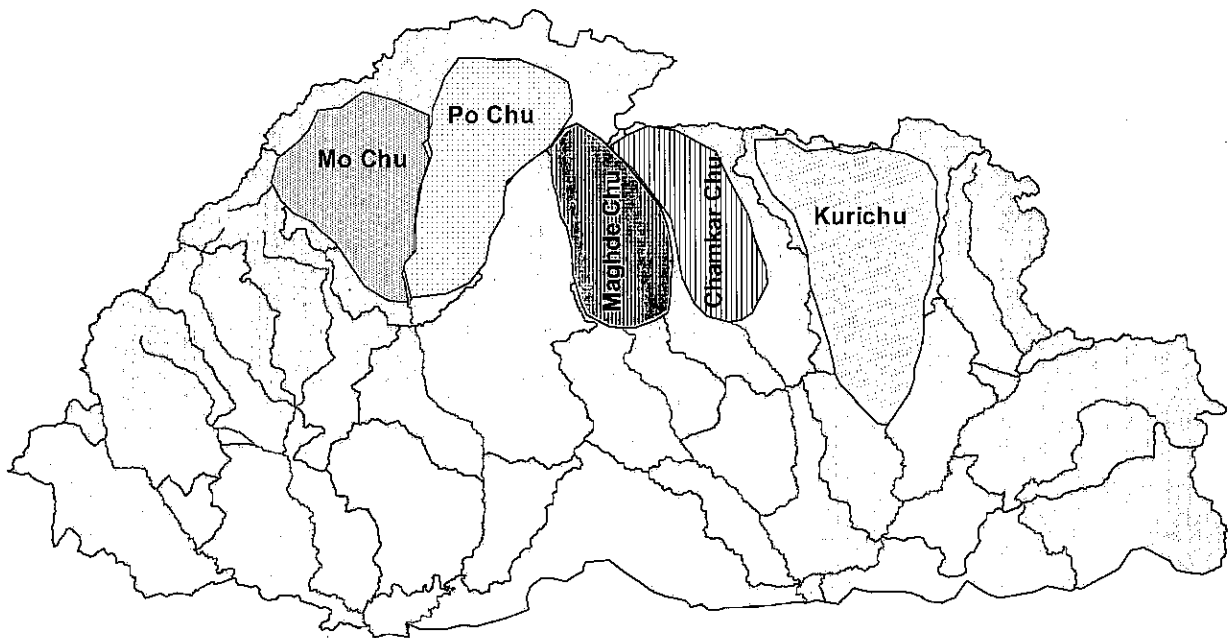
Sl. No.	Lake No.	Name of Lake	Latitude	Longitude	Altitude (masl)	Length(m)	Area(m2)
21	Cham_g1198		27°56'22.27	90°32'15.91	5046	1495	624669.81
22	Cham_g1232		27°59'11.33	90°30'31.42	5200	565	205146.23
23	Cham_g1383		28°01'25.91	90°42'31.77	4840	2645	1035131.5

## 5. Kuri chu sub-basin

Sl. No.	Lake No.	Name of Lake	Latitude	Longitude	Altitude (masl)	Length (m)	Area(m2)
24	Kuri_g1172		27°55'47.56	91°18'08.77		850	161706.43



**Fig. 1 Map indicating potentially dangerous lakes (DGM)**



**Fig. 2 Map of Bhutan with indication of the Five Major GLOF areas (UNDP-Thimphu)**



**Fig.3 Glacial Lakes (DGM)**

**Raphsteng Lake and glacier tongue of Thorthormi glacier - Bhutan**



**1994 December 25    1999 January 3**

**Fig. 4 Developments in Glacial Lakes (DGM)**





Fig. 5 Luggi Tsho glacial lake two weeks after the flood of 7 October 1994 (DGM)

