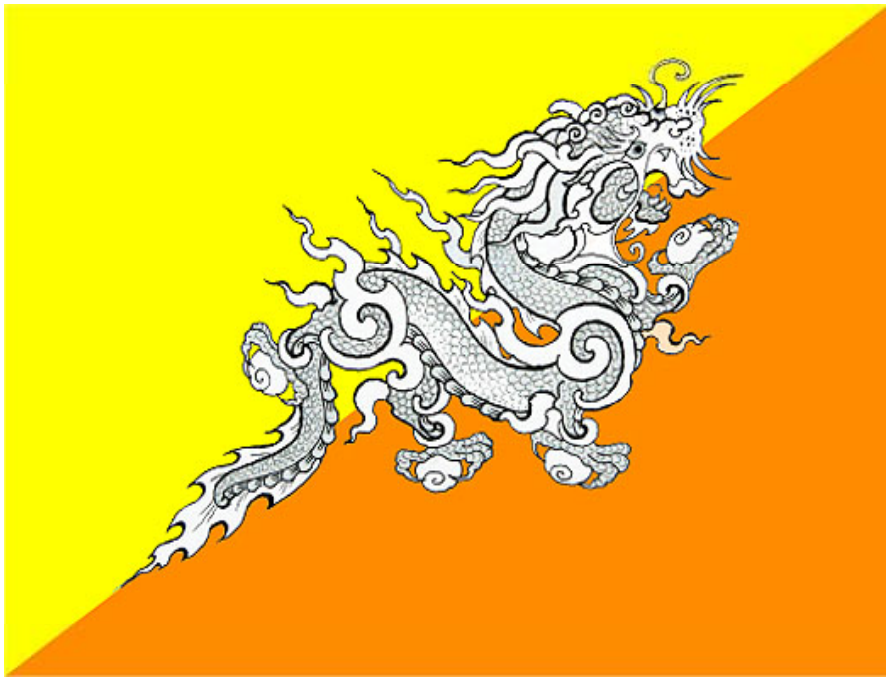
# NATIONAL LAND COMMISSION BHUTAN

## “ Reducing Disaster Risks for a safe and Happy Bhutan”



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**National Land Commission, BHUTAN**

# Presentation Outline

- Introduction
- Hazards in Bhutan
- Adaptation Measures
- Major functions of Disaster Management Department.
- Challenges
- Conclusions

# Introduction

**Bhutan** is a tiny Himalayan Kingdom with population of over 700,000 approximately. It covers about 340 km of the entire Himalaya.

**Geographic Location**

- It is situated in the eastern Himalayas between latitudes 26º40’ to 28º20’ N and longitudes 88º45’ to 92º7’ E.
- Bordered by the Tibetan Plateau in the north and the Indian States of Sikkim in the west, West Bengal, and Assam in the south, and Arunachal Pradesh in the east

**Physical Features**

- Total land area = 38,394 sq. km.
- The rugged mountainous terrain has elevation ranging from 150 m to 8000 m above sea level.
- 20.5 % of the total land is 4000 meters above MSL and mostly covered by snow and ice throughout the year.
- 3.3 % of the total land is covered by the glaciers.


Tibetan Plateau
Nepal
Kathmandu
Bhutan
Kanpur
Bangladesh
Calcutta
Chittagong
Mandalay
Bay Of Bengal
Myanmar

## Economy

- Hydropower is the main economy in Bhutan
- The hydropower projects are Chukha, Kurichu, Basachu, Tala Hydroelectricity, Punatsangchu I and II, Mangdechu, Chamkharchu, Kholongchu, Kuri – Gongri and Amochu
- While some of the projects are already generating power, the others are under construction stage.
- Bhutan has a vision to generate 10,000MW by 2020.

## Climate

- Climate in Bhutan is dominated by a southwestern monsoon, which originates from the Bay of Bengal
- Climatically Bhutan is divided into three broad zones: tropical in the southern foothills, cool winters and hot summers in central valleys, and severe winters and cool summers in northern mountains
- Southern foothills are hot and humid during the summer months and quite cool in winter
- Inner hills are cold in winter and warm in summer with a pleasant spring and autumn with mild temperatures

- **Natural Resources**
- **Flora**
- 72% of the entire country is covered by forest with various species of plants including medicinal plants **.** And as per the constitution, Bhutan is required to maintain the 60 % forest covereage at all times.
- **Fauna**
- Over 165 species of animals including golden langur, takin, blue sheep, snow leopard, red panda, Himalayan black bear, wild pig, musk deer and rare black-necked cranes.

# Hazards in Bhutan

- **In Bhutan the area in the south is highly prone to Landslides and related natural hazards mainly due to weak geological formation and high rate of precipitation.**
- **The area in the north are subject to severe Glacial Lake Outburst Floods, especially due to climate change. The entire northern part of Bhutan is covered by ice and snow, resulting in glaciers that are the sources of the rivers that traverse from north to the south. There are 667 glaciers and 2674 glacial lakes in Bhutan alone.**
- **Although these glaciers are perennial sources of water they are also potential flood disasters. In total, 25 glacial lakes have been identified as potentially dangerous.**

# The current Hazards of Bhutan

- GLOF
- Flash floods
- Landslides
- Earthquakes
- Forest fires
- Epidemic out breaks

