

3rd GEOSS Asian Water Cycle Symposium

2-4 November, 2007
Beppu, Japan

Demonstration Basin

(Bhutan)

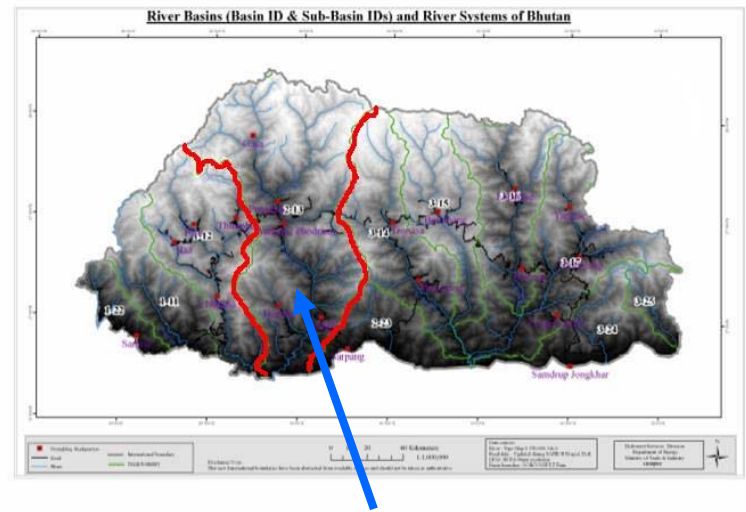
Karma Chhophel
Hydro-meteorological Services
Thimphu: Bhutan

27 10 2007

Why Punatsangchhu or Basin I

- Economic development through construction of hydropower projects.
- Add on social benefits such as schools, health facilities etc.
- Basin prone to GLOF's, so appropriate for flood studies as GLOF is a real threat now as a result of global warming due to climate change.
- Climate change impacts – changes in flow regimes of rivers.

Punatsangchhu Basin or Basin II



Country: Bhutan

Basin Name: Punatsangchhu or Basin II

Basin Area: 13, 263 km²

Latitude: E89⁰21'' – 90⁰24''

Longitude: N26⁰42'' – 28⁰18''