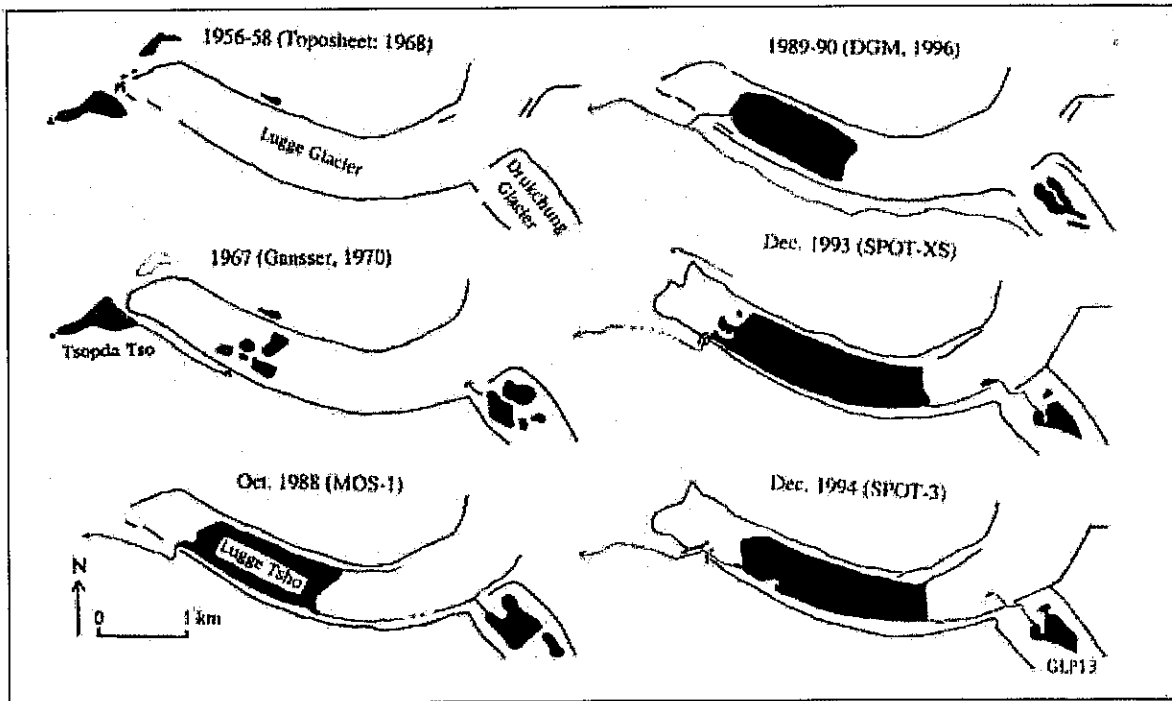
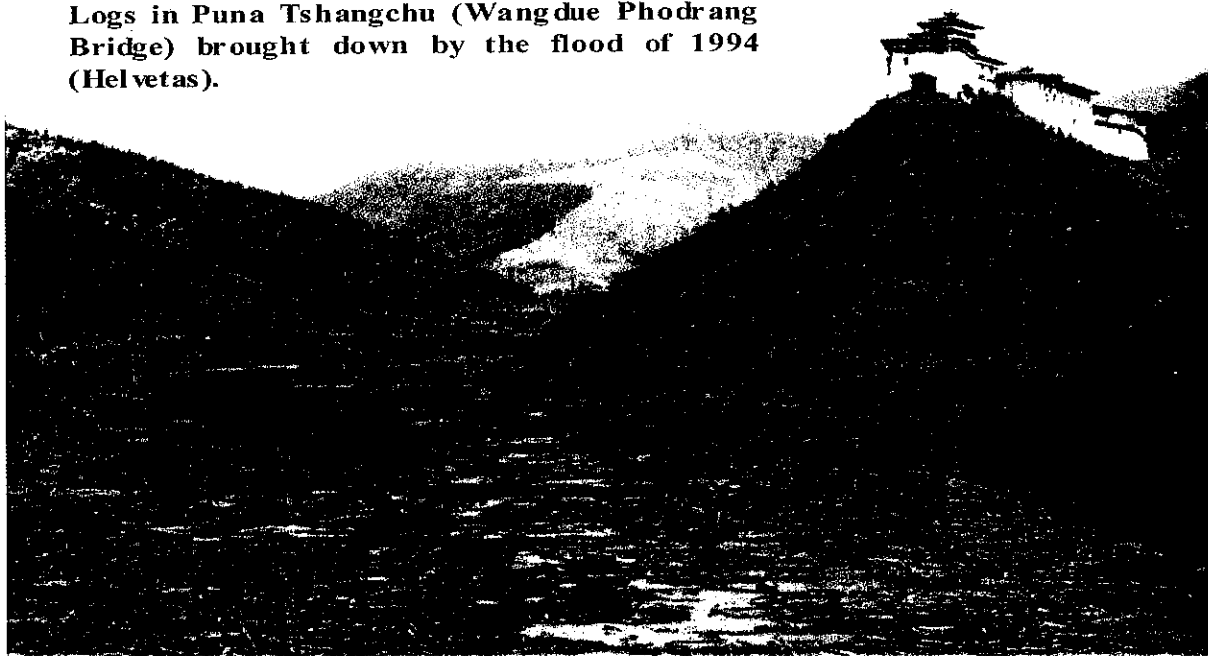


Fig. 6 Expansion of Luggi Tsho, Tsopda Tsho and Drukchung Tsho from 1956 to 1994 -Ageta et al., 1999. (DGM)



