



# **GLOF and Rainstorm Flood Early Warning System in Bhutan**

**Presenter:**

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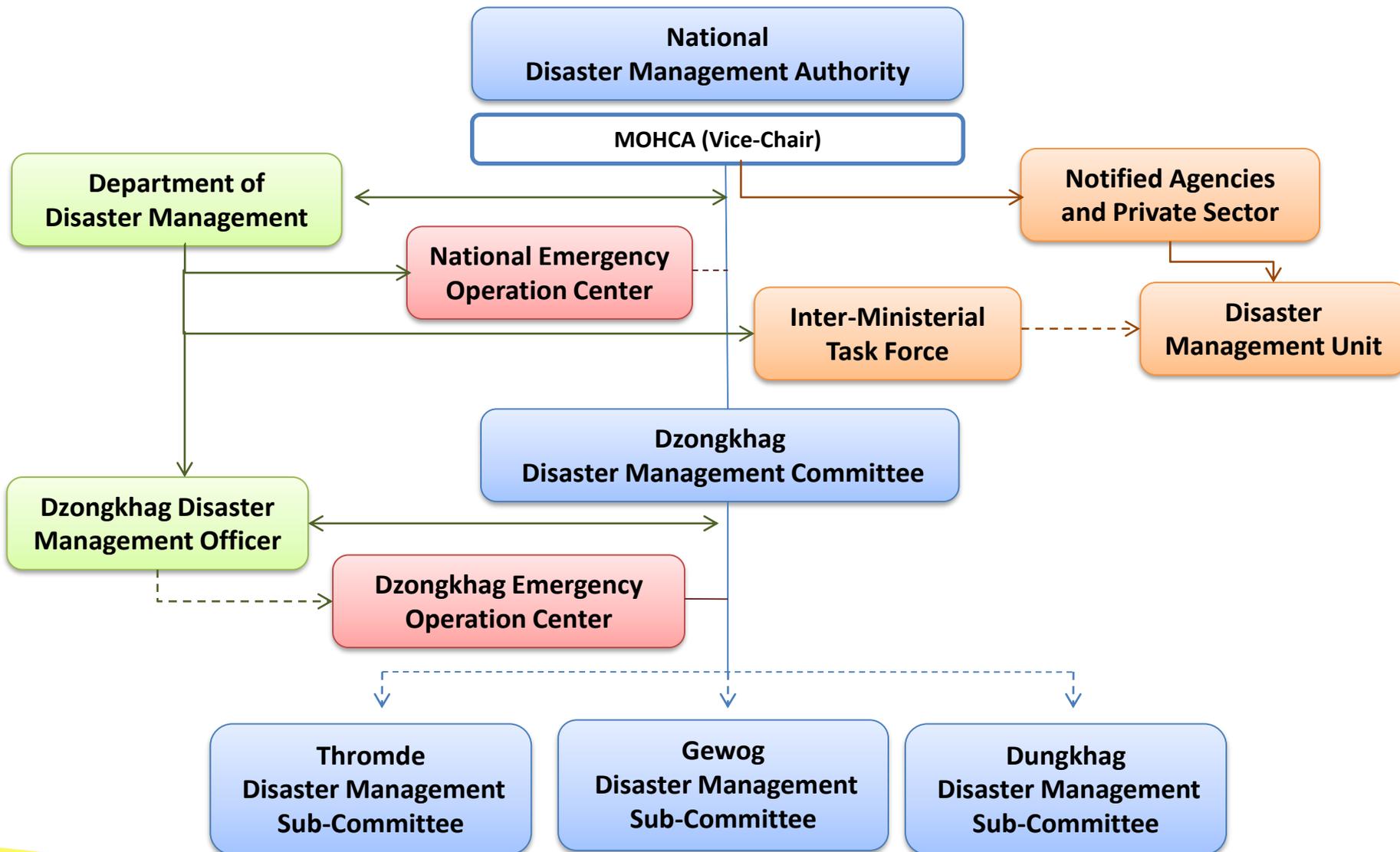
# Presentation Outline

