



South Asia Flash Flood Guidance System Operational Workshop (Step-4) (5th to 7th June 2018)

Operational Flash Flood Forecasting and Early Warnings Capabilities in Bhutan

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Outline

- 1) Operation Flash Forecasting-Bhutan
- 2) Early Warning Capabilities-Bhutan
- 3) Warnings on Flash floods/Flood by NCHM
- 4) Collaboration between Meteorological and Hydrological services
- 5) Mechanisms of Flash Warning dissemination

Flash Flood Forecasting in Bhutan

- Generally, issue warnings as flood related: Heavy rain, cloud out burst and etc..
- Gauge readers: Water level rises issue warnings to public nearby
- There is no clear definition between Floods and Flash Floods.
- Currently term flood and flash flood are used same term by media and others.
- NCHM: Issue weather related to heavy rain advisory to General public

Flood/Flash Flood risk

1. Pre-monsoon season
2. Monsoon season
3. Post monsoon season
4. Glacier
5. Others...

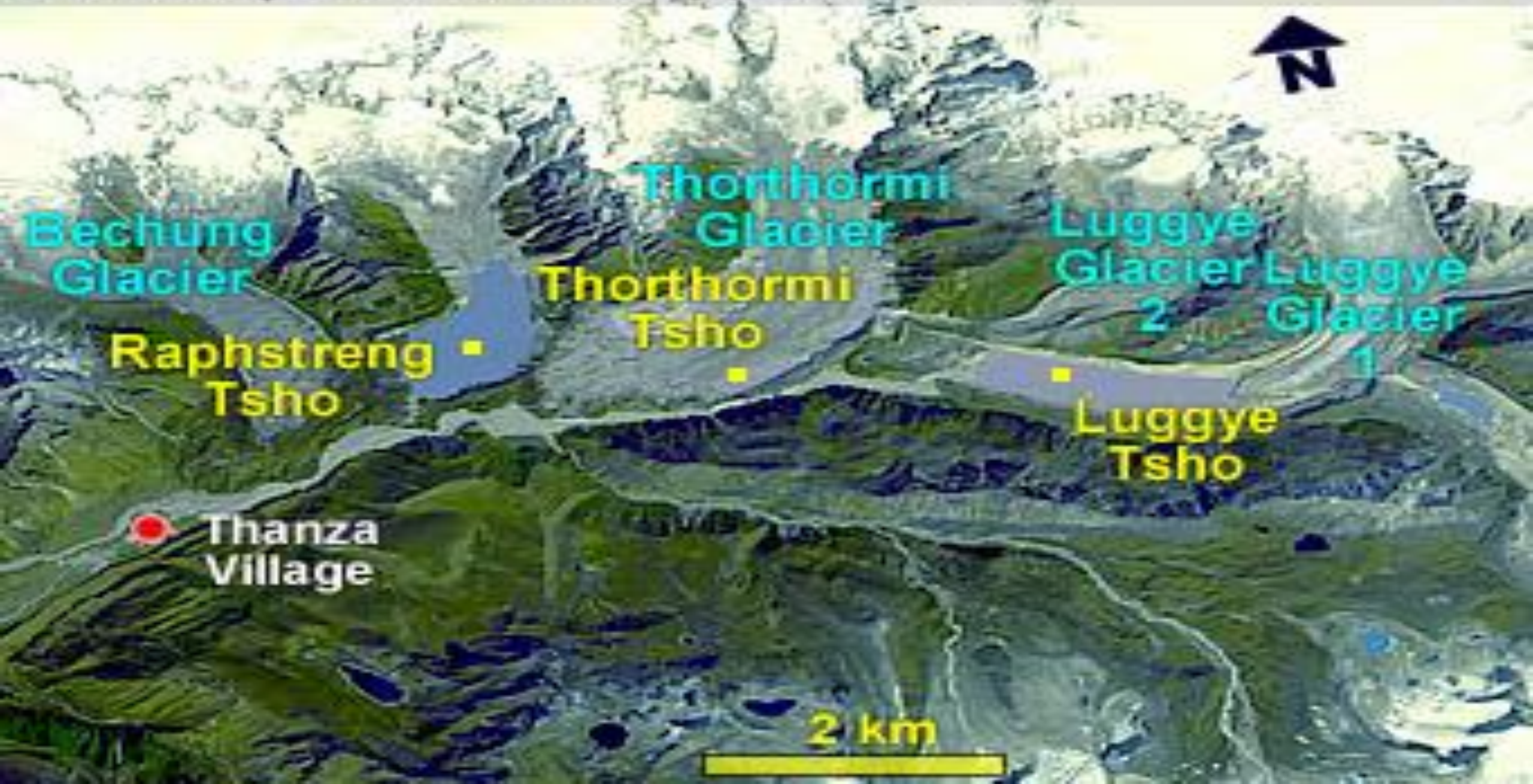
Flood Warning Section-Bhutan

1. The **Flood Warning Section** under the Hydrology Division, NCHM, is responsible to provide flood warning services in Bhutan.
2. Flood warning activity is undertaken by the Royal Government of Bhutan in collaboration between the **Central Water Commission (CWC)** of India mainly to provide early warning for people down streams from floods.
3. River water level and rainfall data from these stations are continuously transmitted to designated stations in **Cooch Bihar, Jalpaiguri, Nalbari and Berbeta in the Indian States of West Bengal and Assam.**
4. The Flood warning stations are monitored for 24 hrs during the **monsoon season** and data are transmitted using wireless sets on hourly basis to stations in India.