**Fig. 7 Luggi Tsho Lake which burst out in October 7, 1994**

**Logs in Puna Tshangchu (Wangdue Phodrang Bridge) brought down by the flood of 1994 (Helvetas).**



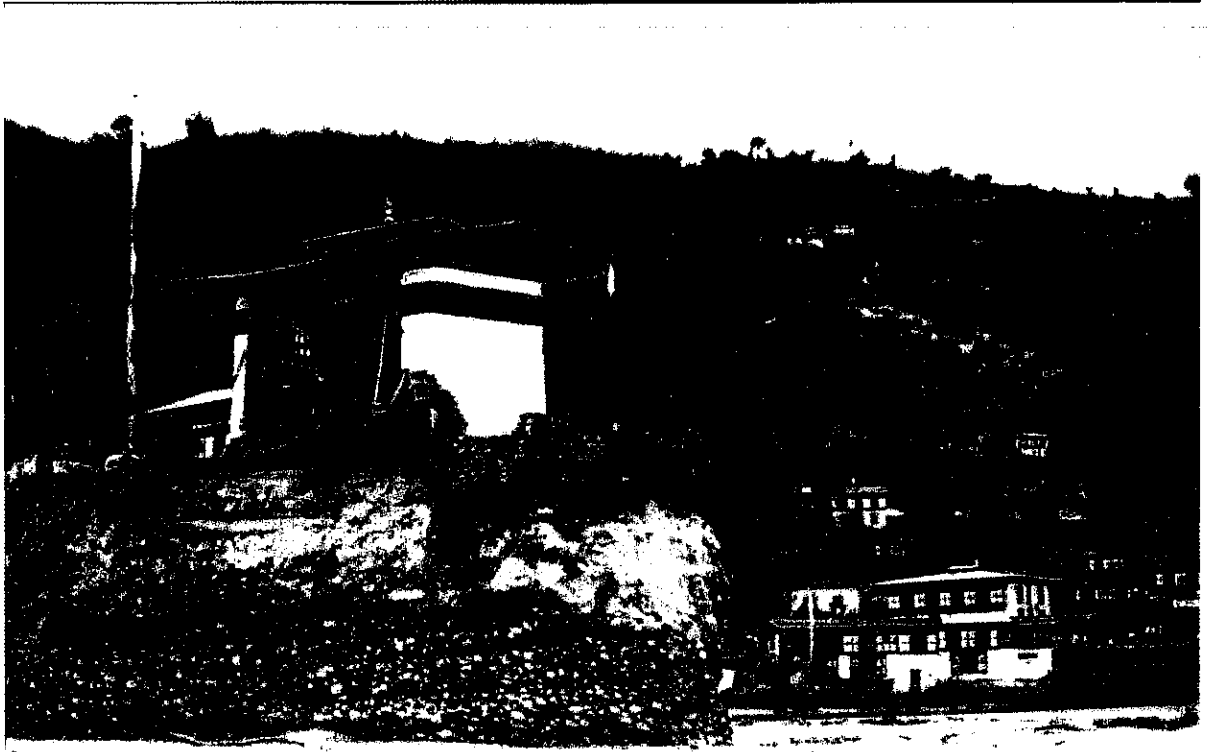
**Fig. 8 Effect of Luggi GLOF down stream**