# Glacier Lake Outbursts Floods

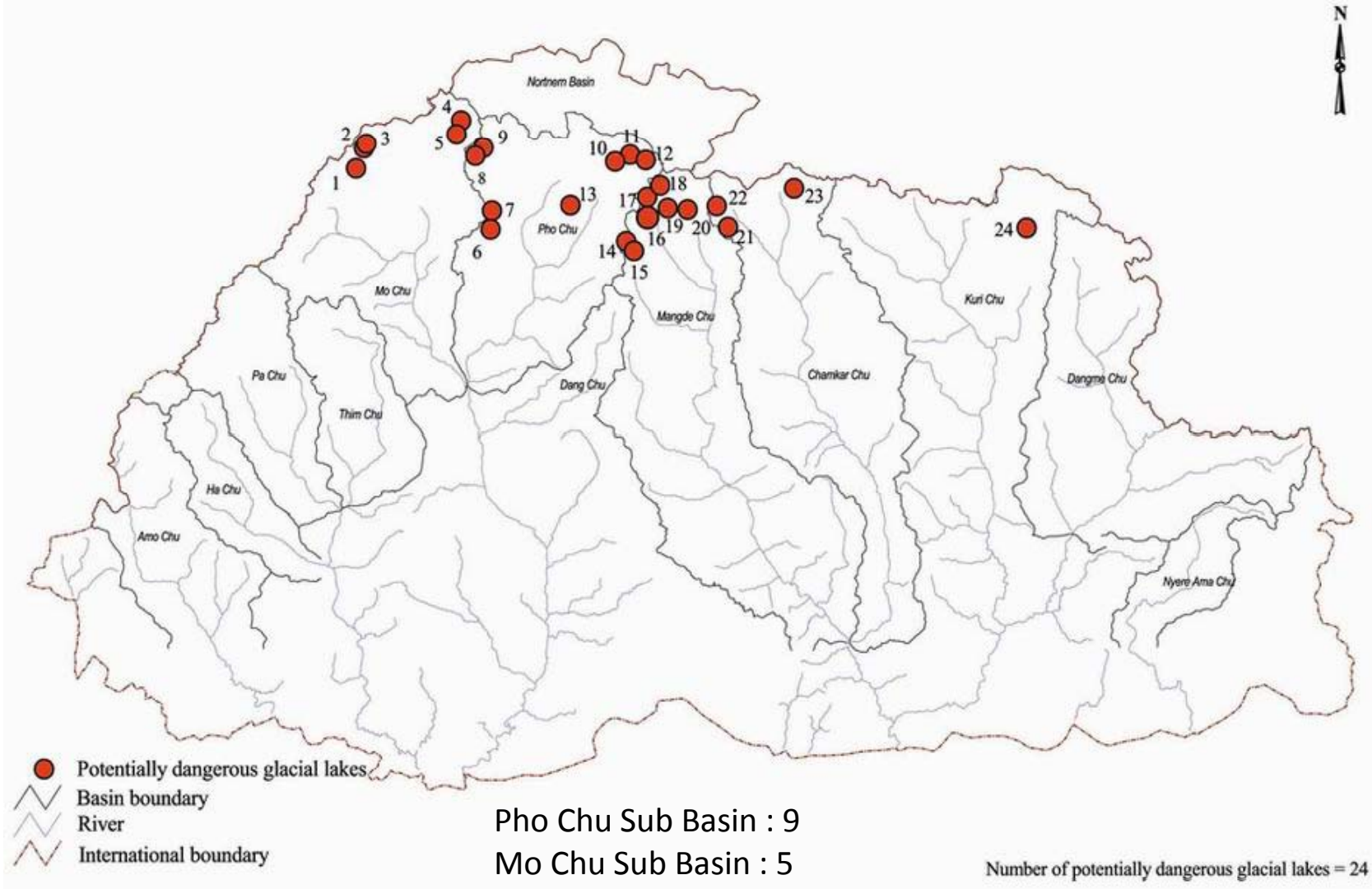
- Number of Glaciers = 667
- Number of Glacial Lakes = 2674
- Potentially Dangerous Glacial Lakes = 25
- Most rivers in Bhutan are Glacier- fed