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1. Disaster Management System & Impact of climate change in Bhutan
2. Important settlements and historical structures located at hazard prone areas.
3. Early warning systems for GLOF and rainstorm flood
4. Hazard zone demarcation/hazard map and safe evacuation place
5. Evacuation Plan and Mock drills with EWS installed
6. Challenges and issues



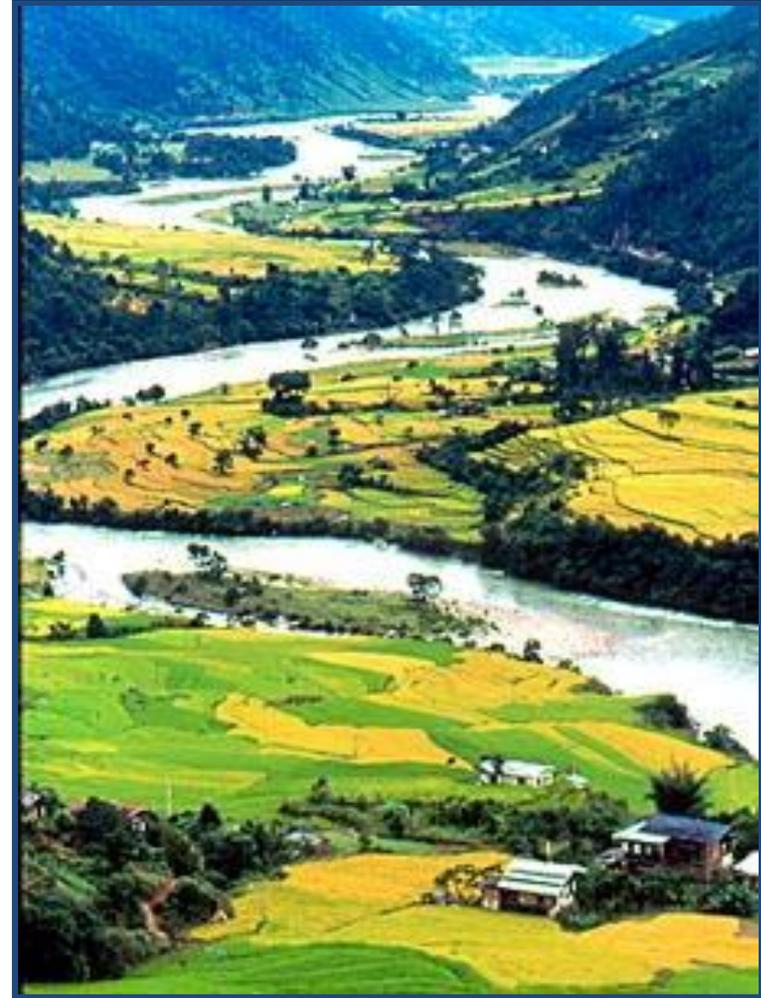
# 1. DISASTER MANAGEMENT SYSTEM (DM ACT 2013)



# 1. 1 Impact of Climate Change in Bhutan

## Introduction

- Agricultural Sector
  - 80% of population
- Water Resources
  - 30,000 MW potential power generation
- Forests and Biodiversity
  - 70% forest
  - high diversity - Eastern Himalayan hotspot