Altitude: 100 masl - >5000 masl

Punatsangchhu Basin

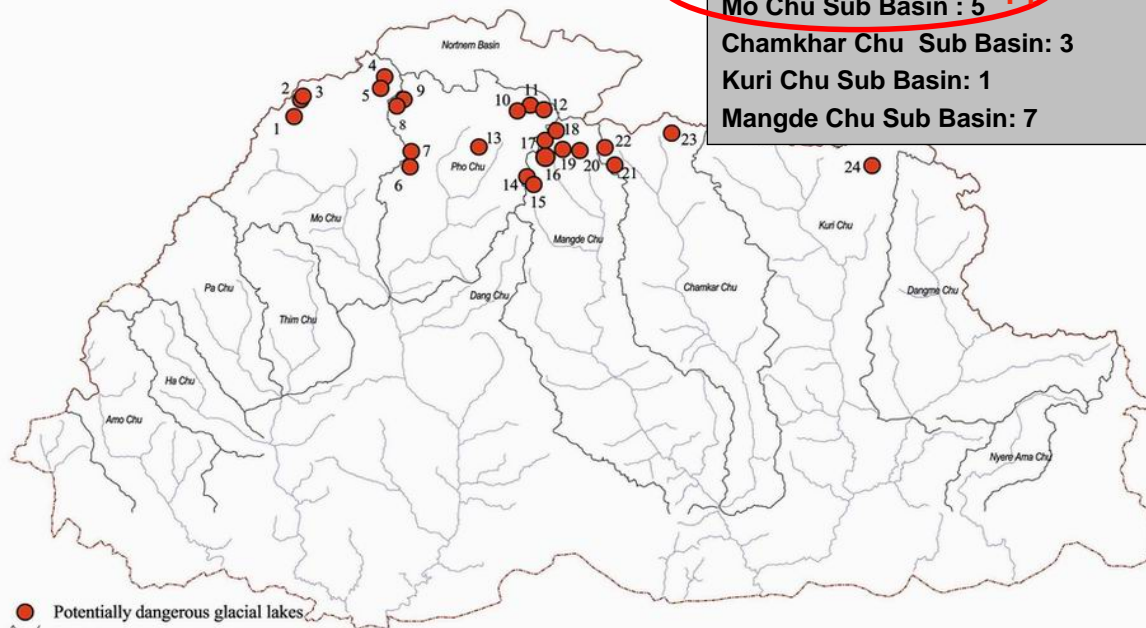
Issues



- Climate Change Impacts
 - Retreat of Glaciers
 - Increases risk of Glacial Lake Outburst Floods
 - Impacts water availability, hence necessary to monitor flow regimes

Potentially dangerous glacial lakes of Bhutan

Pho Chu Sub Basin : 9
 Mo Chu Sub Basin : 5 **14**
 Chamkhar Chu Sub Basin: 3
 Kuri Chu Sub Basin: 1
 Mangde Chu Sub Basin: 7



Number of potentially dangerous glacial lakes = 24

Out of **2674** glacial lakes, **25** has been identified as potentially dangerous lakes.

Source: DGM & ICIMOD publication

Issues

- **Floods**
 - **Flash floods due to short duration high intensity rainfall are recurrent phenomena in Bhutan during the monsoon season in the southern part of the basin**
 - **Determination of an adequate warning system a necessity**



Issues

- **Floods**

- **Sediments affect the optimal performance of hydropower plants.**
- **Study the nature of the sediment load and identification of particles causing damages important.**