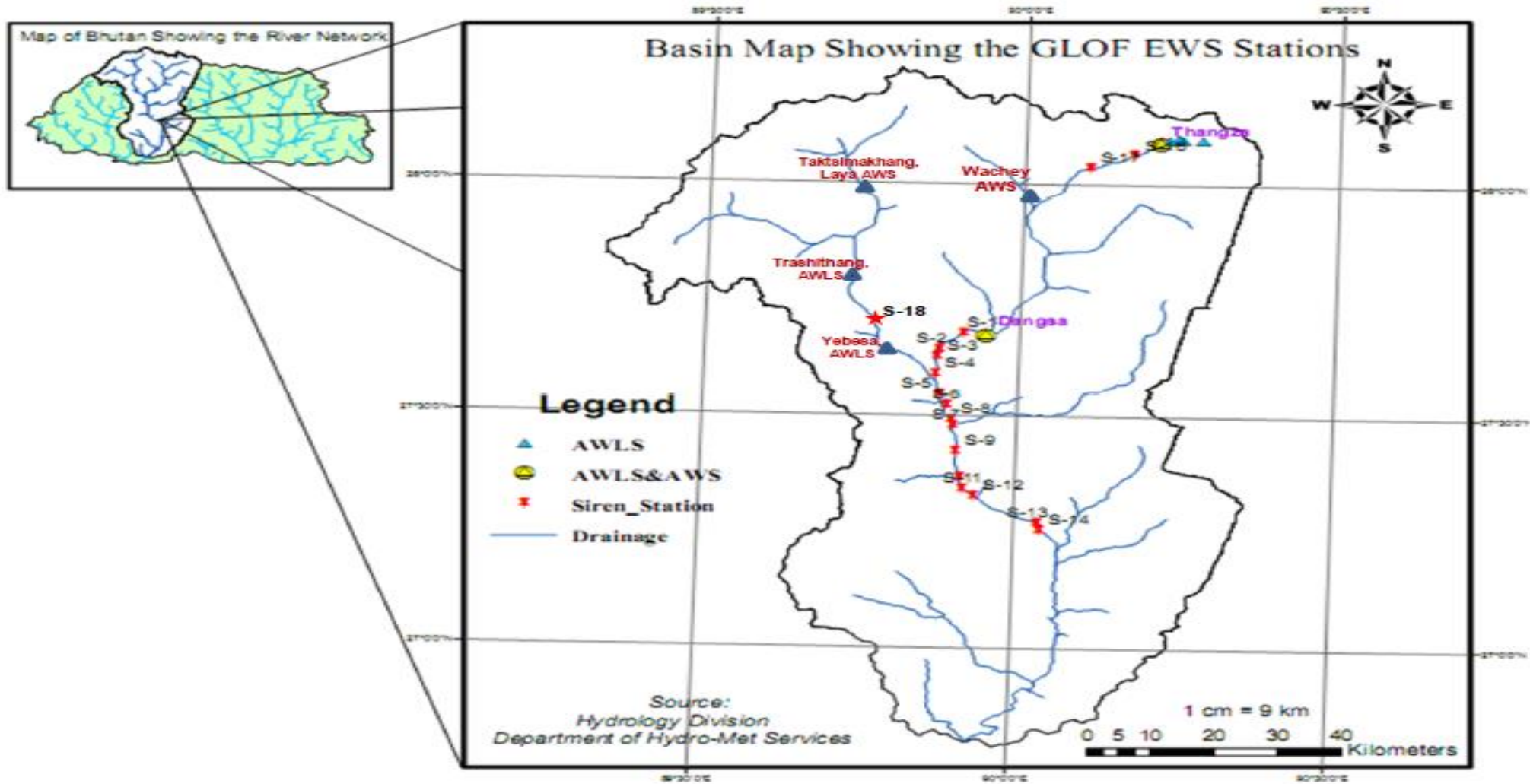
Glacial Lakes such as these are sources of water for the rivers flowing in
Bhutan