**Fig. 9** Punakha Dzong after after 3 days of 1994 GLOF from Luggi Tsho.



**Fig. 10** Debris deposition along the riverbed below Lhedi village

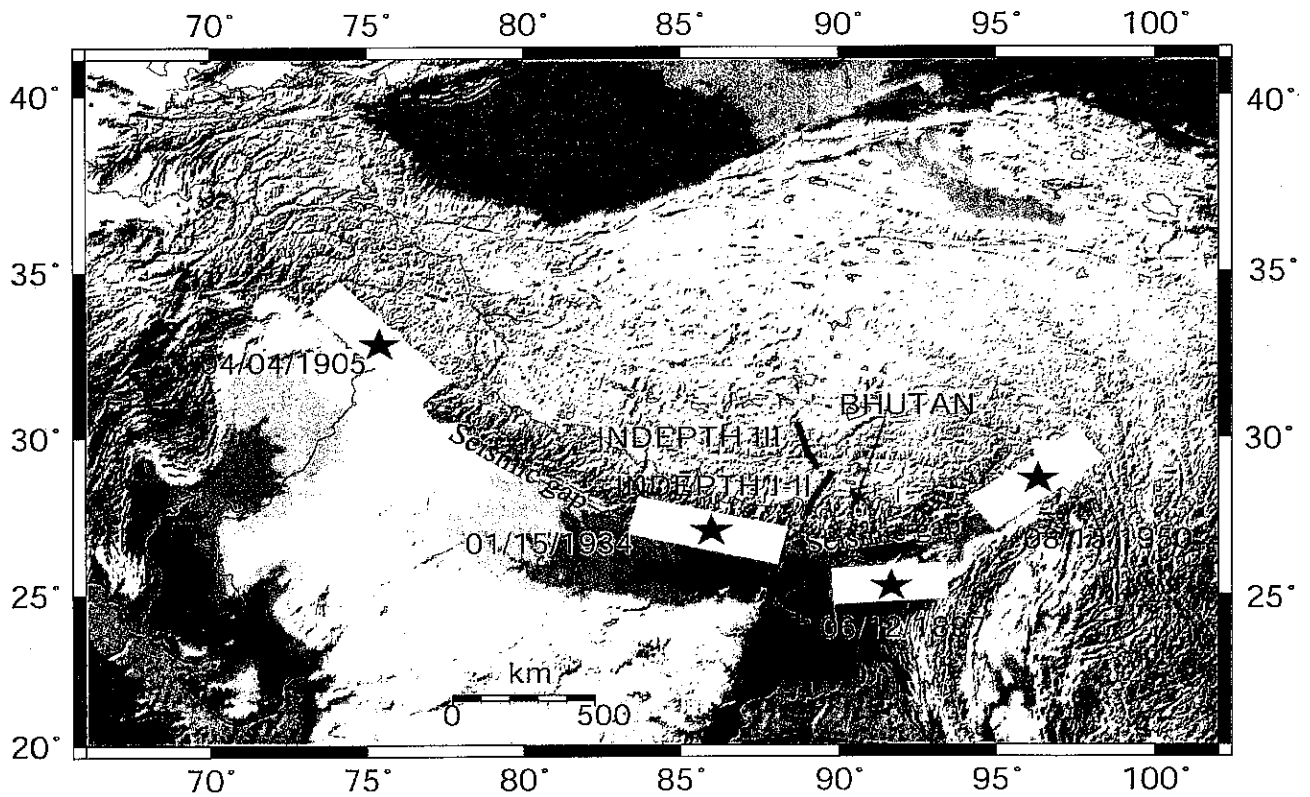


**Fig. 10** Impact of 1994 flood on one of the oldest temples in front of Punakha Dzong

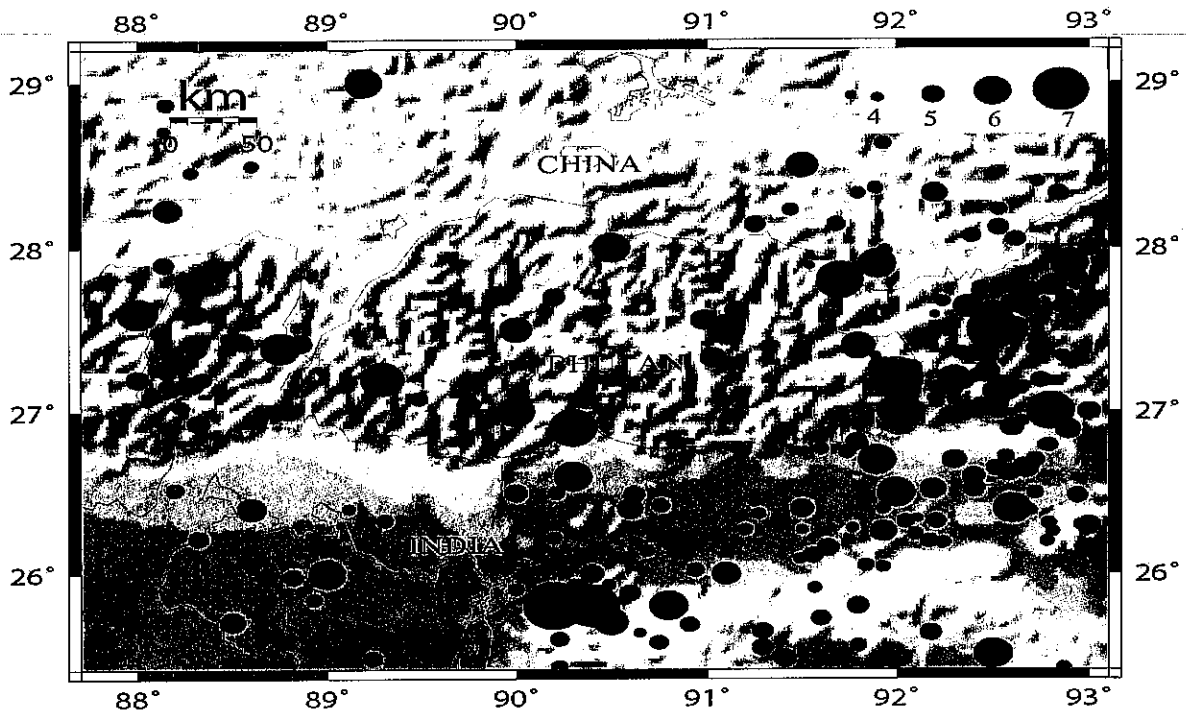
## Appendix II. Earthquakes in Bhutan

Year	Location of epicenter	Magnitude (Richter scale)	Damages in Bhutan
1897 (June 12)	80 Km south of Bhutan in Rangjoli ( Assam, India)	8.7	Catastrophic, destroyed Punakha & Lingzhi Dzong, damaged Wangdi, Trongsa, Jakar and Tashichhodzong