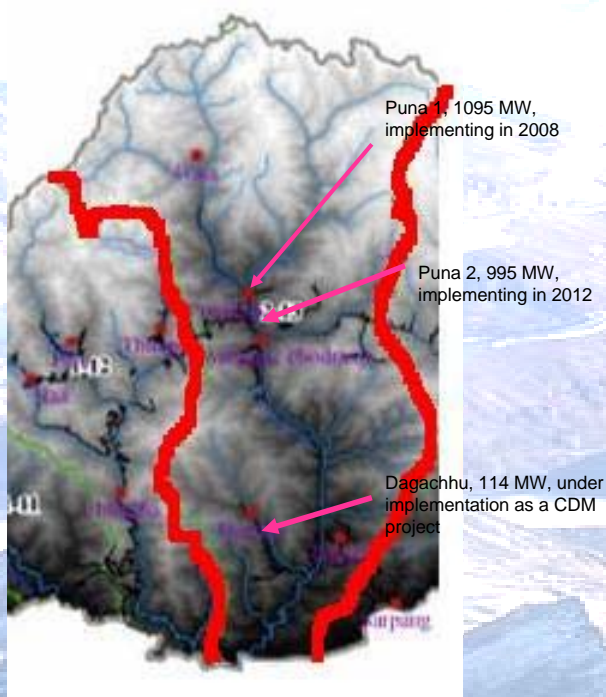
Kurichhu Hydropower Plant

Dam of 1020 MW Tala Dam under Construction

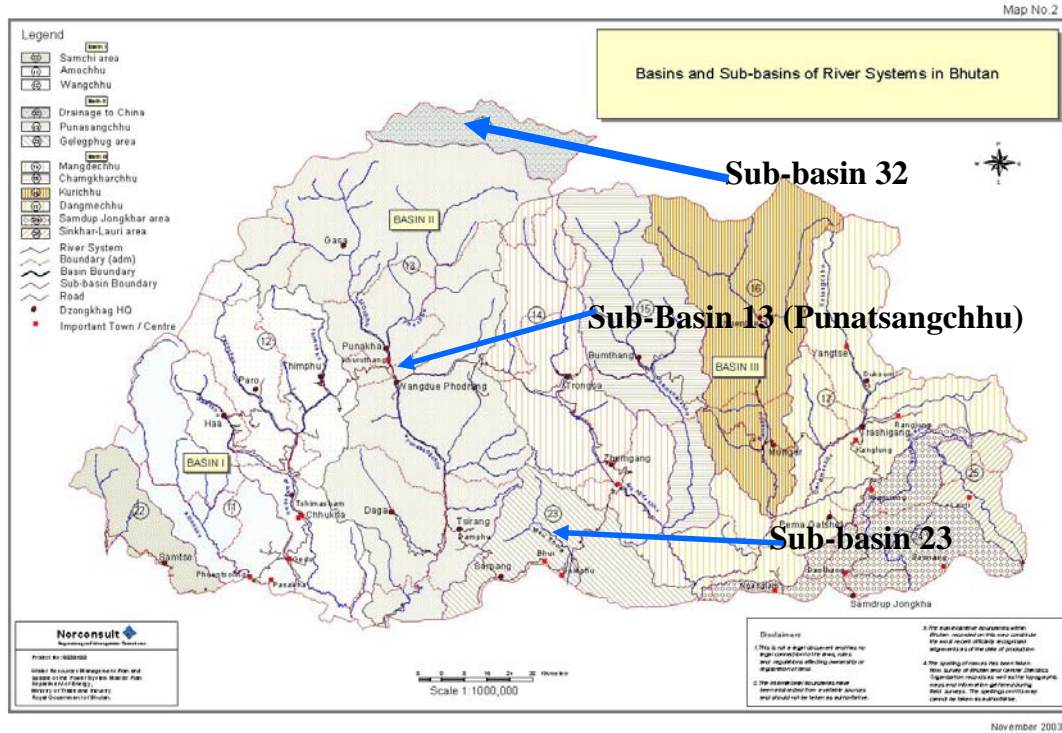
Issues

- **Hydropower Development**

- Socio-economic development
- Issues likely due to environmental flows, upstream and downstream linkages which need to be taken care of while designing a water management plan