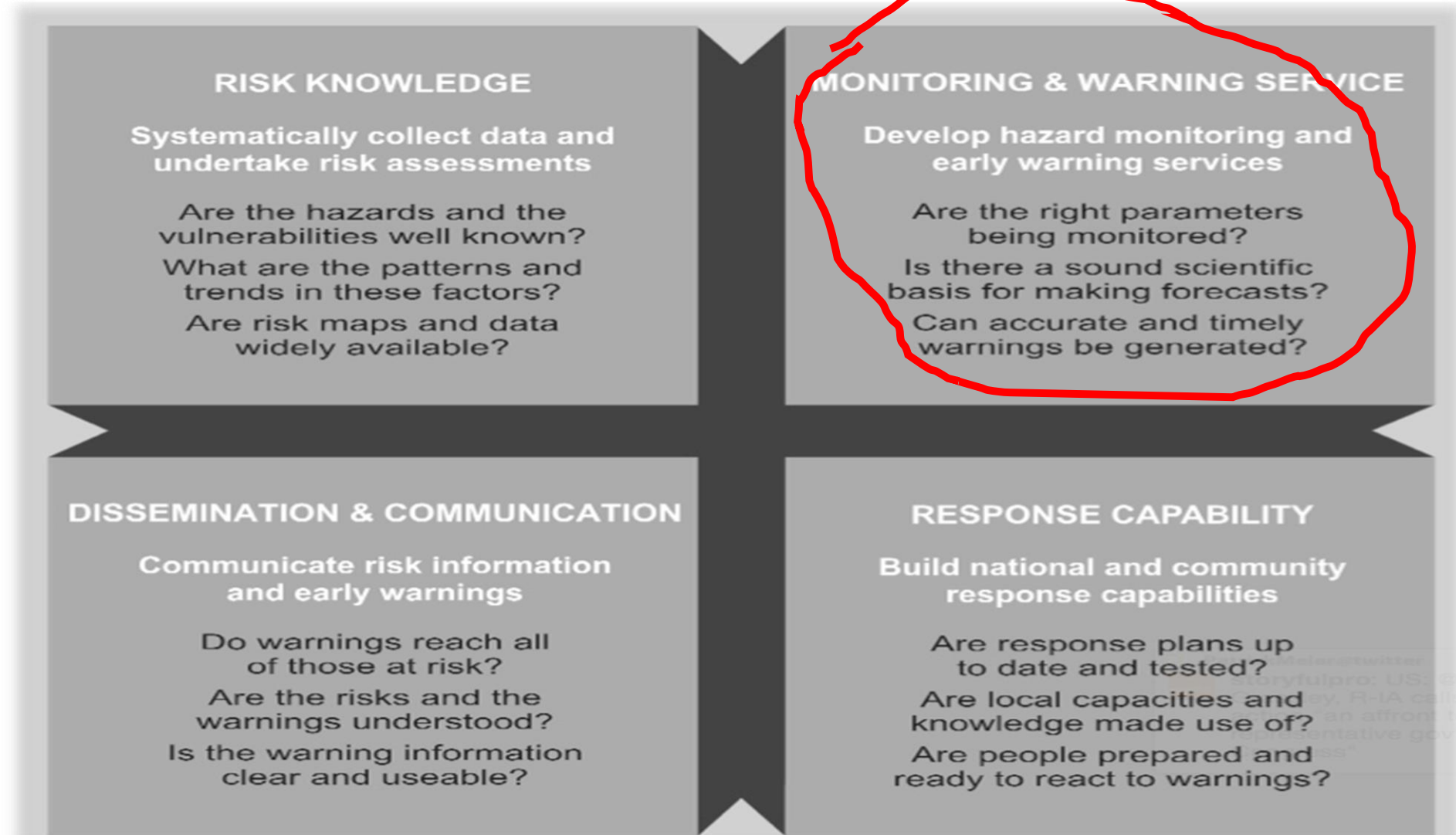
Flooding/Flash Flood: Bhutan



GLOF EWS PHO_MO

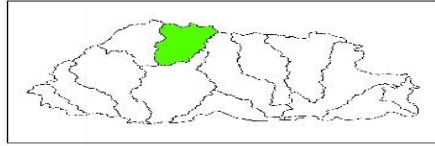


Main Components of Early Warning





GLOF Early Warning System in Pho chhu Sub-basin



Bay-Tsho AWS



Rapstreng AWS



Thorhorwi AWS



Thanza AWS



Tarina-Wachey AWS



Samdingkha Siren



Khowajara Siren



Pemaikha Dzong Siren



Wolathang Siren



Loggy AWS



Thanza-Tenchey Siren



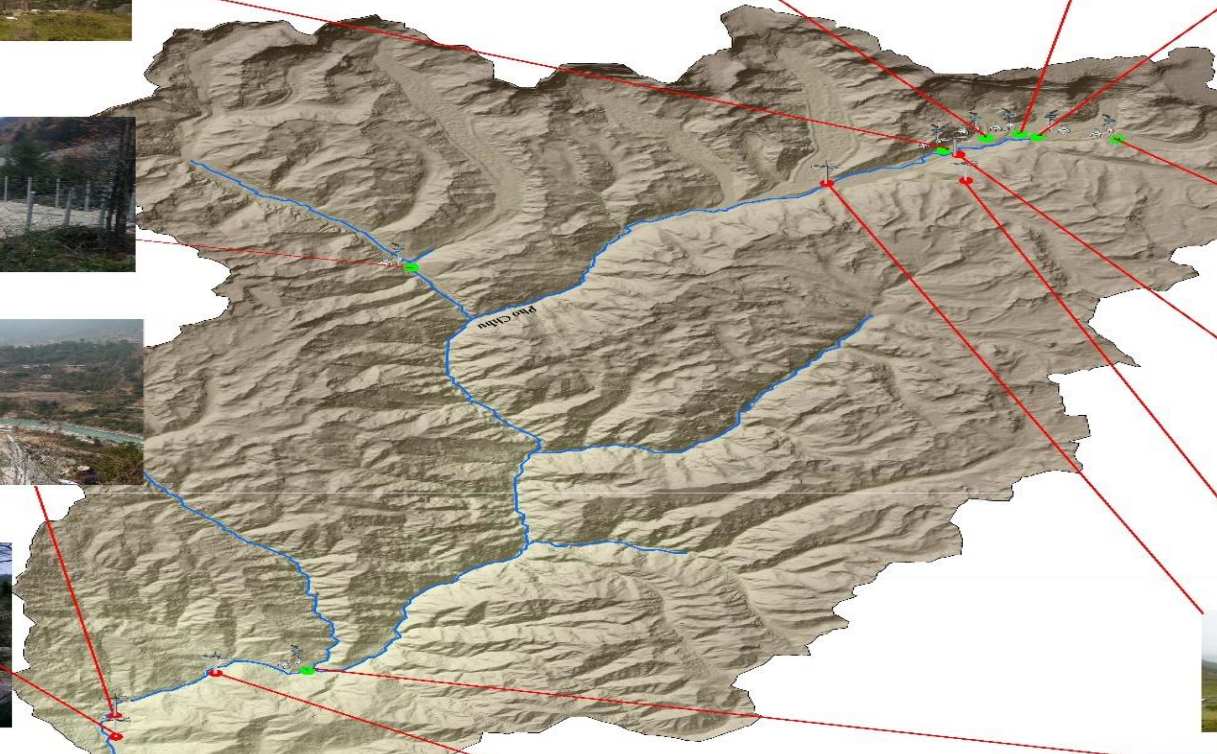
Lhedhi Siren



Tshojo Siren



Dangsa AWS



Legend

- Sensor
- Siren
- phochhu

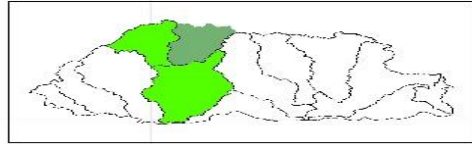
Elevation

- High : 7189
- Low : 1205

1:150,000
0 1.5 3 6 9 12 Km



GLOF Early Warning System in Mochu and Punatshangchhu Basin



Laktesmang AWTLS