1906 (may 12)	Bhutan-China-India border	6.5	No information
1910 (August 13)	North of Punakha	5.7	No information
1934	Bihar, India/Nepal border	8.3	No information
1941(January 21)	West of Trashigang	6.75	No information
1947	Bhutan	7.9	No information
1980 (November)	Bhutan	5.5	No information
1988 (July)	Bhutan	6.6	No information
1988 (December)	Bhutan	4.9	No information
2003 (March 26)	Gunitsawa-Paro, Bhutan	5.5	Minor cracks in some of the buildings in Thimphu

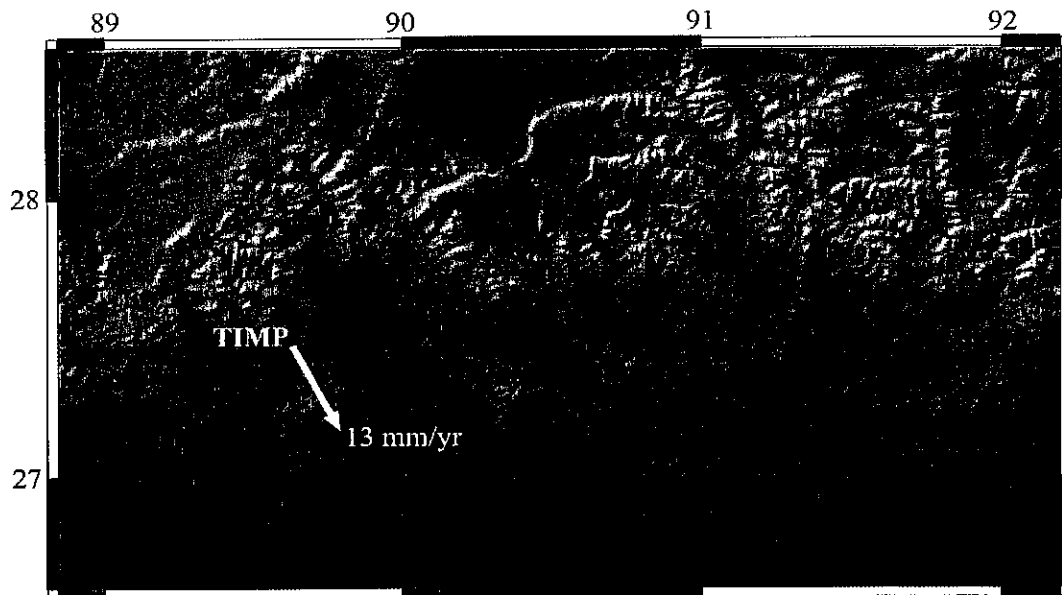
**Table 1. History of Earthquakes in Bhutan (Ministry of Works & Human Settlement)**