## 1.2 Impact of Climate Change in Bhutan

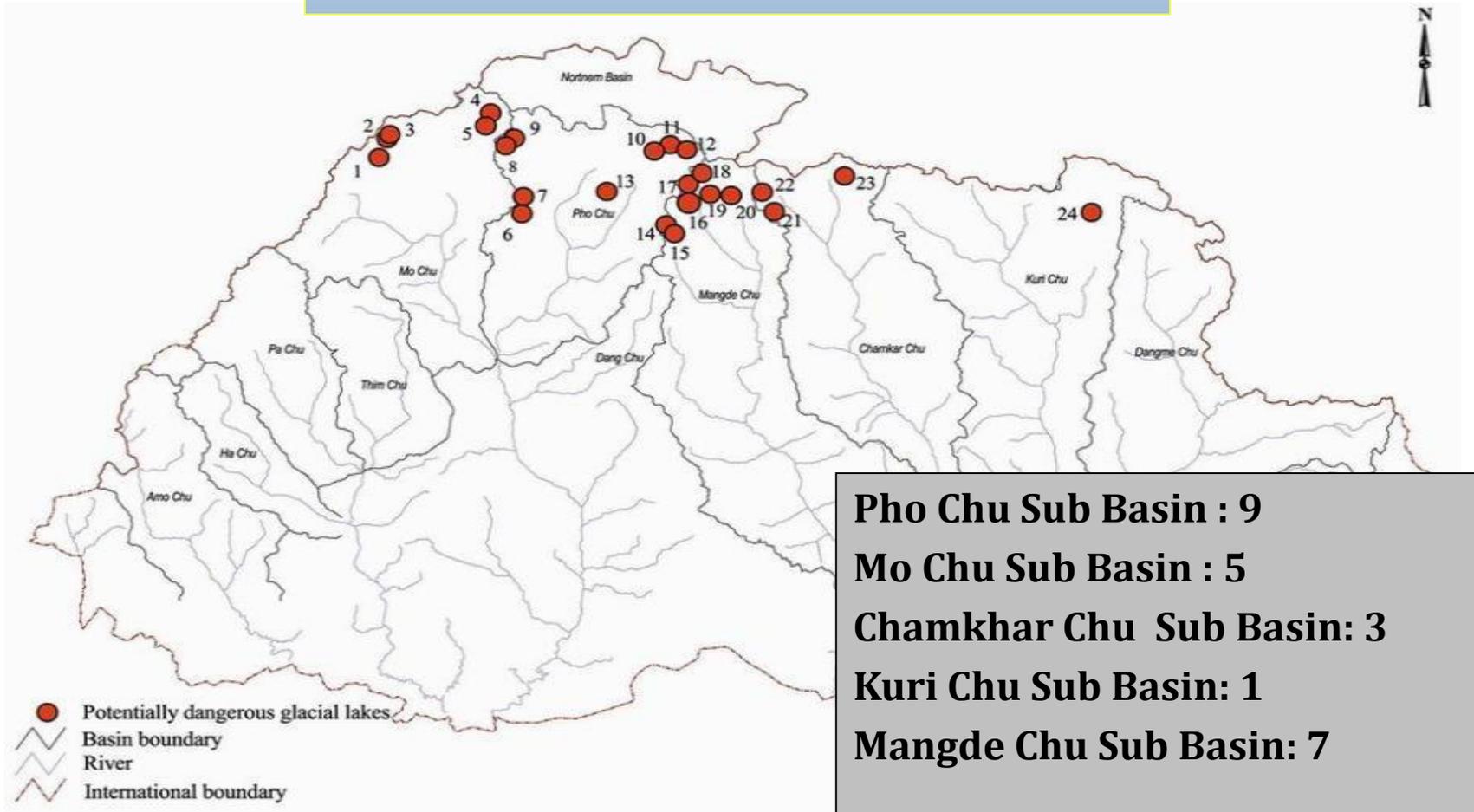
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- Natural Disasters
  - Glacial Lake Outbursts Floods
  - landslides
- Human Health
  - Increase in tropical diseases and heat stress



# 1.3 Impact of Climate Change in Bhutan

## Potentially dangerous Lakes



**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**

Out of 2794 glacial lakes, 25 has been identified as potentially dangerous lakes.