**Causes:**

- Global Warming
- Avalanches (Rapidly sliding masses of snow)
- Earthquakes

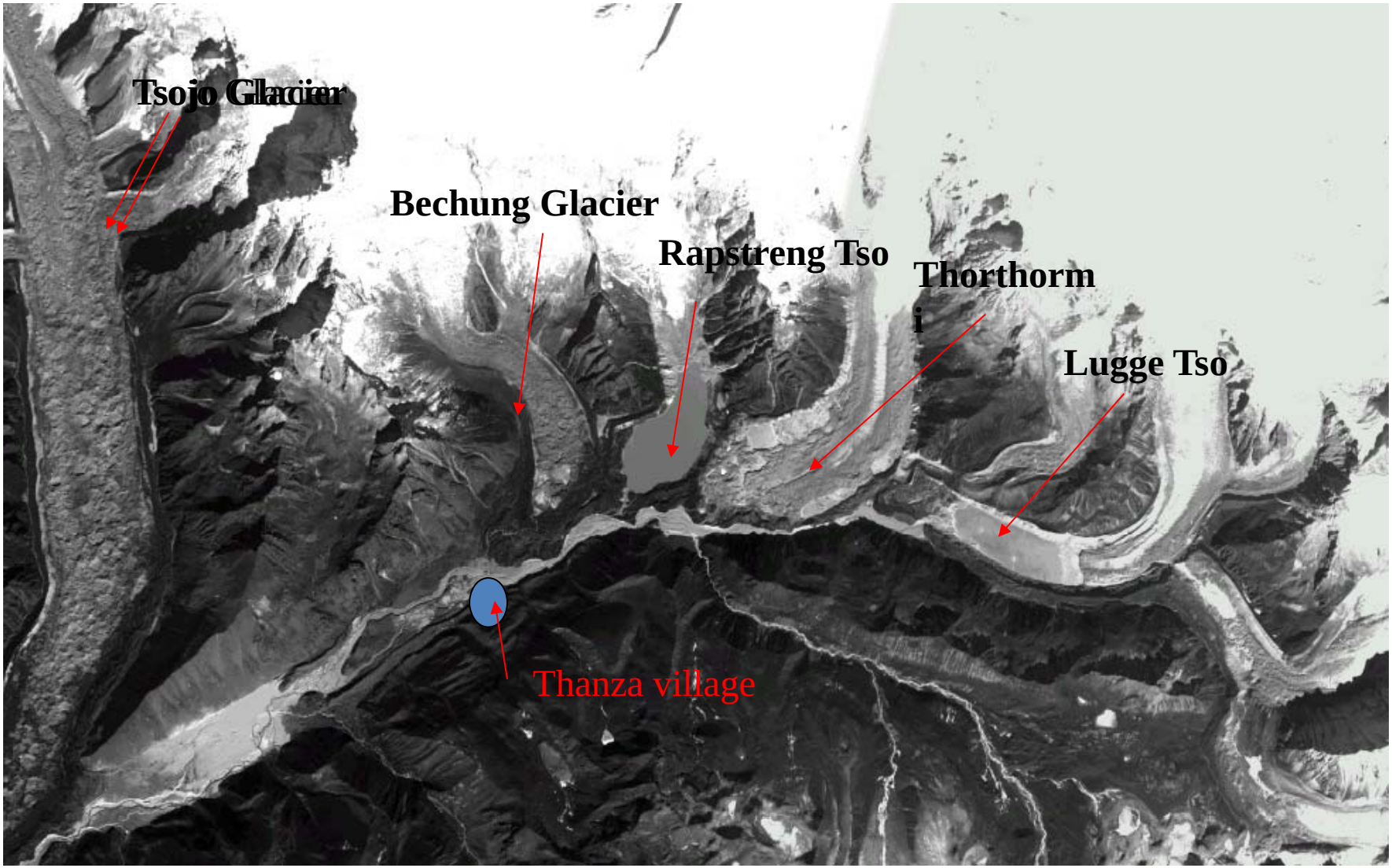
**Past Events: 1957, 1960, 1994**

# Potentially Dangerous Glacial Lakes of Bhutan



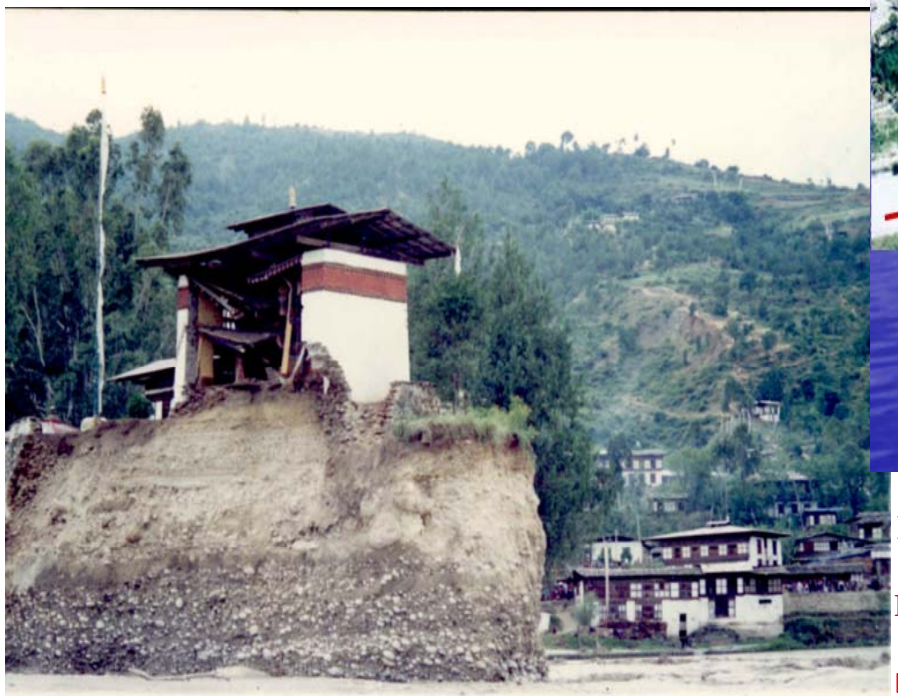

Pho Chu Sub Basin : 9
Mo Chu Sub Basin : 5
Chamkhar Chu Sub Basin: 3
Kuri Chu Sub Basin: 1
Mangde Chu Sub Basin: 7

# Current Scenario of Glaciers and Glacial Lakes in Lunana



# Present Situation of Glaciers and Glacial Lakes in East Lunana in 2008

**Luggye Tso which burst in October 7, 1994 and down stream Punakha Dzong, partially damaged**

➢Impact of 1994 flood on one of the oldest temples in front of Punakha Dzong. Loss of lives (21 people killed )– human, cattle

Damages to Properties – Dzong, bridges, houses, rice fields

# Flash Floods

- Recurrent in Bhutan
- Eastern and Southern districts most vulnerable.
- Past Events:

- 2000-Phuntsholing and Pasakha Floods
- 2004-Severe landslides in the east (9 Lives lost)

# Loss and Damage

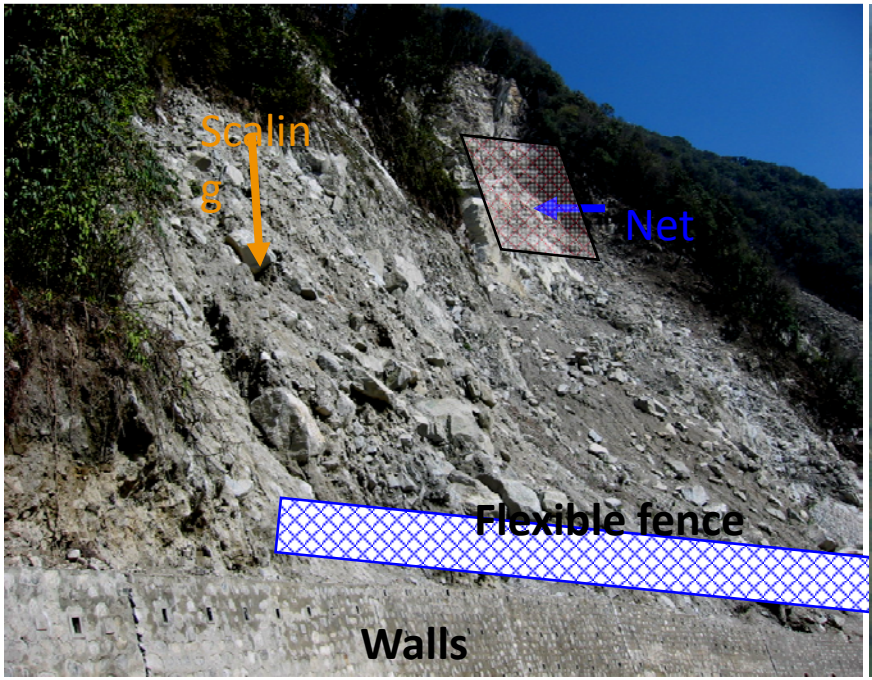
- 13 lives lost.
- Govt. Infrastructure: Nu. 544 Millions
- Farm and feeder roads: Nu. 47 millions
- Agriculture property: Nu. 7.5 million
- Bridges: Nu.56 millions
- Drinking water and irrigation: Nu. 45 million
- Livestock: Nu. 15 million
- Private properties: Nu. 7 million
- Total: Nu. **722 million**

# Landslides

- Eastern and southern Bhutan are very much prone to landslides while the area in the north is prone to glaciers and other natural hazards.
- Associated with very heavy rainfall, tend to worsen the effects of flooding that often accompanies these events.
- In areas burnt by forest lesser amount of precipitation may initiate landslides.
- Other triggers: Earthquake, Poor land management.


Bird’s Eye View of Jumjha Slide


Close up view of Jumjha Slide


Scalin
g
Net
Flexible fence
Walls

# Fires on forest and Human settlement.

- **Forest fires**

-Annual event in Bhutan

-99.9 % man-made

- **Fires on human settlement**

-Unsafe habits- Electrical wirings, temporary housing.

-Use of wood

-Numerous isolated events.(picnics)