Yelosa AWTLS



Parakha Dzong



Lakhithang AWTLS



Wakuan Siren



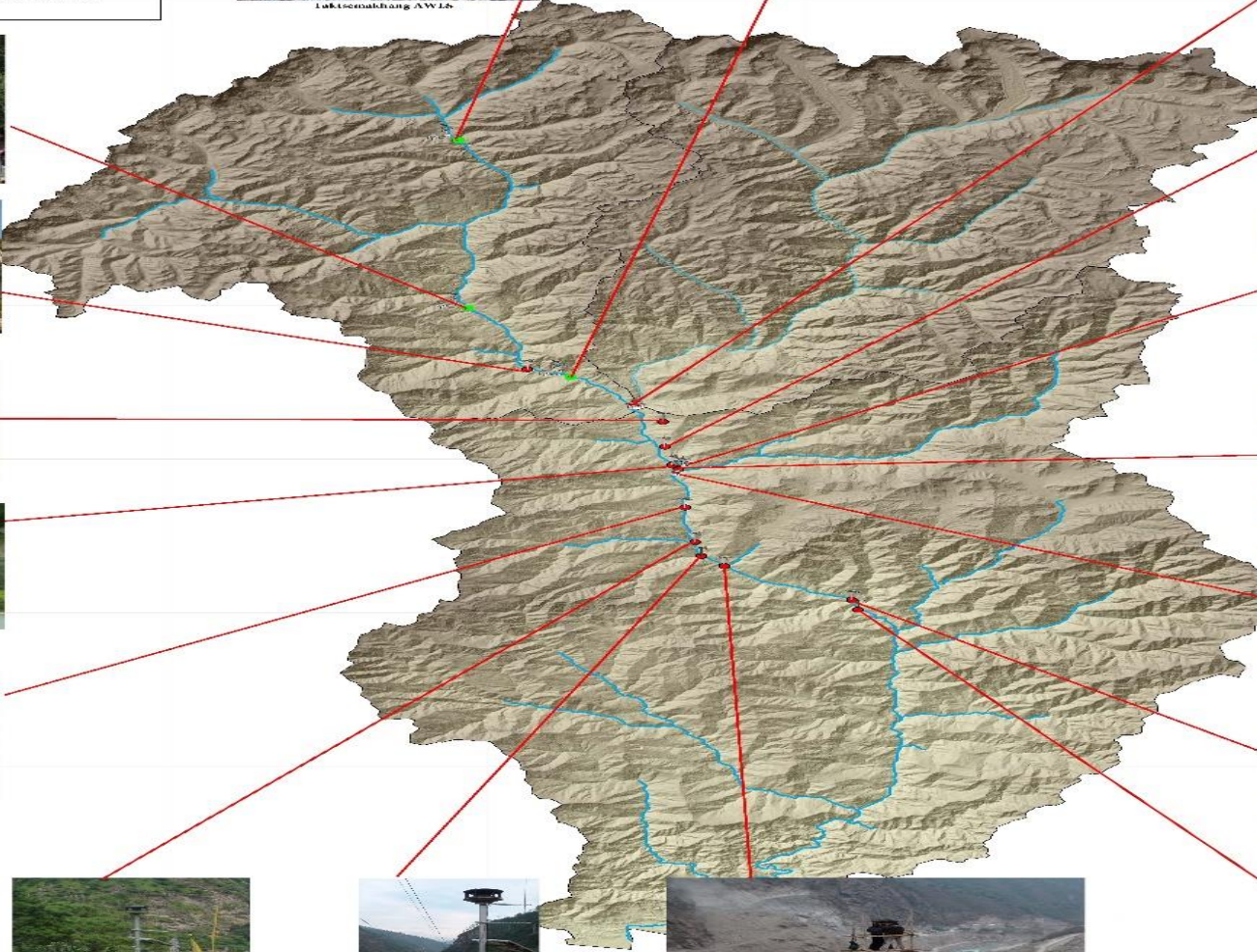
Khurethang Siren



L'Yagou Nest Siren



Punatshang-Chhu I dam complex Siren



Surothang Siren



Wangdue Control Center



Wangdue Siren



Wangdue Phodrang Dzong



Kuroi Chhu Siren



Basu Chhu Siren



Kuroi Chhu Siren



Punatshang Chhu I Power house Siren



Punatshang Chhu II Siren

Legend

- Control Center
- Dzong
- Sensor
- Siren
- Mochhu

Elevation

High - 7159
Low - 87

1:300,000



Components of GLOF EWS

Remote Monitoring Stations



Communication



Sirens



Control Room



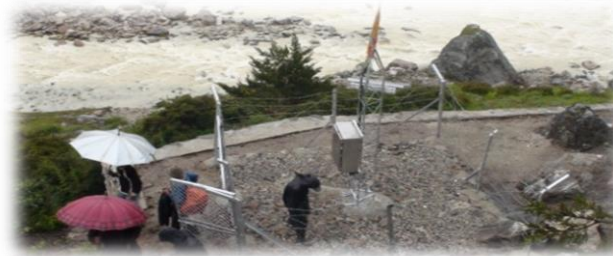
Remote Monitoring Stations

Automatic Monitoring Stations in lakes in Lunana :