# 1.4 Impact of Climate Change in Bhutan

## Glacial Lakes in Lunana



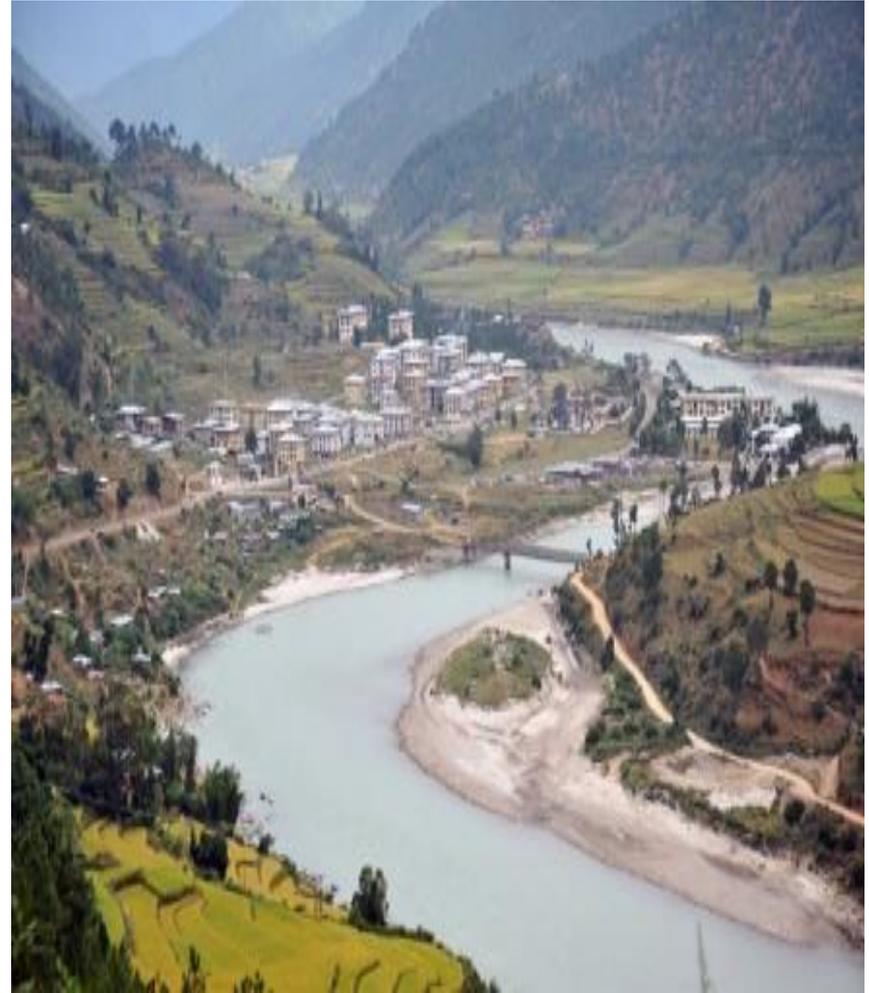
**Interconnected glacier and glacial lake systems.**