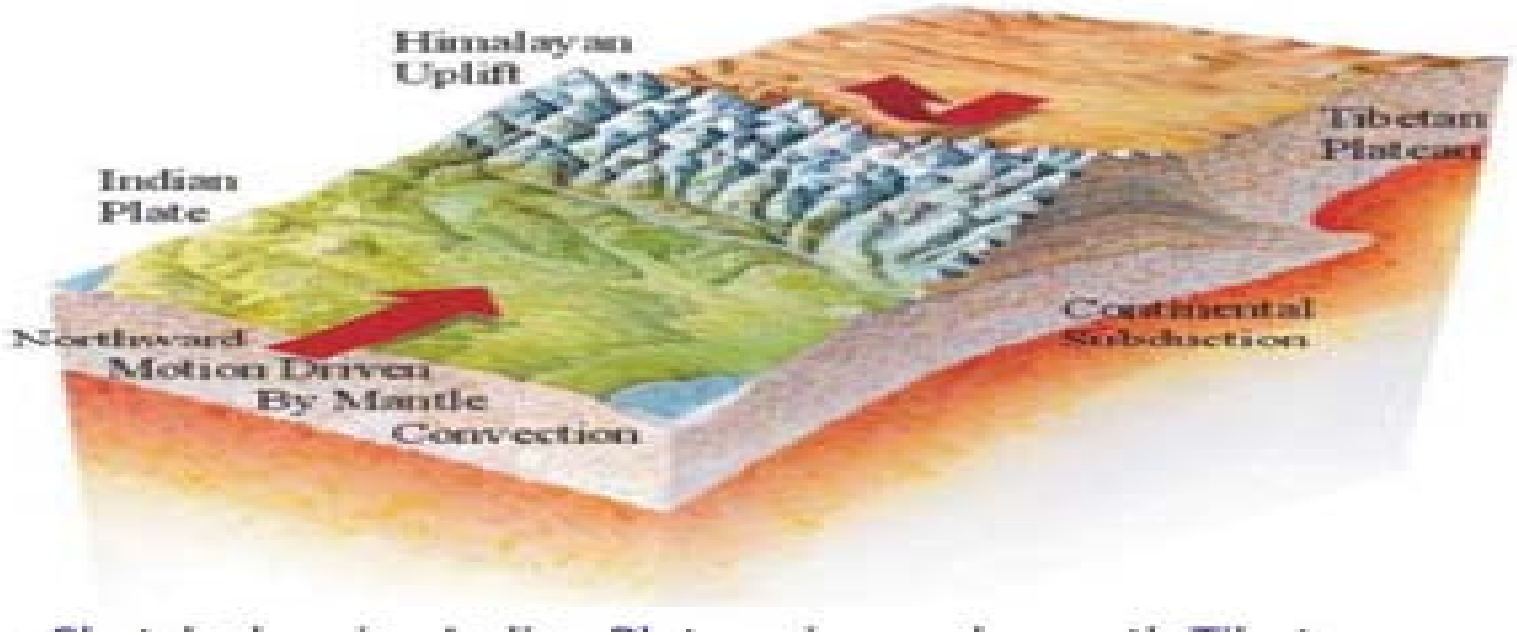
**Response:**

-Armed force

-Volunteer base

# Earthquake in the Himalaya

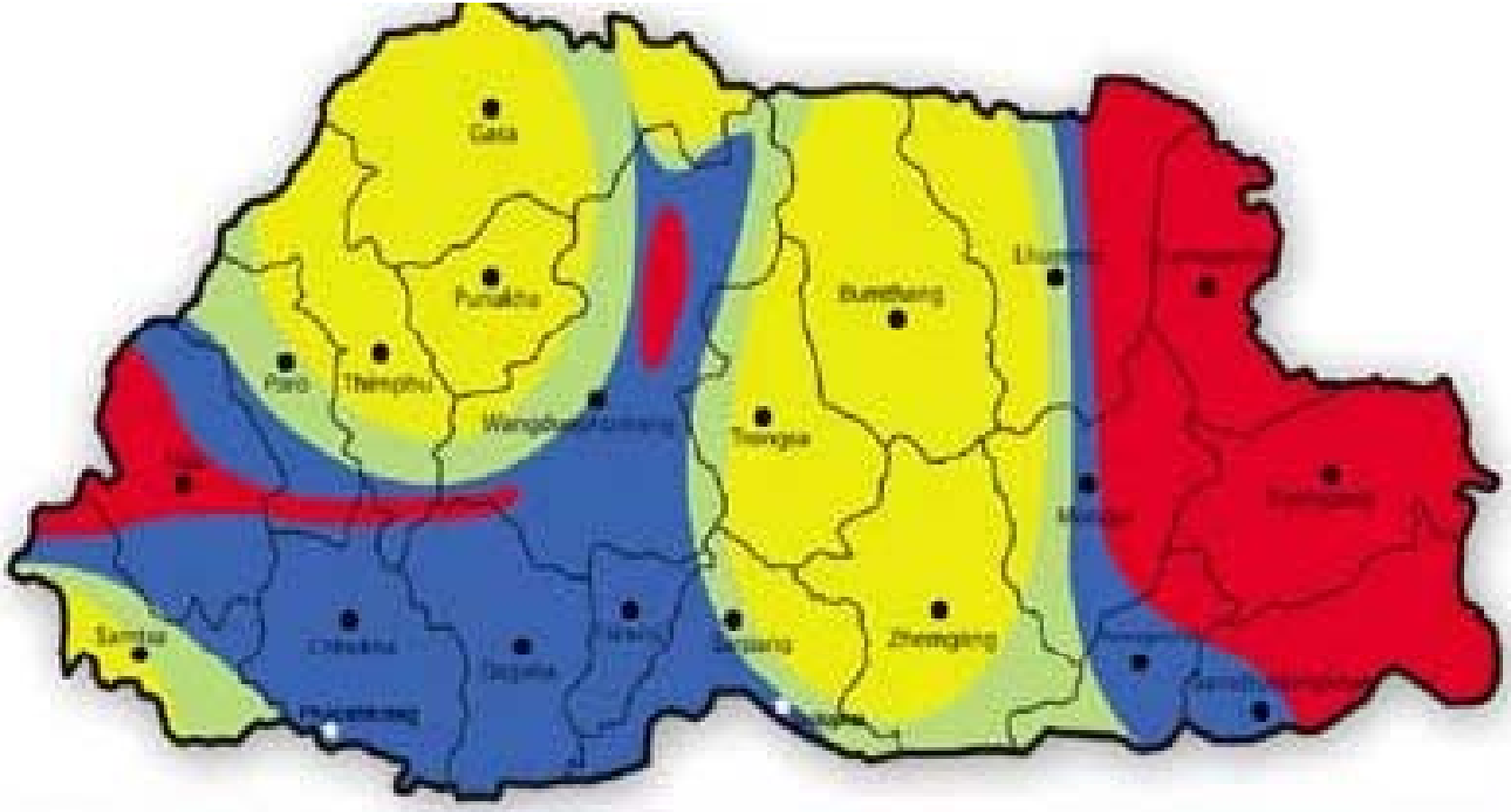
- Bhutan is located well within the Himalayan Mountain Chains
- Because of Plate movements, Himalaya still rising in height




**Sketch showing Indian Plate going underneath Tibetan Plate causing growth of Himalayas & earthquakes .**

## **Earthquake History**:

- 4 exceeding 8 on Ritcher scale (1897,1905,1934,1950)
- 10 exceeding 7.5(Himalayan belt in the last 100 years)
- 1980 (6.1, Sikkim)
- 1988 (6.6, Indo-Nepal border)
- 2003 (5.5, Bhutan)
- February 2006(5.8 and 5.5 in Bhutan)