- 6 Automatic Water Level Station (AWLS) installed in all the four lakes in upper region

Automatic Monitoring Stations in upstream Punakha on Phochhu:

- 2 AWLS and
- 2 AWS



Siren Towers

- ❖ 18 Sirens
- ❖ All Siren stations are placed high above the population centers for maximum sound projection.
- ❖ Whelen OA-1 siren produces a sound pressure of 60 dB at a distance of 2800 feet (0.85 km).
- ❖ Siren stations placed high above the population centers for maximum sound projection.
- ❖ Sirens can be activated from Control Room automatically and manually



Control Room



- Control Center is located at **Wangdi**, Flood Warning Office and is equipped with the State-of-Art-Technology hardware and software for monitoring GLOF /flood.
- Manned by staff for 24/7
- Functions:
 - Retrieving Environmental Data for all Flood Warning and Siren Sites,
 - Remote Monitoring of Flood Warning and Siren Sites,
 - Remote Control of Flood Warning and Siren Sites,
 - Displaying Health System of System
 - Displaying warnings to the operator.

Bhutan Control Center Interface Gui

Bhutan Control Station Interface
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Siren Status and Control Interface

High Altitude Sirens

Turn Group ON
Turn Group OFF

Siren Site Name	Siren Status	Last Update	Siren Control	
S-15 Thanza & Tenchey Villages	OFF	Oct 4, 2014 12:01 AM	Turn ON	Turn OFF
S-16 Tshojo Village	OFF	Oct 8, 2015 12:01 AM	Turn ON	Turn OFF
S-17 Lhedhi Village Siren	OFF	Oct 8, 2015 12:03 AM	Turn ON	Turn OFF

Low Altitude Sirens

POCHU ON
POCHU OFF
MOCHU ON
MOCHU OFF

Siren Site Name	Siren Status	Last Update	Siren Control	
S-1 Wolathang Community School	OFF	Oct 8, 2015 12:01 AM	Turn ON	Turn OFF
S-2 Samdingkha Area	OFF	Oct 8, 2015 12:00 AM	Turn ON	Turn OFF
S-3 Khowajara Area	OFF	Oct 8, 2015 12:01 AM	Turn ON	Turn OFF
S-4 Punakha Dzong Area	OFF	Oct 8, 2015 12:00 AM	Turn ON	Turn OFF
S-5 Kuruthang Area Punakha	OFF	Oct 8, 2015 12:04 AM	Turn ON	Turn OFF
S-6 Samthang Area	OFF	Oct 8, 2015 12:00 AM	Turn ON	Turn OFF
S-7 Control Station, Wangdue	OFF	Oct 8, 2015 12:00 AM	Turn ON	Turn OFF
S-8 Dragon Nest Resort Siren	OFF	Oct 8, 2015 12:00 AM	Turn ON	Turn OFF
S-9 Punatsangchhu I -Project Dam Site	OFF	Oct 8, 2015 12:00 AM	Turn ON	Turn OFF
S-10 Basochhu at Mazafal	OFF	Oct 6, 2015 12:04 AM	Turn ON	Turn OFF
S-11 Rurichhu Basochhu Power House Siren	OFF	Oct 8, 2015 12:01 AM	Turn ON	Turn OFF
S-12 Punatsangchhu I -Powerhouse Siren	OFF	Oct 8, 2015 12:01 AM	Turn ON	Turn OFF
S-13 Kamichhu Suspension Bridge	OFF	Oct 8, 2015 12:01 AM	Turn ON	Turn OFF
S-14 Punatsangchhu II -Powerhouse	OFF	Oct 8, 2015 12:09 AM	Turn ON	Turn OFF
S-18 Wakuna-Mochu	OFF	Oct 8, 2015 12:02 AM	Turn ON	Turn OFF

Water Level Status and Station Operations

Water Level Station Status

SITE NAME	UPDATE TIME	WATER LEVEL(mts)	ALERT	
AWLS-1 Luggy AWLS	Oct 8, 2015 3:00 PM	6.6	7.8	
AWLS-2 Thorthomi AWLS	Oct 8, 2015 3:00 PM	6.55	7.5	
AWLS-3 Rapstreng AWLS	Oct 8, 2015 3:00 PM	6.32	7.4	
AWLS-4 Bay-Tsho AWLS	Oct 8, 2015 3:00 PM	6.35	7.4	
AWS-2 Thanza AWS	Oct 8, 2015 3:00 PM	6.64	7.7	
AWS-1 Dangsa AWS	Oct 8, 2015 3:00 PM	4.15	6.5	
AWS-4 Taktsemakhang (L...	Oct 8, 2015 3:00 PM	5.59	7.5	
AWLS-5 Tashithang	Oct 8, 2015 3:00 PM	5.79	8.5	
AWLS-6 Yebessa	Oct 8, 2015 3:00 PM	1.63	5	
AWS-3 Tarina-Wachey	Oct 8, 2015 3:00 PM	6.78	8.5	

Station Operations

Station

Operation

Send

Station Operations information

Get Limits: Fetches the Alarm, Alert and ROC Limits which are set at the remote station sites. This is helpful in cases where the limits are set at those in the control center.

Set Limits: Sets the limits on the remote station sites with their corresponding limits.

Set Clock: Sets the Clock time on the remote station sites with their corresponding limits.

Get Current: Fetches the current water level value for the remote station sites with their corresponding limits.