## 2.1 Important structures located along Punatshangchhu River



**Punakha Dzong (Fortress) located between two rivers**



**Khuruthang Town located at the banks of river Punathangchhu**



## 2.1 Important structures located along Chamkhar Chhu River



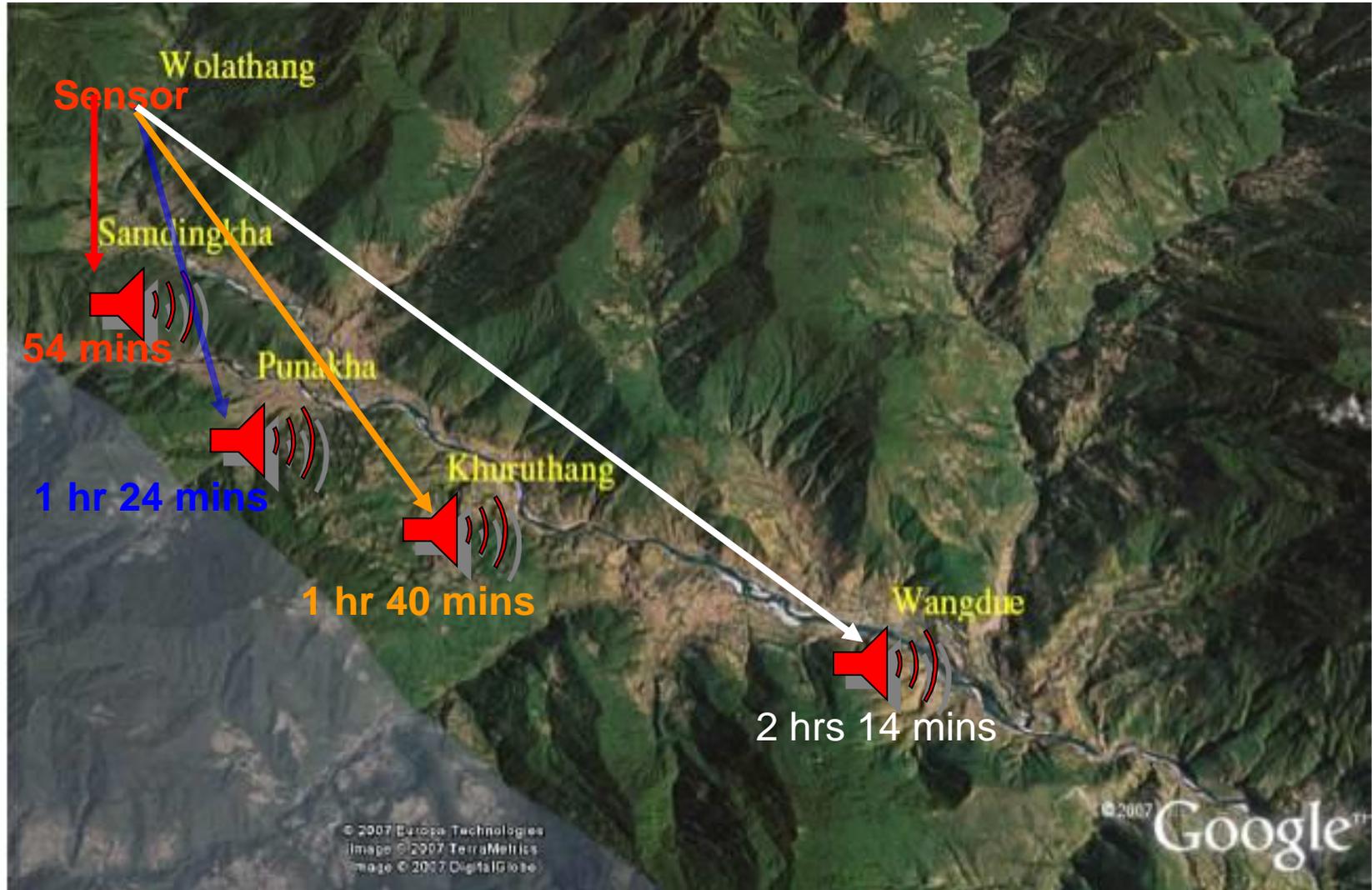
**Bumthang Airport located near Chamkharchhu River**



**Chamkhar Town located near Chamkharchhu River**



### 3.1 Early Warning System (EWS) in Punatshang Chhu River



# 3.2 Early Warning System (EWS) in Chamkhar Chhu

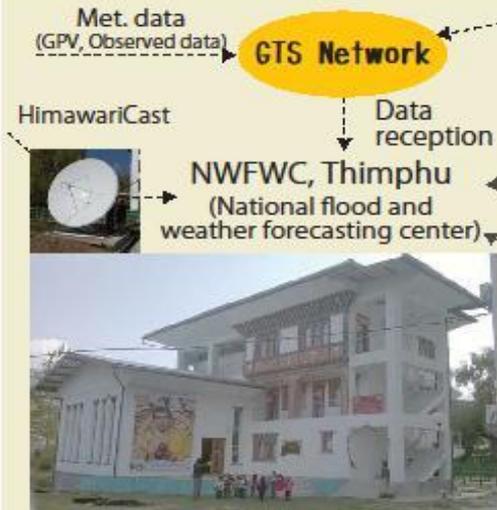
The Project for Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning

Sep. 2013 - Sep. 2016  
(9 JICA Experts)