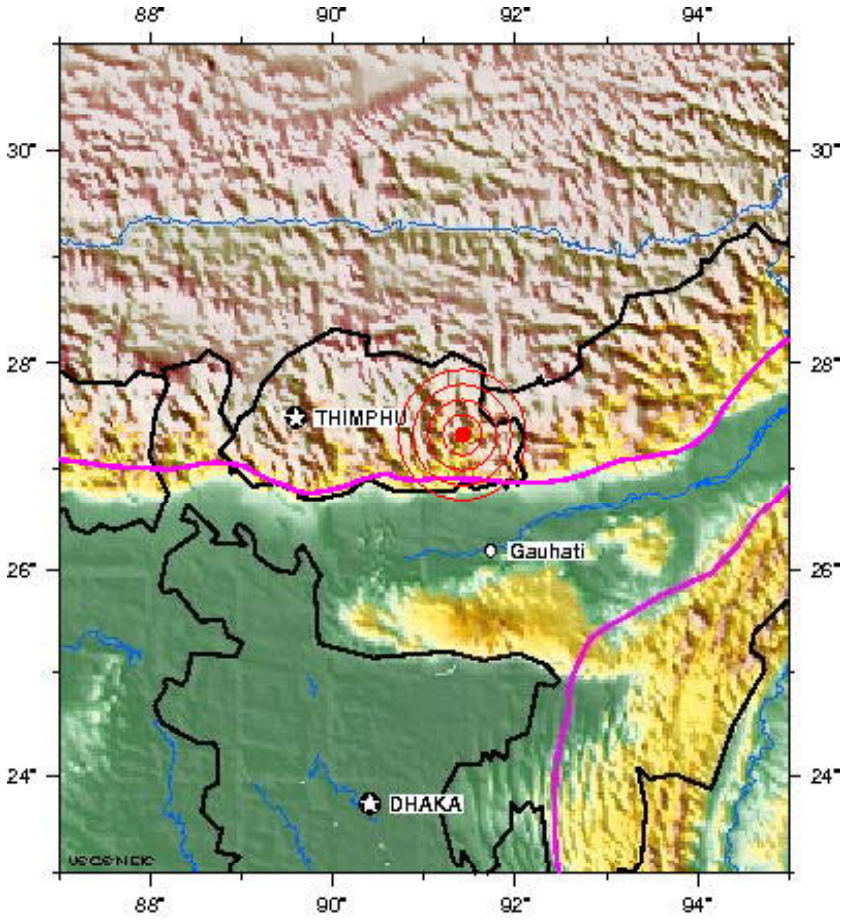

**Seismic Hazard map of Bhutan**

*Redrawn from March 2009 IIT Rourkee, handout of the map*

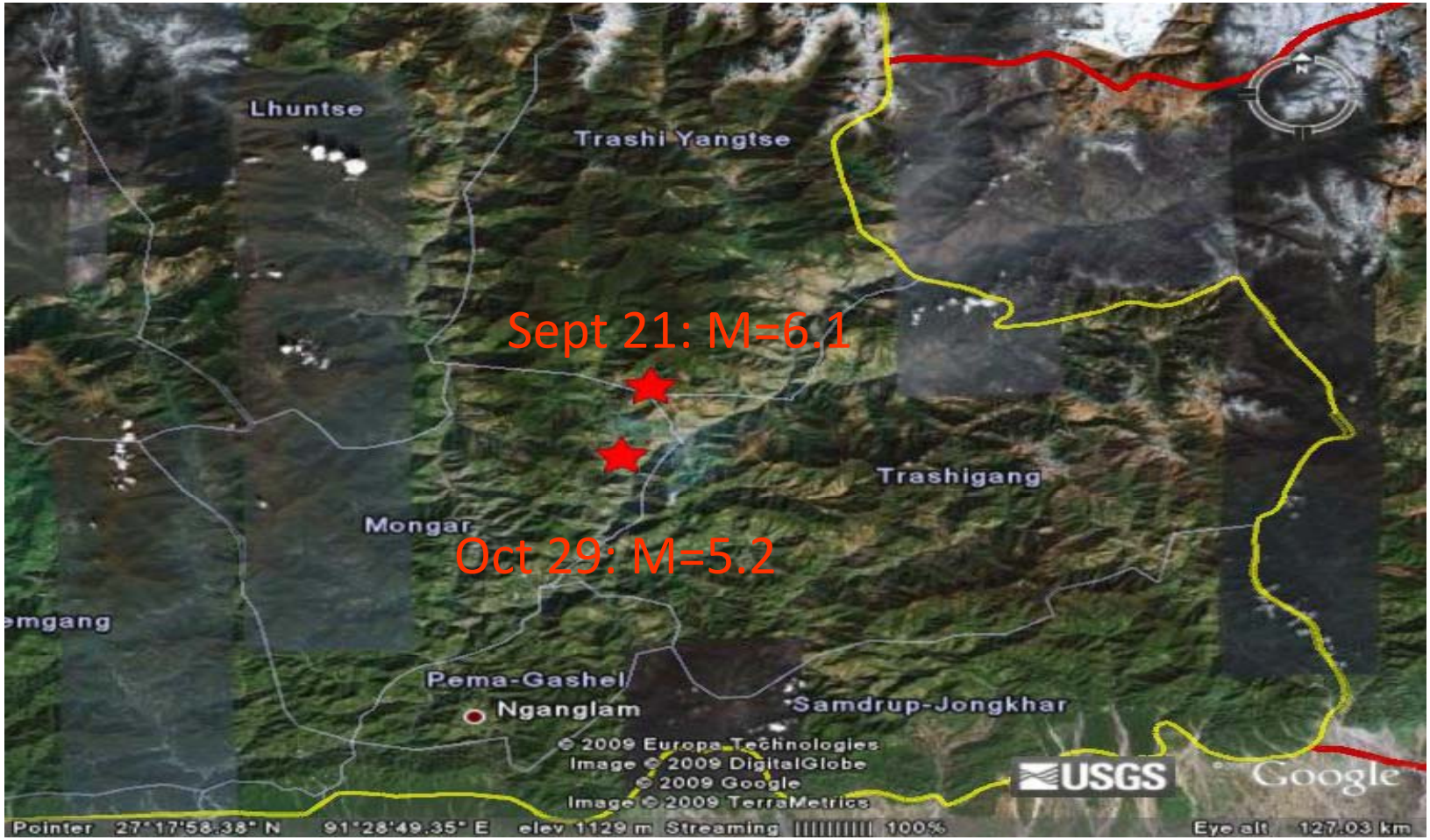
Source: DGM

# September 21, 2009 earthquake

- Magnitude 6.1 (2.53 PM local time)
- Epicenter - Narang Monger
- Duration: 95 Secs
- Depth: 10 Kms shallow
- Repeated after schocks
- Widespread geographical area- 13 districts