**Fig.1 The four great Himalayan earthquakes (indicated with red stars) and their estimated rupture areas. (DGM)**

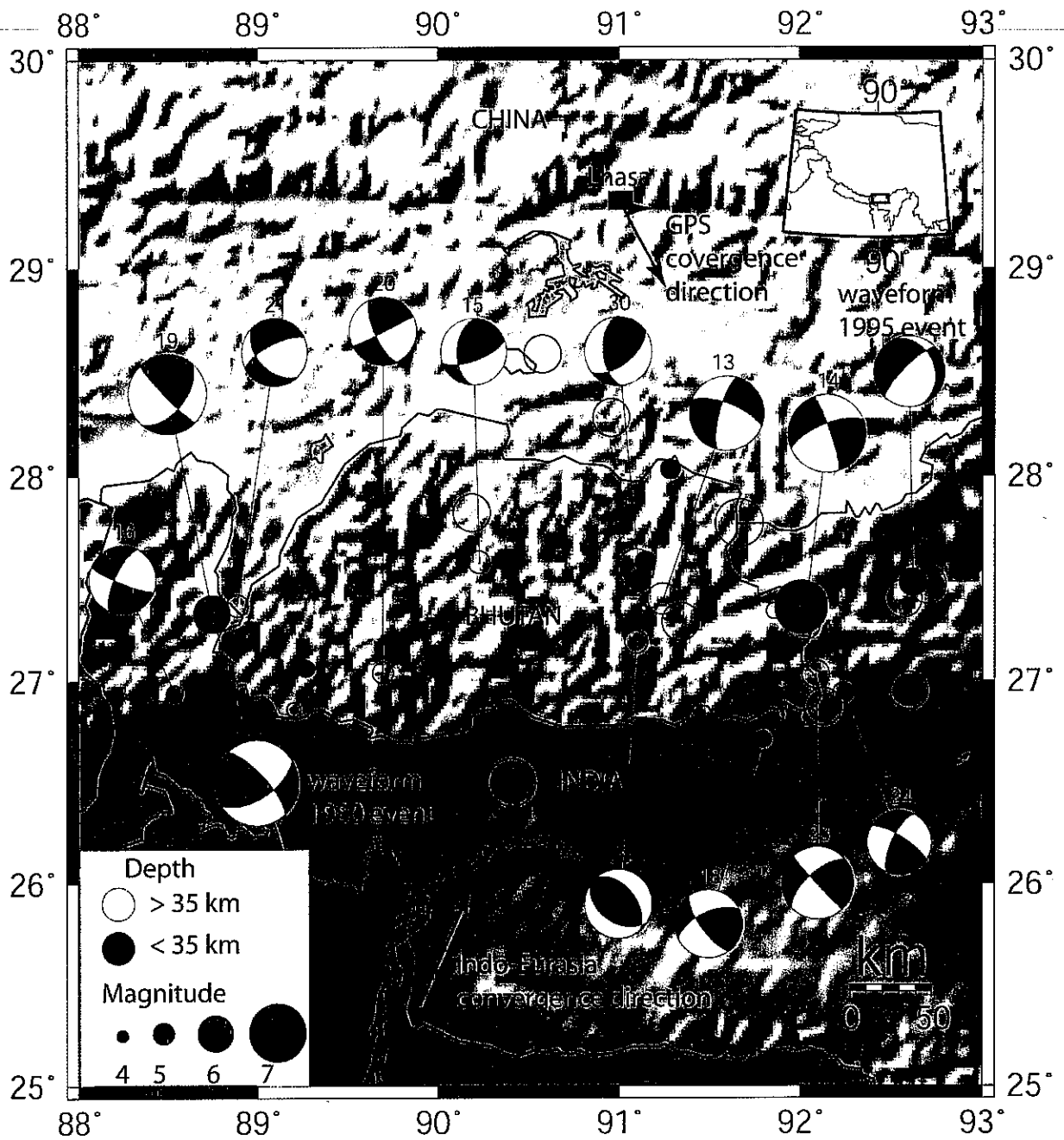


**Fig.2 NIEC earthquake epicenters (1923-2002) for the Bhutan region. Symbol size denotes the magnitude (DGM)**



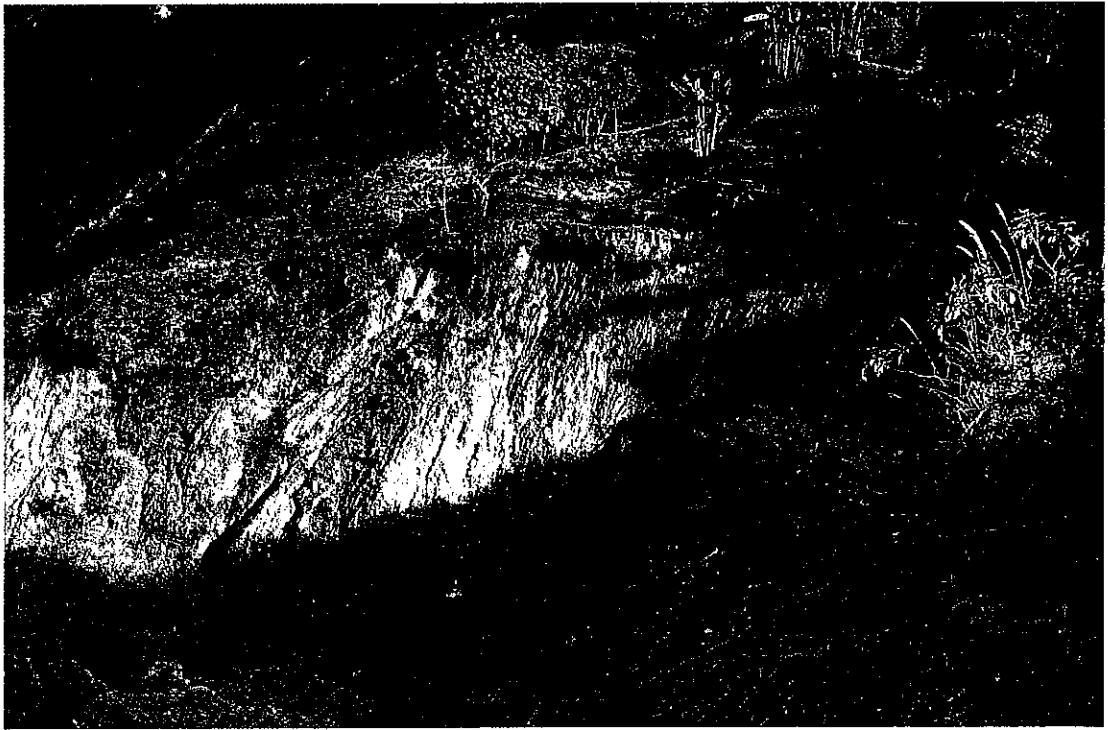
The horizontal velocity of station TIMP relative to Bangalore, recorded over 20 months at the Department of Geology and Mines in Thimphu.