Basin Characteristics

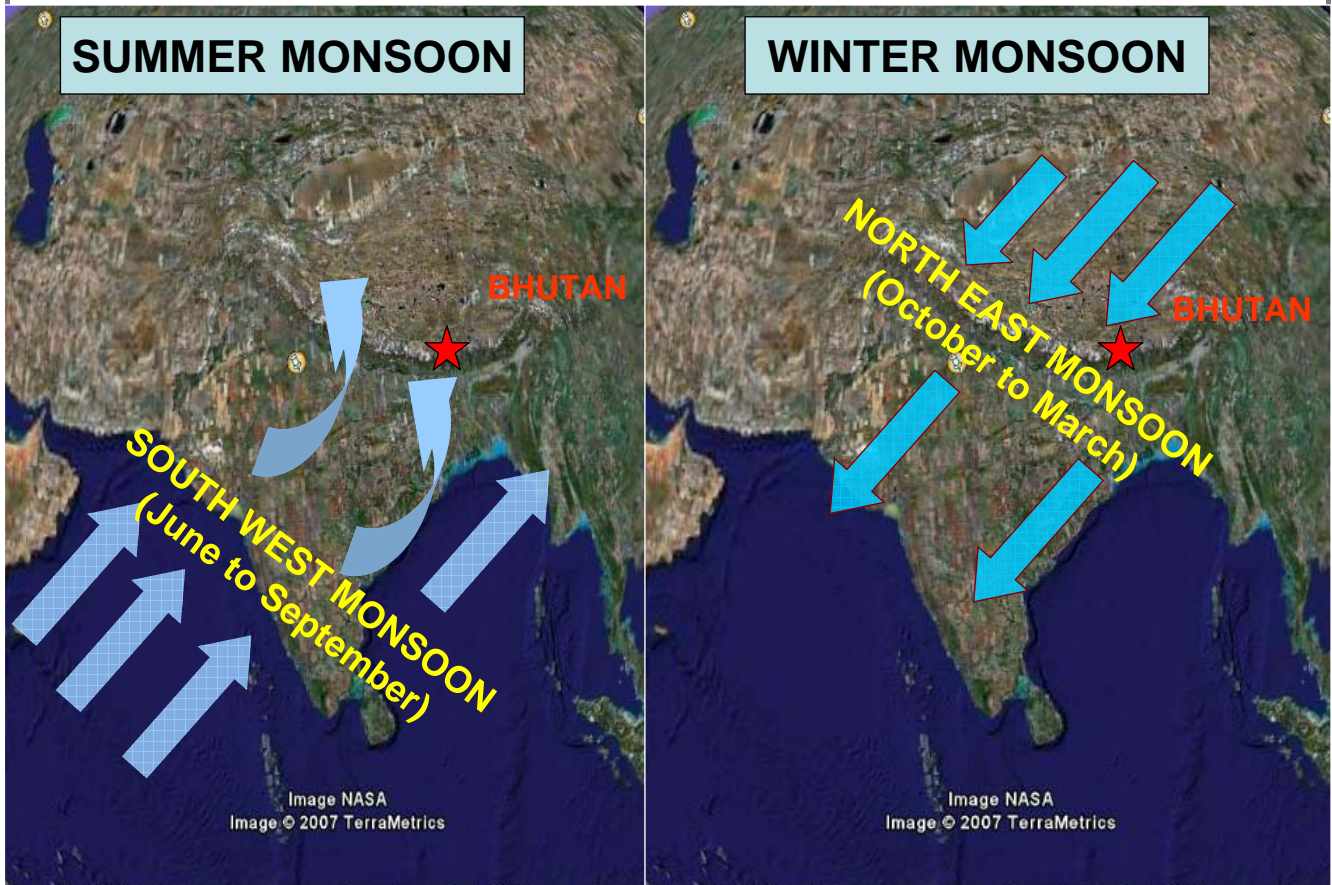


Basin Characteristics

Table I: Basin II River System Characteristics

	Main N/S River	Tributaries	N/S River Origin	Drainage Area km ²	Approx. Length of N/S River (km)	Approx. Average River Slope (%)
Sub-Basin 13 - Punatsangchhu	Punatsangchhu, Mochhu, Pochchu	Dangchhu,	Bhutan Bhutan Bhutan	10,355	134 84 86 57	0.8 4.3 3.6 4.6
Multi-River Basin 13 - Gelephu	Sum for basin	Sarpang Khola Mau Khola	Bhutan Bhutan Bhutan	1,956 145 811	Na 21 21	Na 7.6 1.0
Multi-River Basin 32 - Drainage to the north	Sum for basin		Bhutan	952	na	na

Climatic Condition

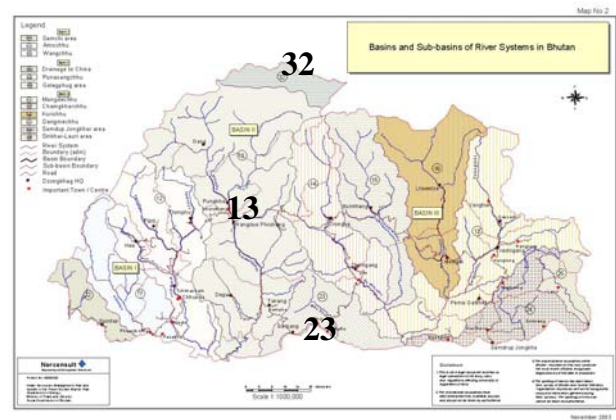


Climatic Condition

- Bhutan Climatic is generally dominated by monsoon winds
 - Dry winter and wet summer monsoon
- Climate of Bhutan is affected by
 - Latitude
 - Altitude
 - Prevailing Wind Direction
 - Orientation of Mountain Ranges
 - Local Winds
 - Vegetation

Land Use and Soil Type

- Land use
 - Agricultural Land Use: 517 km² (3.9 %) of basin area
 - Sub-basin 13: 418 km² (17.8 %)
 - Sub-basin 23: 89 km² (3.7 %)
 - Basin 32 has no agricultural land
- Soil Type
 - Detailed soil survey report not available for the whole basin. Soil survey reports with varying levels of details available for specific locations in the basin.