Legend

Siren Status and Control

NA Not available (no contact with the siren)

ON Siren is ringing

OFF Siren is silent

Water Level Status and Station Operation

Water Level Within permissible limits

Water Level Alert Level

Water Level Alarm Level

Water Level Not Active

NA Not available or limits are not set

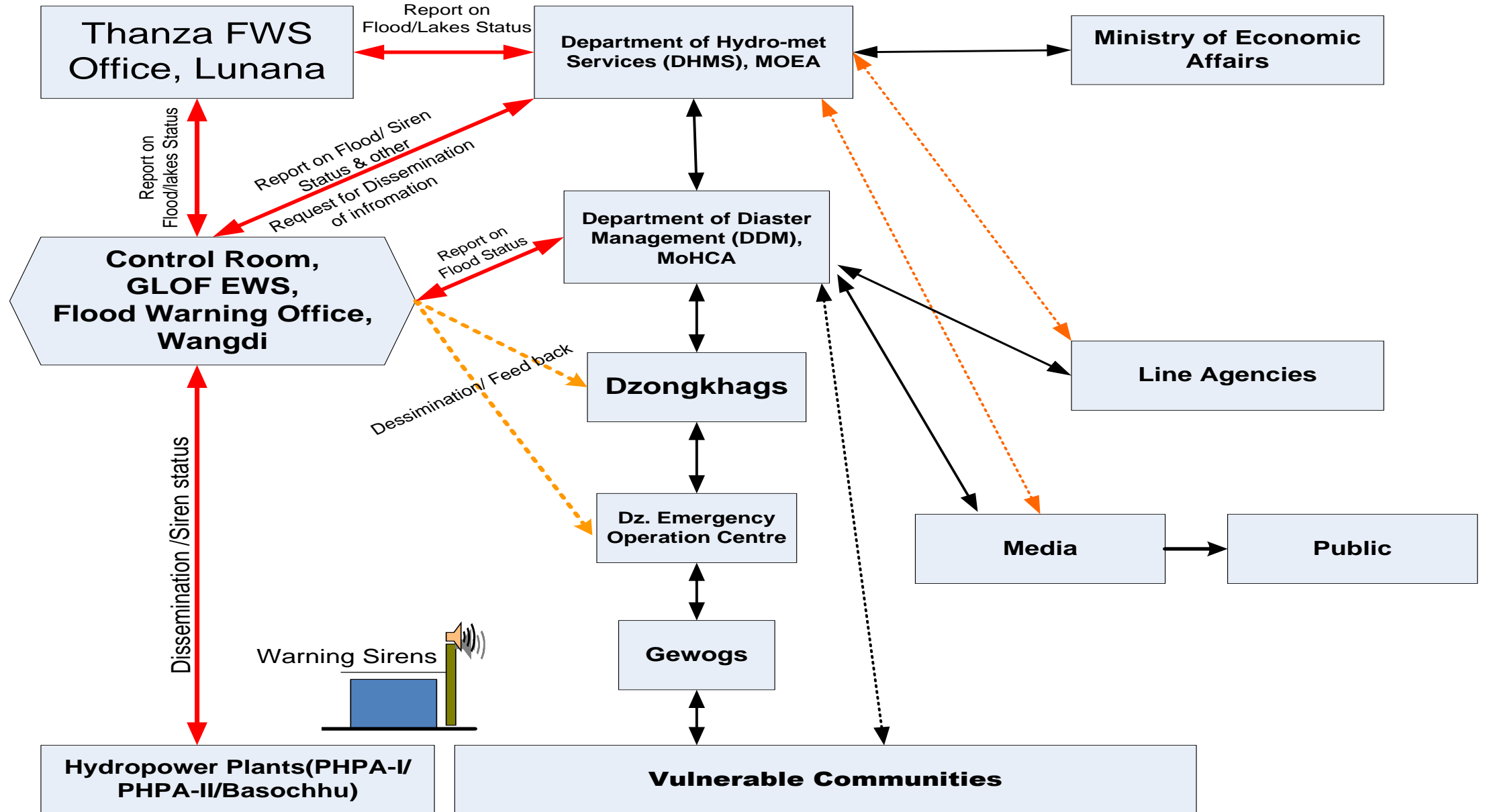
Limits Remote and local limit match

Limits Remote and local limit mismatch

Siren Event Messages

Information Flow chart

Standard Operation Procedure (SOP)