**Fig. 3 Result of continuously-running station in Thimphu (DGM)**



**Fig. 4 Focal mechanism determined from first motion polarities and way form modeling and their relocated epicenters**

Appendix III. Landslides

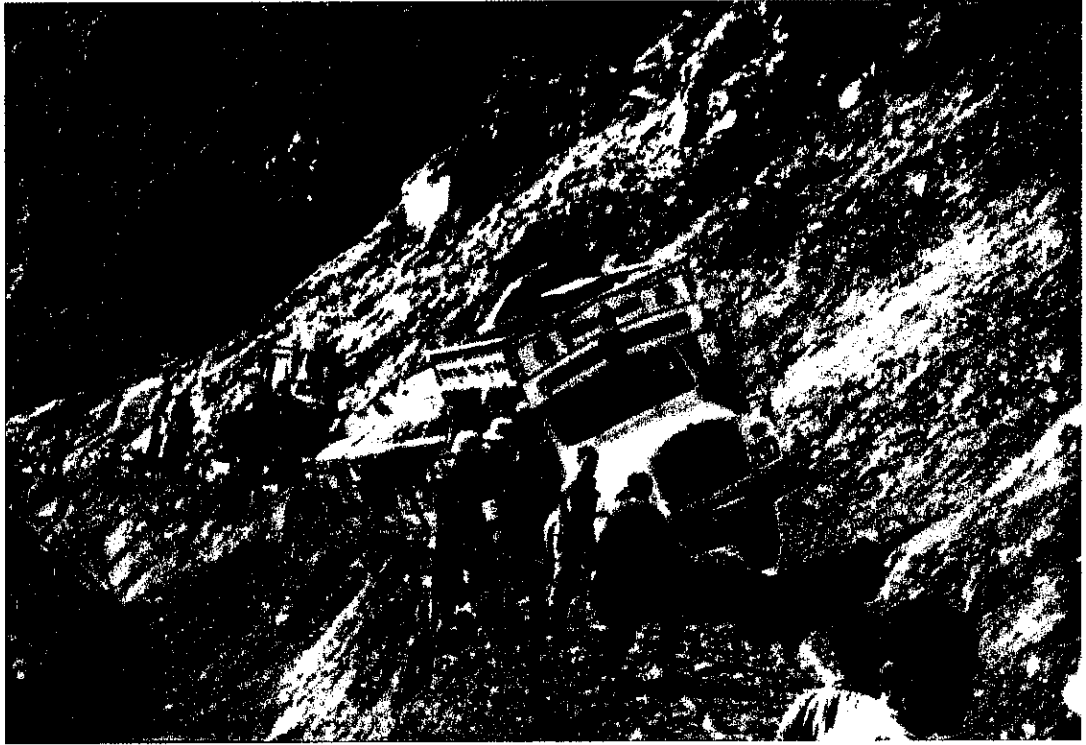


**Fig. 1** Landslide a common problem in Bhuan (Pema Dorji)



**Fig. 2** Formation of Tsatichu landslide dam above Kurichu due to landslide. This landslide blocked one of the tributaries.