13

Socio-economic Information

- **Population:** > 200,000
- **Migration:** Evidence of rural-urban migration
- **Income and Expenditure:** Income from agriculture and livestock, expenditure on food, health and religious ceremonies
- **Employment:** Agriculture main source of employment, others include tourism, casual worker, civil service and trade
- **Poverty:** Some areas in the basin vulnerable (vulnerability arrived at by considering income, food security, access to facilities and services)
- **Social Infrastructure:** Basin has 17% of the educational infrastructure. Has access to health through 7 hospitals, 58 basic Health Units and 170+ Outreach Clinics

Observation System

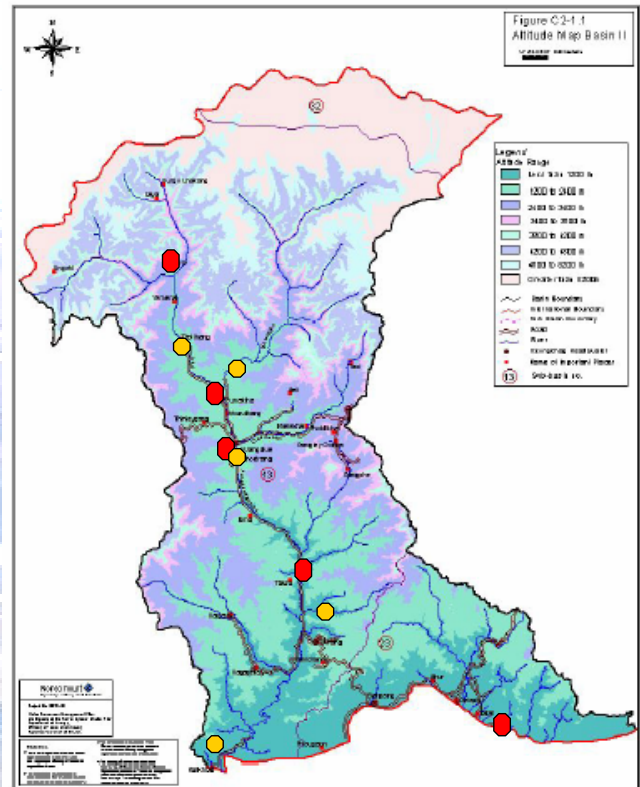
Meteorological Stations (●)

Automatic Weather Stations

(7 parameters) : 5 No.

Hydrological Stations (○): 5 No.

Climatological stations : 17 No.



Models and GIS Data Availability

- Database: HYDATA (CEH Wallingford)
- Hydrological Models
 - DAMBRK, HEC-RAS for simulating Glacial Lake Outburst Floods
 - Working on Mike 11 mathematical modeling for the Punatsangchhu basin
 - GeoSFM (USGS): Geo stream flow model with inputs from rainfall estimation software
- Meteorological Models
 - RFE (Rainfall Estimation) using IR, AMSU, SSMI (NOAA)
- GIS data
 - RS: Aster and IRS
 - GD: Aster and SRTM DEM
 - PD: Hydro-met stations

Implementation Schedule

	2008/I	2008/II	2009/I	2009/II	2010/I	2010/II	2011/I	2011/II
Hydro-meteorological and water quality monitoring								
Data integration system (input data preparation, quality check)								
Improvement of in-situ observation network system								
Setting-up a Distributed Hydrological Model (Optional LSS)								
Scenario Studies: Land use change analysis, dry periods, etc								
Capacity building on Floods, Droughts and Water Quality								
Parallel testing of the system at operational stage								
IWRM plan development floods, droughts and water quality								