Project Purpose

Capacity of DHMS and relevant stakeholders on emergency response against GLOF and rainstorm flood is enhanced

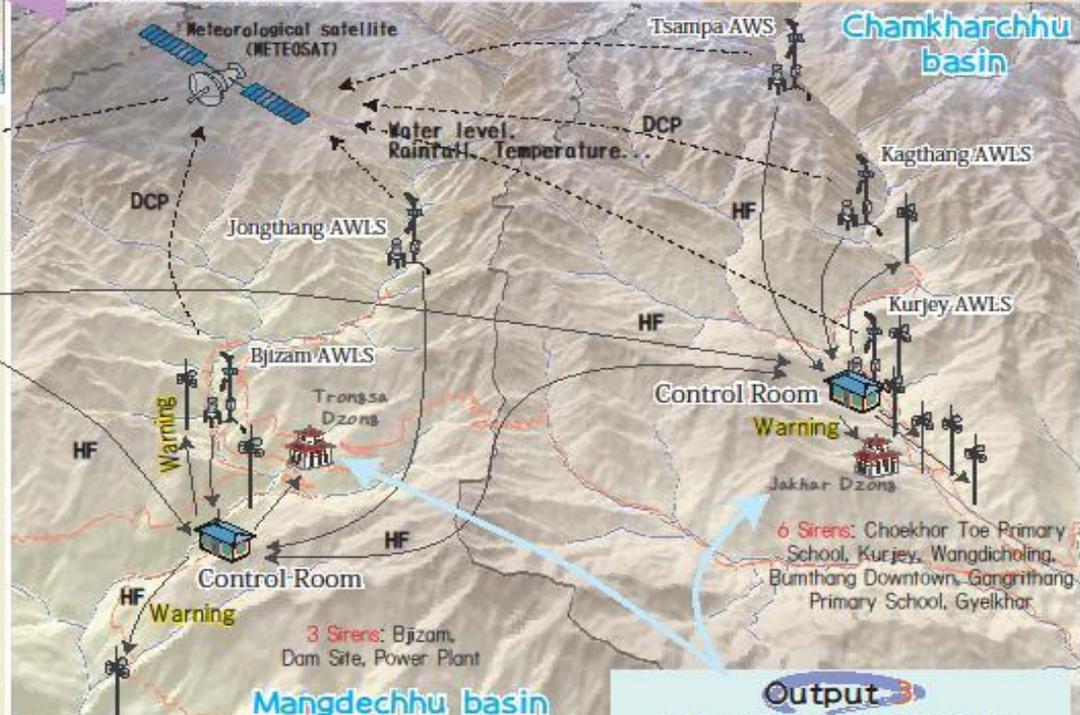


**Output 1**  
Capacity enhancement on disaster response at central level

Weather Forecasting and Warning (GTS etc.)  
Flood Risk Assessment  
Mainstreaming Disaster Risk Reduction into Development