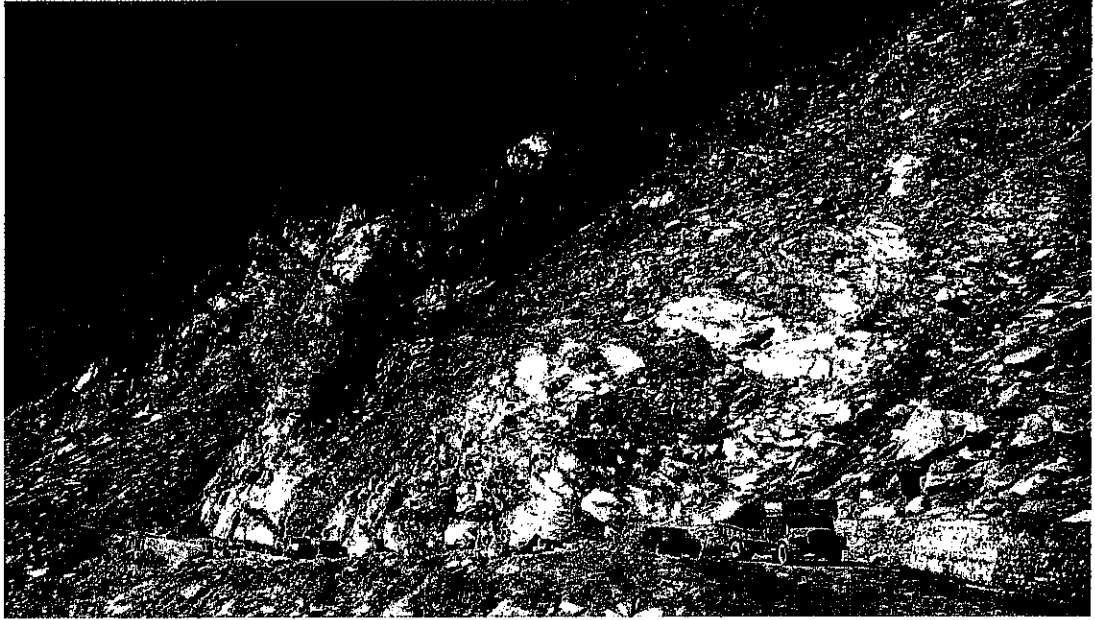




**Fig. 3** landslides due to torrential monsoon rain blocking the highway between Bumthang and Mongar



**Fig. 4** Landslides in Rotpashong, Lhuntse



**Fig. 5 Jumja Landslide where you see caution sign like ‘beware of shooting boulders’.**



**Fig. 6 Sorchen landslide in phuentsholing- Thimphu highway.**



**Fig. 7 EFRC method of road construction in Yadi-Sershong road (Pema Dorji)**



**Fig.8 Road constructed with EFRC techniques to avoid landslides (Pema Dorji)**

**Appendix IV. Floods and flashflood.**



**Fig. 1 Lungtenzampa town in Trashigang after the 2004 monsoon Flood (Kuensel)**



**Fig. 2 Increase in flow volume during 2004 monsoon created another river course in Autso, Lhuntshe. (Pema Dorji)**



**Fig. 3** Portion of the road washed away in Lungtenzampa, Trashigang (DoR)



**Fig. 4** Flashflood in Tshangkha, Trongsa (DoR)



**Fig. 5 Debris deposit on Trashigang –Mongar Highway due to flashflood (DoR)**



**Fig. 6 Flashflood damaging permanent civil structures in the East (DoR)**

Appendix V. Forest fire



Fig. 1 Forest fire above Trashigang Town (Kuensel)

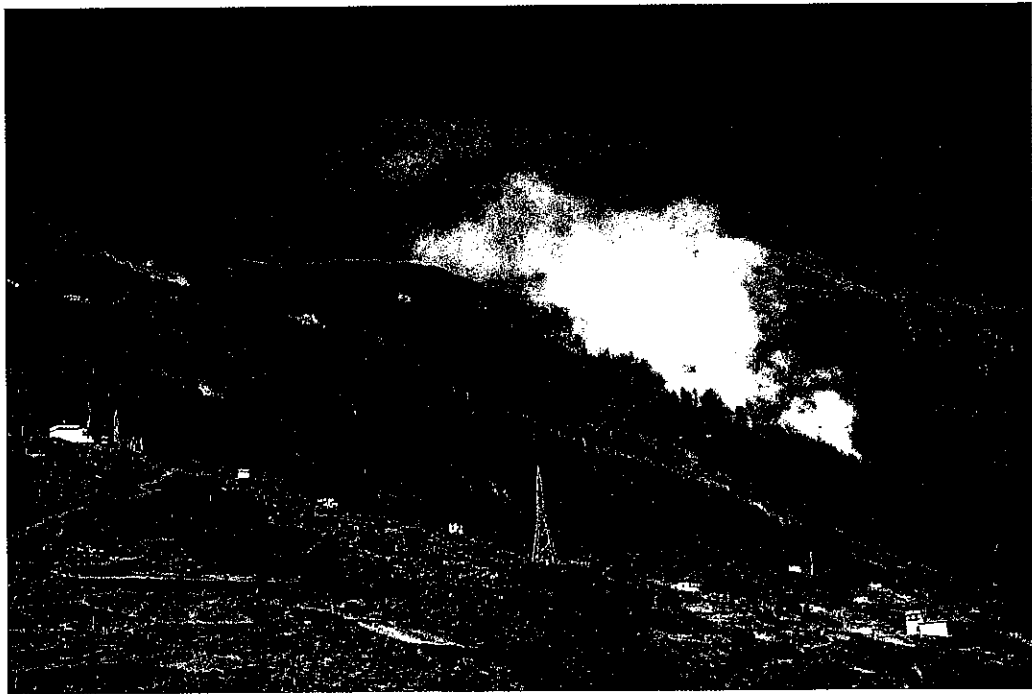


Fig. 2 Forest fire in Chapcha (kuensel)

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