Web Page

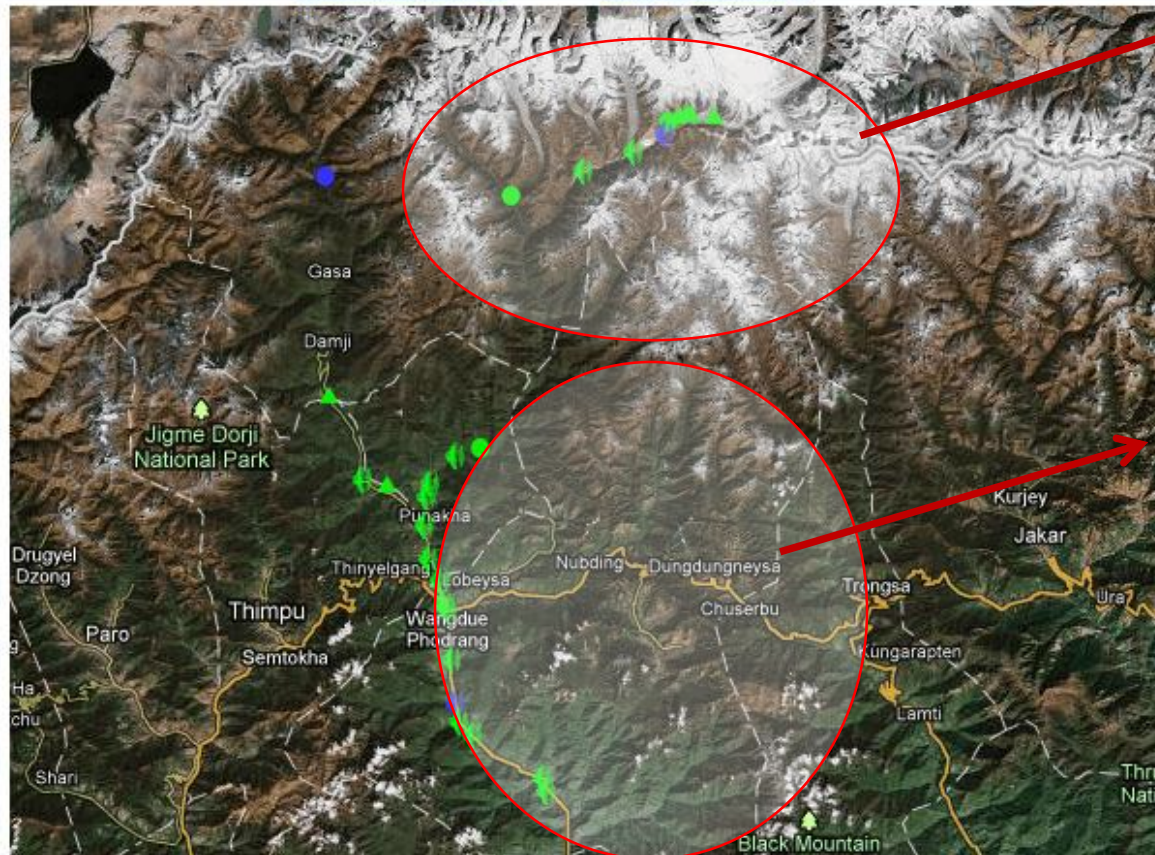


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 བསྐྱར་རྒྱས་ལྷན་ཁག།
 DEPARTMENT OF HYDRO-MET SERVICES
 MINISTRY OF ECONOMIC AFFAIRS
 THIMPHU : BHUTAN
 Royal Government of Bhutan



Luanan Area

[Northern Region Map](#) [Southern Region Map](#)



6 Water level Station
3 Sirens

Punakha-Wangdi Valley

4 Water Level/Weather
Stations
15 Sirens Stations

[Custom Site Reports](#)

[Custom TimeSeries Reports](#)

[Bhutan Alarms](#)

[Bhutan Water Level](#)

Quick 48 Hours Plots For Water Level:

[Luggy AWLS](#)

[Thorthomi AWLS](#)

[Rapstreng AWLS](#)

[Bay-Tsho AWLS](#)

[Tashithang AWLS](#)

[Yebesa AWLS](#)

[Dangsa AWS](#)

[Thanza AWS](#)

[Tarina Wachey AWS](#)

[Taktsemakhang AWS](#)

Graphical Reports For All Stations:

[Today](#)

[This Week](#)

[This Month](#)

[This year](#)

Tabular Reports For Water Stations:

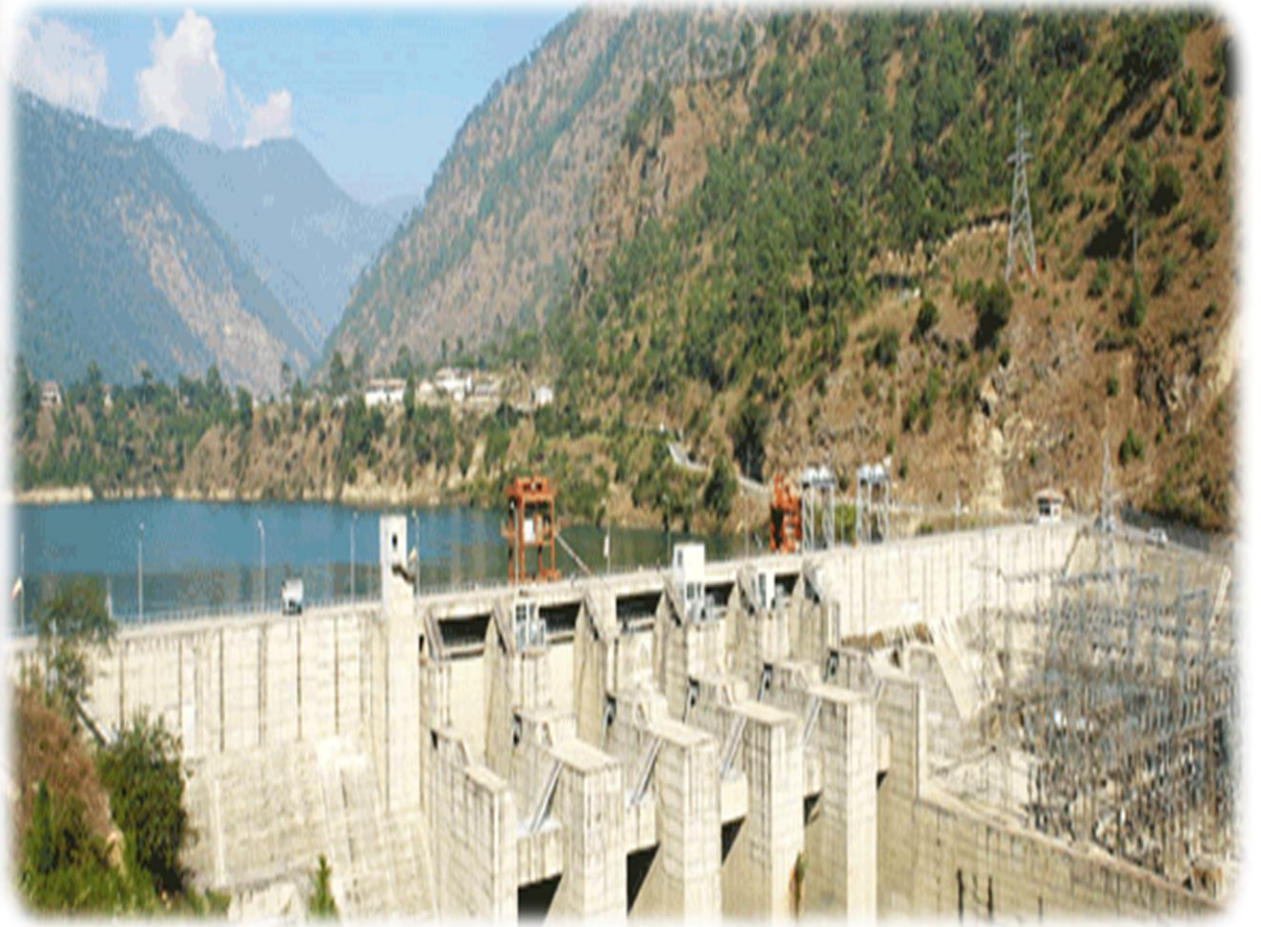
[Today](#)