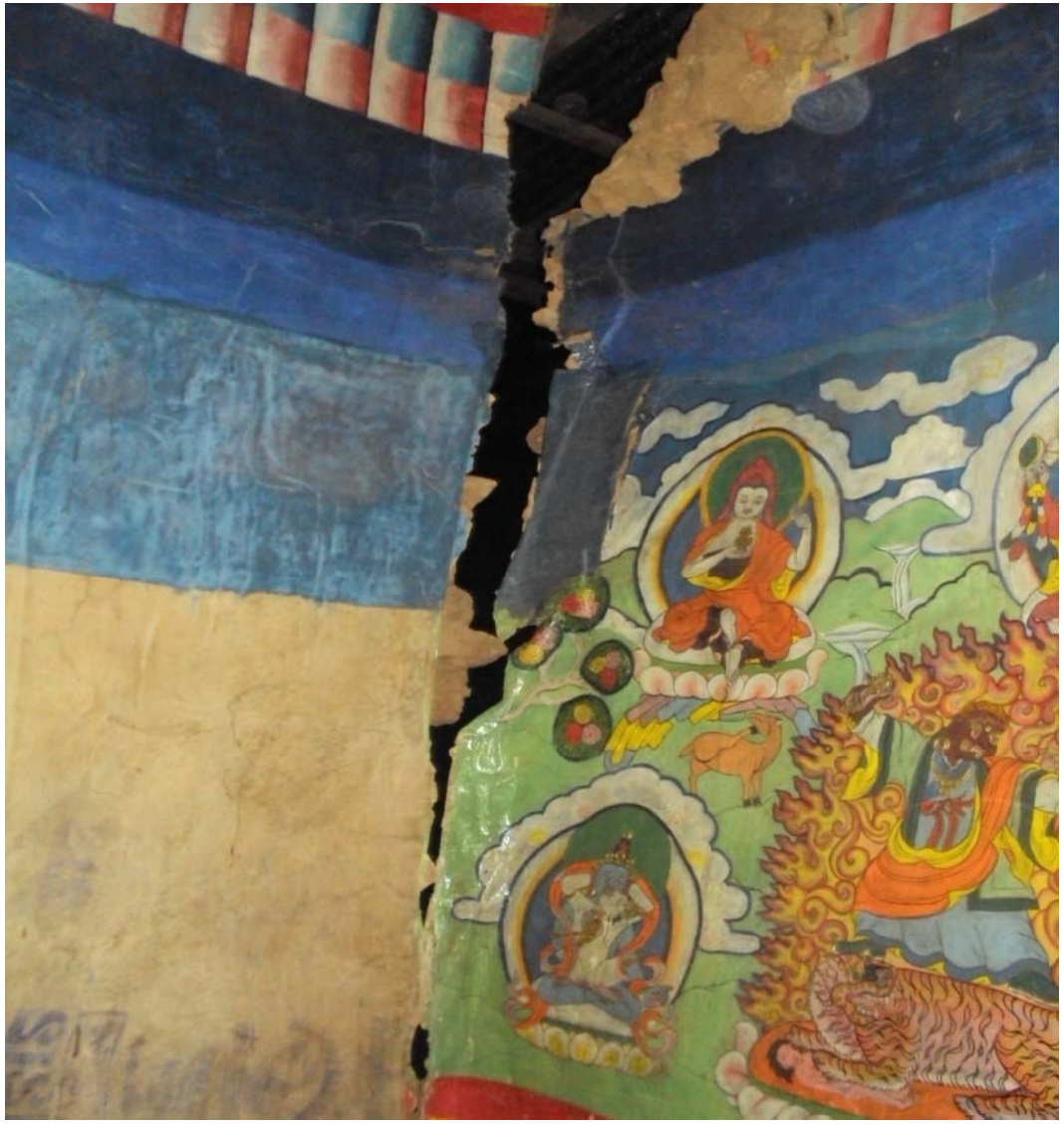


# Location of September (M6.1) and October (M5.2) 2009 earthquake



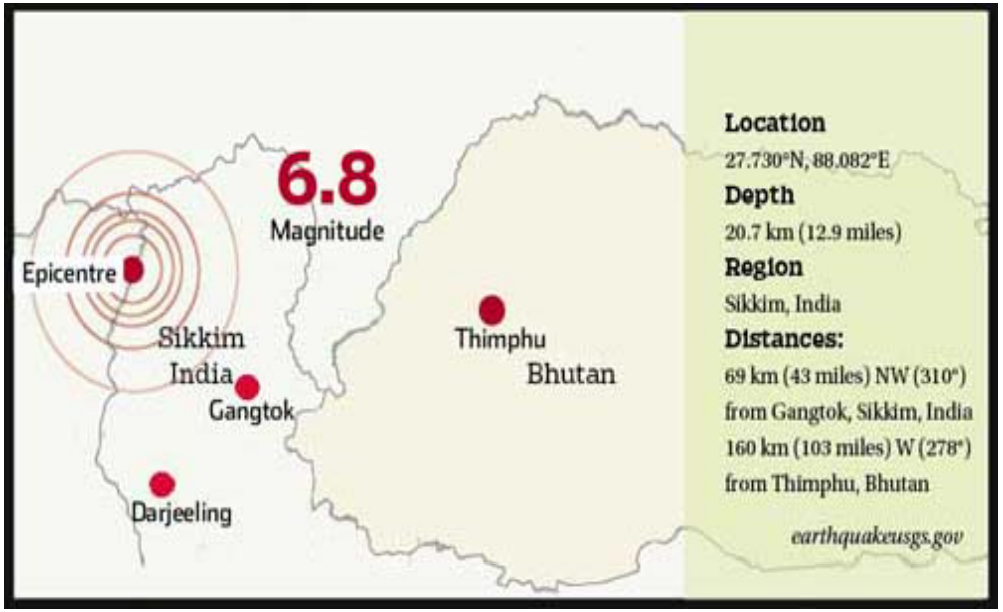
# Impacts of Sept 21, 2009 Earthquake

- 4950 households damaged.
- 422 beyond repair
- 884 major repair
- 1335 partial repair
- 2269 minro repair
- Cost estimate USD$ 23.3million.



- 281 heritage sites damaged.
- 539 stops
- 8 Dzongs
- Estmated coast of loss is USD$ 13.5million.
- 45 health centers
- 117 schools
- 55 government offices
- Estimated cost USD$15.8 million

**18 September, 2011 -** Earthquake




**A portion of the Paro Ta Dzong wall come apart**

- Magnitude
- 6.8
- Date-Time Sunday, September 18, 2011 at 12:40:48 UTC Sunday, September 18, 2011 at 06:10:48 PM at epicenter
- Location 27.730°N, 88.082°E
- Depth 20.7 km (12.9 miles)
- Region SIKKIM, INDIA
- Distances 69 km (43 miles) NW (310°) from Gangtok, Sikkim, India 120 km (74 miles) NNW (343°) from Shiliguri, West Bengal, India 133 km (83 miles) E (94°) from Namche Bazar, Nepal 166 km (103 miles) W (278°) from THIMPHU, Bhutan

**Families forced to camp outside**

- **Cracked/collapsed/damaged in 10 dzongkhags.**
  329 homes
- 7 dzongs
- 19 lhakangs
- 10 chortens
- 15 schools
- 5 BHU/Hospitals/ORC
- 7 RNR
- 8 gewog centre/ gup office
- 6 other infrastructure

# Other Hazards

- Wind storms /Thunder storms /Snow storms /Hail storms
- Epidemics, Pest and Diseases.

# Cyclone Aila

- Bhutan is also highly vulnerable to the weather pattern of its southern neighbors. When ever there is depression or cyclone in the Indian State of West Bengal and Bangladesh, there is heavy rainfall in Bhutan. Typical Example Cyclone Aila of May 2009).
- Bhutan was hit by *Cyclone Aila* from the Bay of Bengal on May 24,2009 which caused a record breaking average rainfall of *76 mm* in the country from May 25, 9 AM to May 26, 9 AM

A Flood from Olarongchu River

Gasa Hot Springs, the country's most famous hot springs were completely washed away *(5 soaking ponds, VIP bathhouse, an outreach clinic, shops, public toilets, camping ground)*

# Adaptation Measures

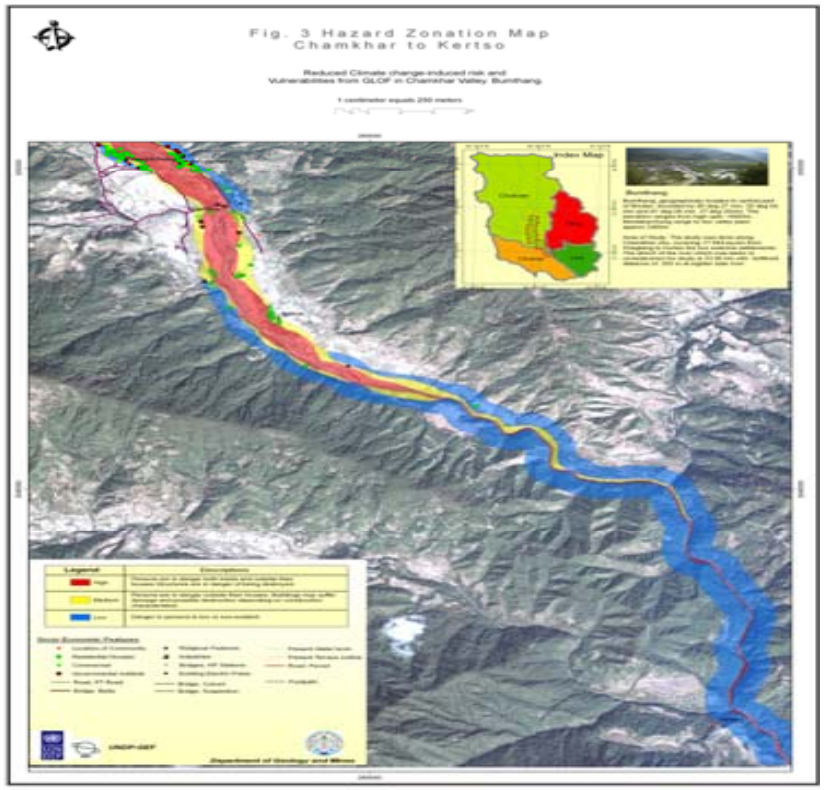
1. **GLOF hazard zonation and vulnerability assessment.**