DHMS, DHMS, DoES, DGM  
DDM, DHMS, DHS, NLCS

**Output 2**  
Development of EWS in the pilot basin  
DHMS, Local Government, Power Corporation



**Output 3**  
Strengthen of emergency response in the basin

Community Based Disaster Risk Management: Local Government, Community, DDM, DHMS

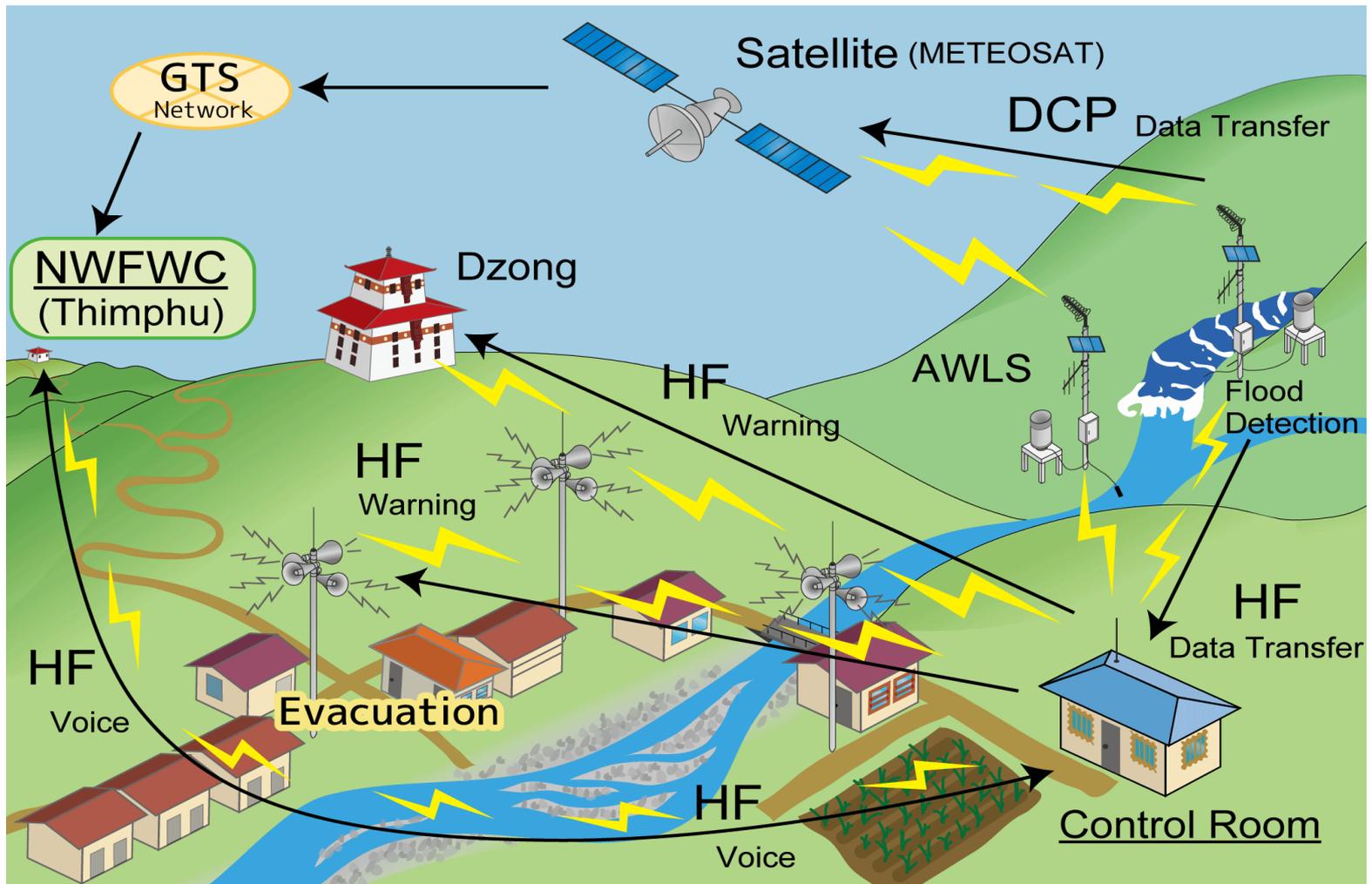
Inter-ministerial Working Groups

Source: JICA Expert



Ministry of Home and Cultural Affairs

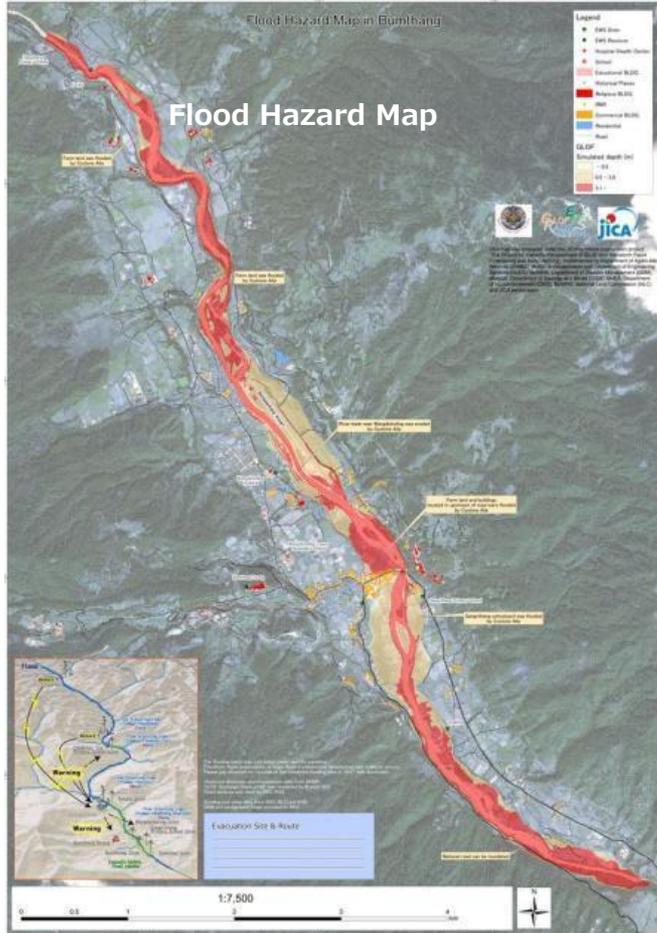
# 3.3 Overall Networking System for EWS



# 4.1 Preparation of flood hazard map

## Flood Hazard Map

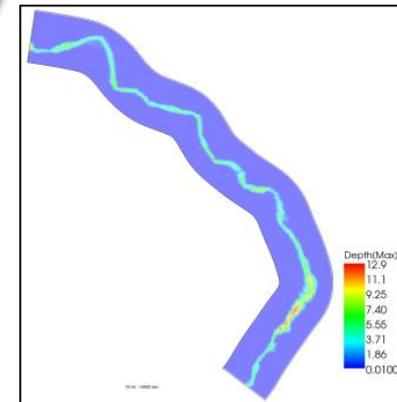
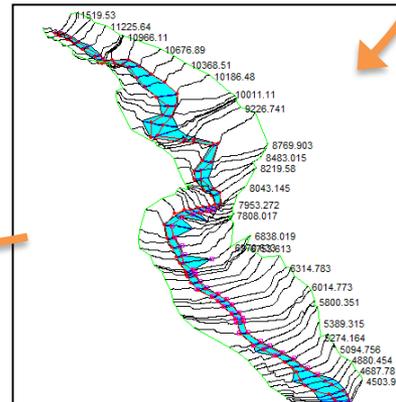
“Flood Hazard Map Working Group” prepared the Map in Bumthang Valley



Field survey  
OJT



Runoff/flood  
analysis  
training



Modeling &  
Analysis



## 4.2 Demarcation of hazard zone

### Red Zone:

- Represents high risk areas where most probably water level will reach and the areas will be submerged (worst scenario).

### Yellow Zone:

- Represent medium risk areas where most probable indirect impact of GLOF can occur during the worst case scenario.

### Blue Zone:

- Represents areas that are found safe from the worst case of GLOF



## 4.3 Safe Evacuation Site

- Evacuation area for a group of settlements
- Fairly good road/foot track with the settlement/community
- Within the shortest possible distance from the settlement/community
- An open area and unused land
- Safe location during GLOF



# 5.1 Evacuation Plan and Mock drills with EWS installed



Community/ school workshop to discuss and formulate evacuation plan



Evacuation Plan prepared by the community/ school



Evacuation drill at a primary school and vulnerable settlements



## 6.Challenges and Issues

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1. Poor/unsafe construction practices
2. Rapid and unplanned urbanization
3. Inadequate level of awareness and human ignorance
4. Low levels of preparedness and response capacities
5. Low institutional and technical capacities
6. Environmental degradation
7. Lack of capacity and coordination to develop multi-hazard atlas
8. Insufficient mainstreaming of DRR and climate change





Department of Disaster Management  
Ministry of Home & Cultural Affairs  
Royal Government of Bhutan



**Thank You**