[This Week](#)

[This Month](#)

[This year](#)

Picture of Hydro-power plan



Hydropower contributes over 27% of government revenue and 14 percent of Bhutan's GDP.

Flash Flood Forecasting: HRC

1. Brief and made presentation to HRC members (Director, Chief, Hydrologists, Meteorologists and Forecasters).
 - Explain case studies of Bhur/Gelephu and findings
 - Benefits from FFG system to Forecasters/NCHM
 - Plans and program related to FFG: Regional (IMD)
 - How users can operate the FFG system other than Regional Center (IMD)

Do Bhutan need Flash Flood warning?



Collaboration: Meteorological and Hydrological

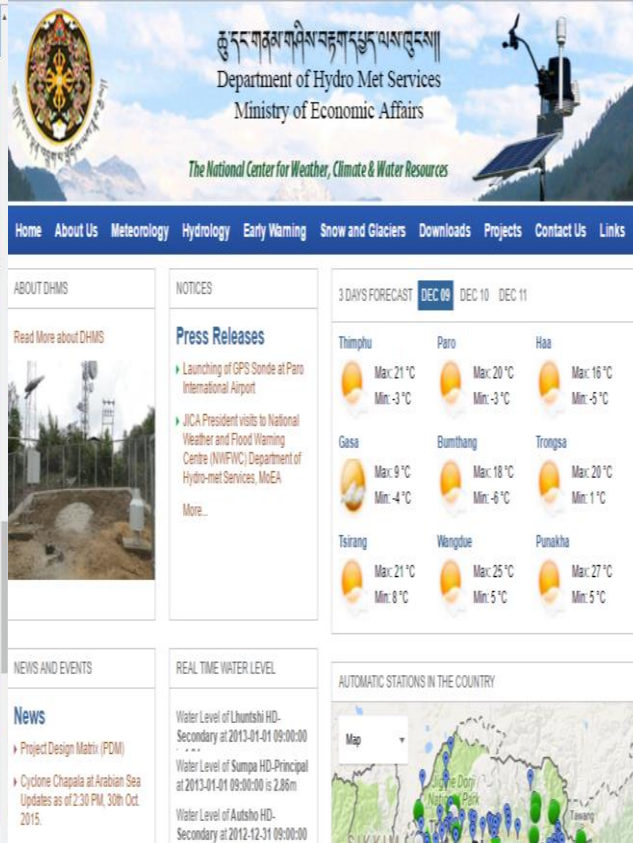
- One Director: National Center for Hydrology and Meteorology
- Weather monitored by Weather and Climate Services Division
- Early Warning/Flash flood monitored by Hydrology Division

Extreme weather warning:

- ✓ Warnings are issued through press release (Media/television)
- ✓ Disaster Management office for planning and action with Dzongkhags
- ✓ PMO office
- ✓ HM office and ministers



Extreme weather warnings



Press release of Cyclone storm "KOMAN" - 31st July 2015 4.00 PM

According to forecast from the Department of Hydro-Met Services, Ministry of Economic Affairs, a cyclonic storm 'KOMEN' was developed on 30 July over northeast Bay of Bengal. The cyclonic storm Komen has now weakened into Deep Depression over the Chittagong, Bangladesh. The deep depression would move west-northwestwards and weaken gradually into depression and then into low pressure. There is no direct impact from this system on Bhutan however heavy rain is expected in most parts of the southern and eastern Bhutan during next 48 hours due to the peripheral effect of the depression. Rest of the country will be mostly cloudy with moderate rain during next 48 hours.

Weather is expected to improve from Monday. Updates on weather will be provided if there is any change in the system.

Department of Hydro Met Services
Ministry of Economic Affairs.



We issue extreme weather warning through different mode of communication such as Facebook, website, mobile and press release to different media houses (Print media, radio and television).

Services

1. HM office
2. PMO, Ministers, Government Secretary
3. Disaster Management office
4. National television (BBSC)
5. Print media- (Kuensel and others)
6. Agriculture office- farmers information
7. Tourism-in tourist seasons/off season
8. Helicopter services and to individual who request us
9. We also provide 72 hours/3 days weather forecast on our website
10. We also update weather information in Mobile apps (**Druk Namshey**)

Thank you for your attention