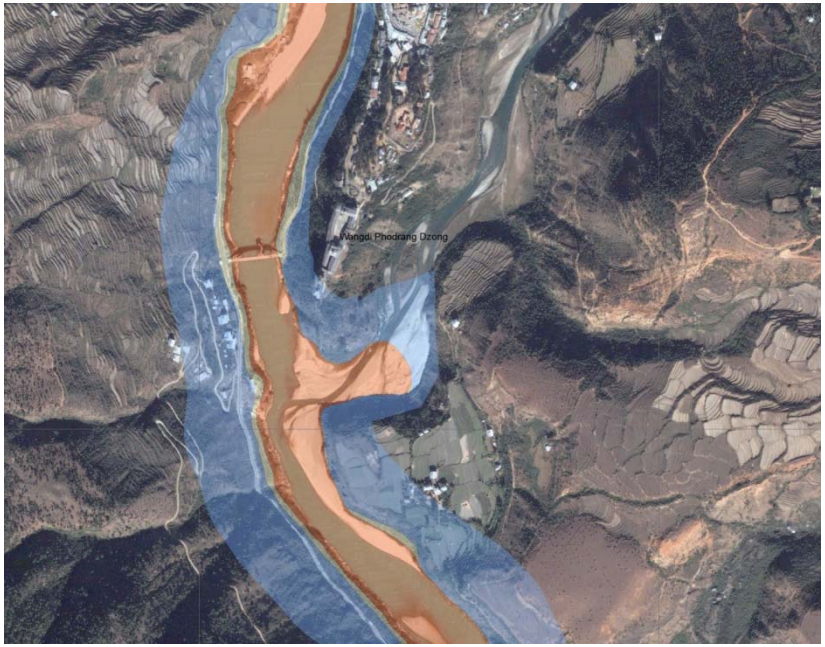
-To reduce risks on lives and properties downstream through proper planning

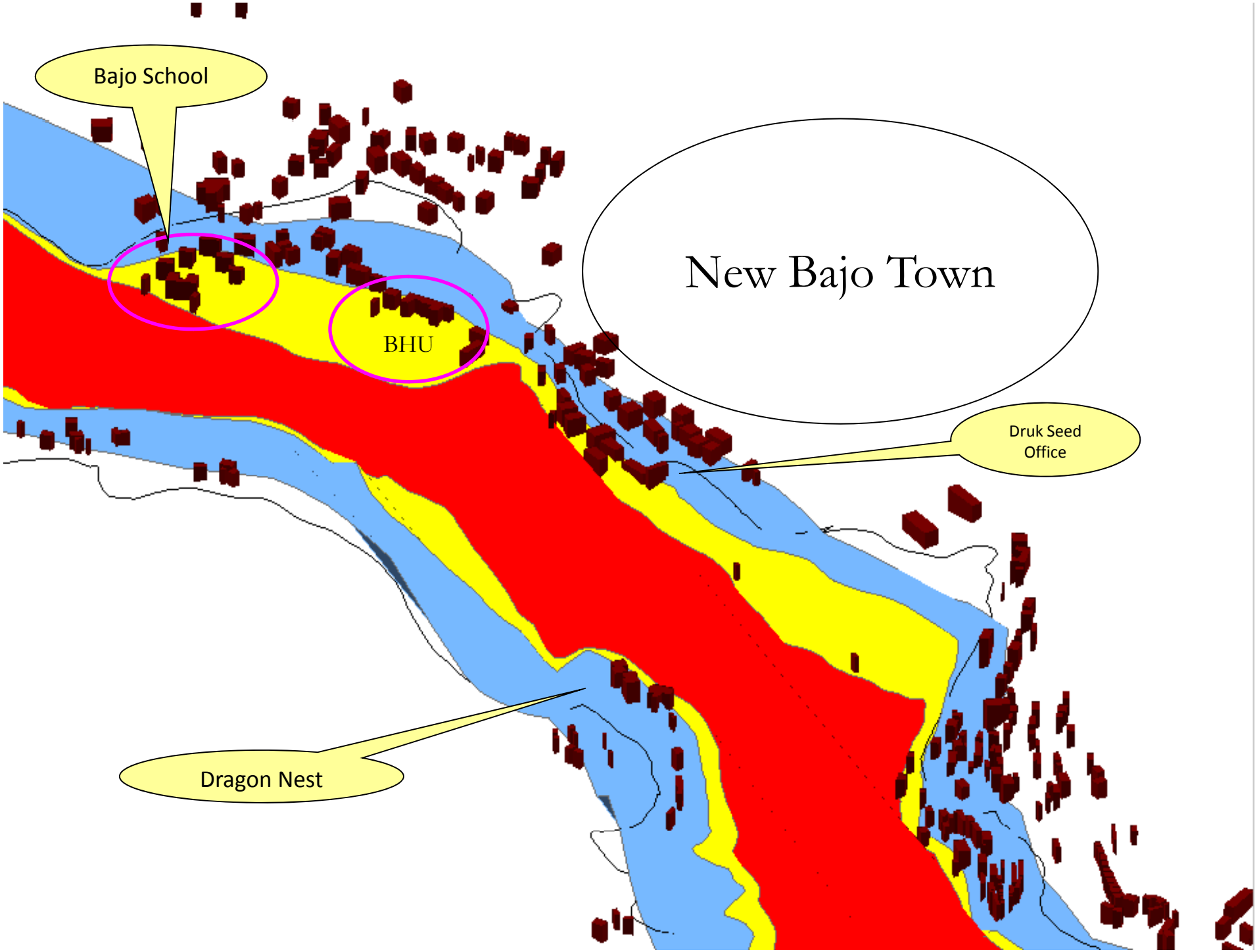
I. Lunana to Khuruthang: Austro-By DGM-Austrian Project in 2003

II. Khuruthang-Lhamoizingkha (Indo-Bhutan Border): DGM under Netherlands Climate Assistance Program (NCAP, 2007)

III. Chamkhar valley, Bumthang: DGM in 2007 funded by the Global Environment Facility (GEF).




Bajo School
BHU
New Bajo Town
Druk Seed Office
Dragon Nest

# Hazard Level

| Hazard Level | Descriptions |
|---|---|
| High | Persons are in danger both inside and outside their houses. Structures are in danger of being destroyed. |
| Medium | Persons are in danger outside their houses. Buildings may suffer damage and possible destruction depending on construction characteristics. |
| Low | Danger to persons is low or non-existent. Buildings may suffer little damages. |

## 2. Artificial Lowering of Lake water level/Mitigation of Lakes at the source

-**To reduce risks at source**

i. Raphstreng Tso (1996-1998): funded by the Government of India

ii. Thorthormi Lake (2008-2012): Planned under the DGM-UNDP/GEF Project with funding from LDCF and co-financers Government of Austria, UNDP, WWF Bhutan and RGoB

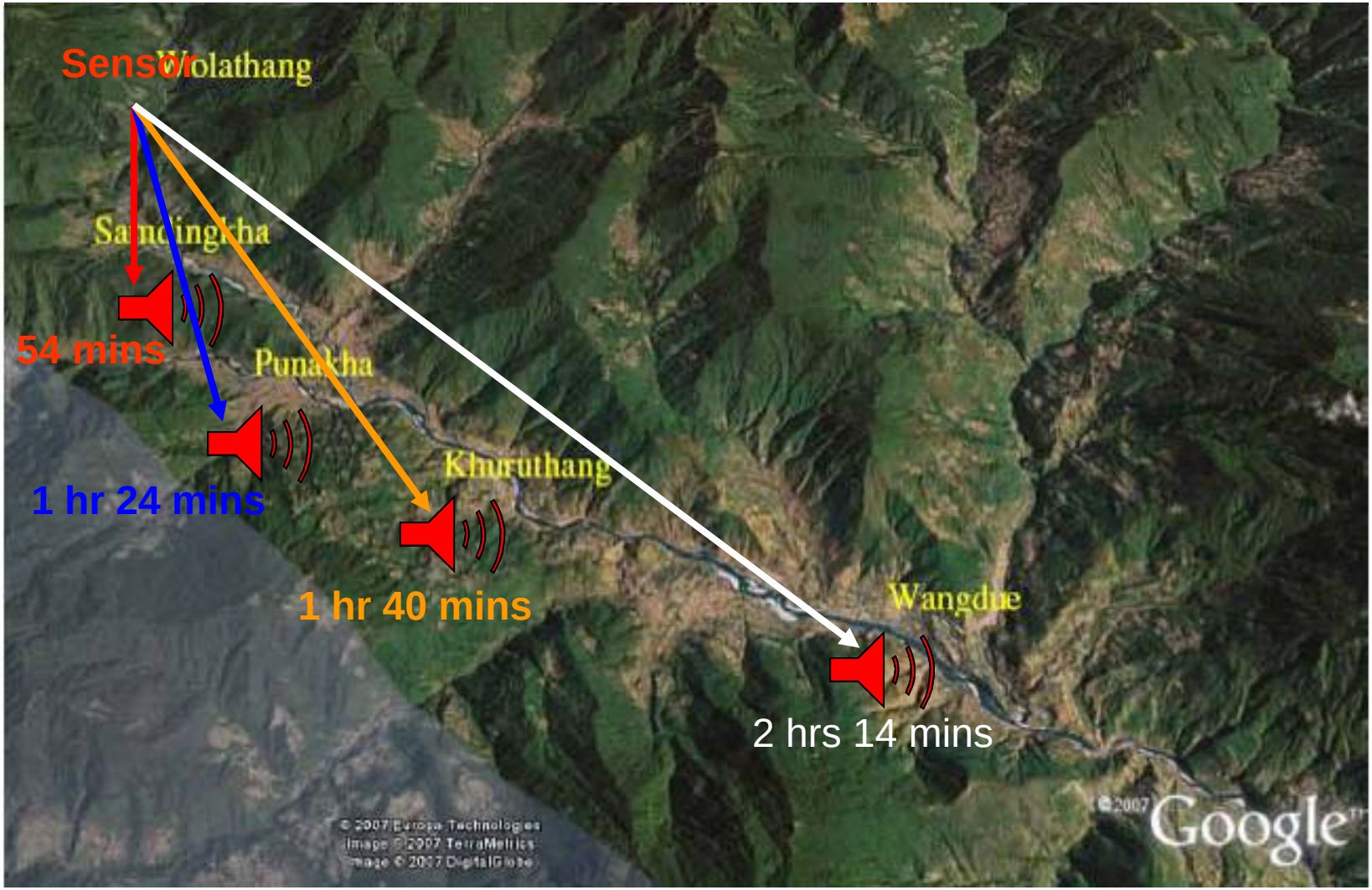
## 3. Installation of Technically Early Warning System (TEWS):

**-To alert people during GLOF and provide enough evacuation time.** Early warnings for major river basins are installed. GLOF EWS for Punakha-Wangdue basin (DoE & DGM) Community based EWS Sirens installed in Punakha, Khuruthang, Bajothang and Wangdue with the help of UNDP/GEF Funding.

Initially there was wireless radio network and satellite phone with DoE personnel in Lunana.

Now the mobile connectivity is provided.

# Installed TEWS



## 4. Create GLOF Risk Awareness

- DGM and Disaster Management Division conduct GLOF and early warning system awareness in the country.

- With the current technology of Bhutan, GLOFs can neither be ***totally prevented*** nor ***predicted*** *and the threats from the GLOF should be taken very seriously.*

# Underlying Vulnerabilities

- Unsafe construction practices
- Rapid Urbanization
- Lack of Enforcement
- Socio Economic Factors
- Lack of Awareweness
- Lack of Preparedness Planning
- Culture Insurance

## Functions of Department of Disaster Management

- National coordinating agency for all DM activities(Among all sectors/ agencies/ stakeholders).
- Institution and functioning of DM institutions.
- Formulation of guidelines, codes and standards.
- Facilitate preparation and implementation of all DM plans at all levels.
- Establishment of disaster communication networks.
- Capacity building- Preparedness, response and recovery.
- Awareness and advocacy at all levels.
- Facilitate mainstreaming of all DRR into development.
- Collaboration with all International, Regional and National Agencies.

**Emergency Communications:**

- National Emergency Operation Center
- District Emergency Operation Center
- Emergency Tele-Communication Network System
- Emergency Transportation

# Challenges

- Resource constraint
- Lack of capacities (Technical Expertise)
- Multi sectoral coordination
- Lack of Awareness
- Peoples attitude
- Mainstreaming of DRR
- Response Capacities

## Conclusions, (GLOF & Landslides)

- Since GLOF cannot be “totally prevented” or predicted, the threat from GLOF should be taken seriously.
- Mitigation measures for risk reduction are planned only along Punatshangchu and Chamkhar Chu.
- Most rivers in Bhutan are glacier-fed and we have Plans to replicate similar projects in other river basins.
- For effective land risk management, the potential landslide prone areas should be identified. Delineation of susceptible areas and different types of landslides hazards at a scale will be useful for planning and decision making.
- At present the hazard prone areas are mapped on 1:50,000 scale, which is not really useful for micro-scale infrastructure development.
- For Earthquake, we can only say that Bhutan is a earthquake prone areas, but we can never say when the earthquake will occur.
- Measures may be taken by constructing earthquake resilient structures
- In order to mitigate earthquake risk, Bhutan needs a micro-zonation map for the most vulnerable urban cities. Today one building standard is followed across all municipalities. If we have the micro-zonation map the standard building needed could be different from one place to another.. We should establish seismic observatories, prepare active fault maps, prepare micro zonation and then develop building codes based on these studies.

# Thank You