



**The 8th meeting of GEOSS Asian Water Cycle Initiative and
1st Climate Change Assessment and Adaptation Workshop
Seoul, Korea, 2011**

AWCI Activity Country Report: Nepal

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And

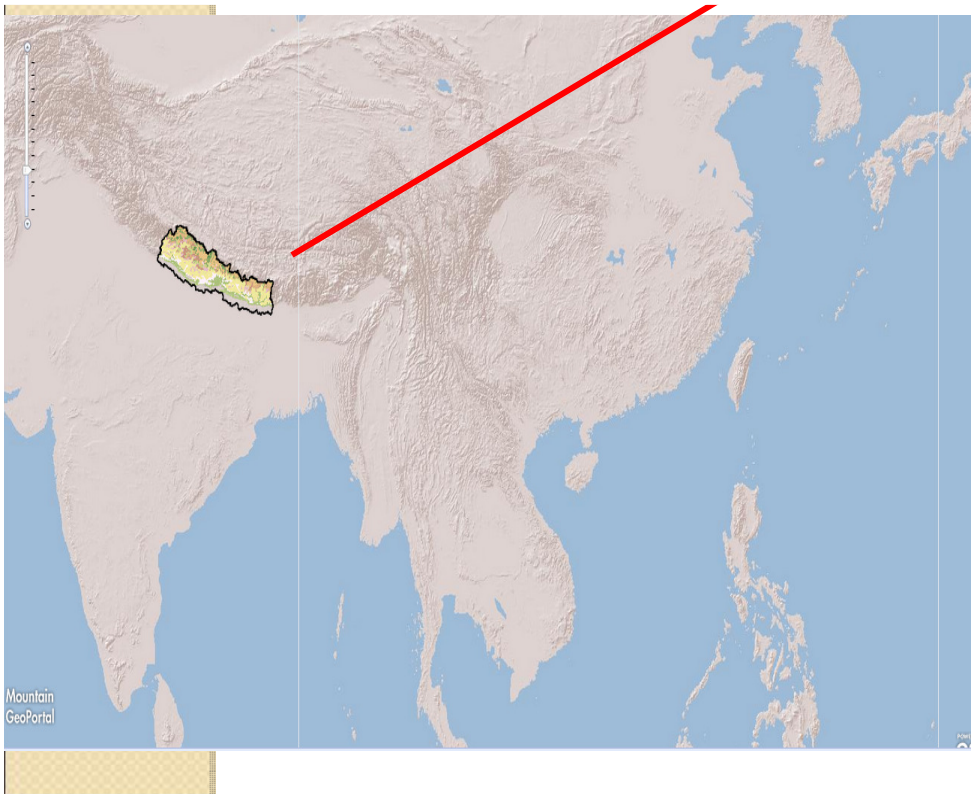
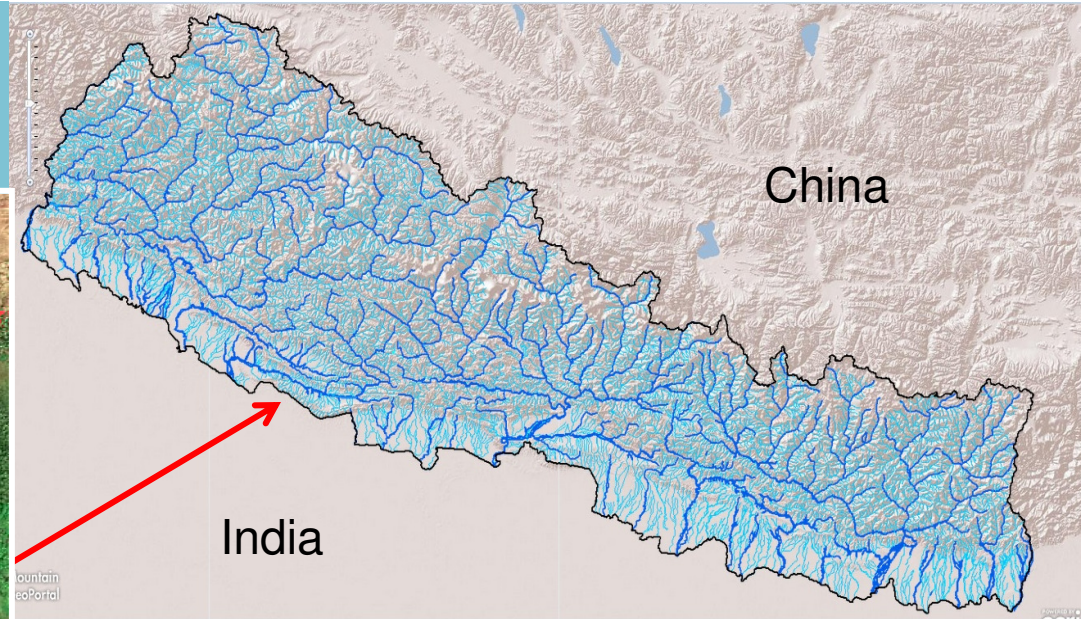
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Nepal: At Glance



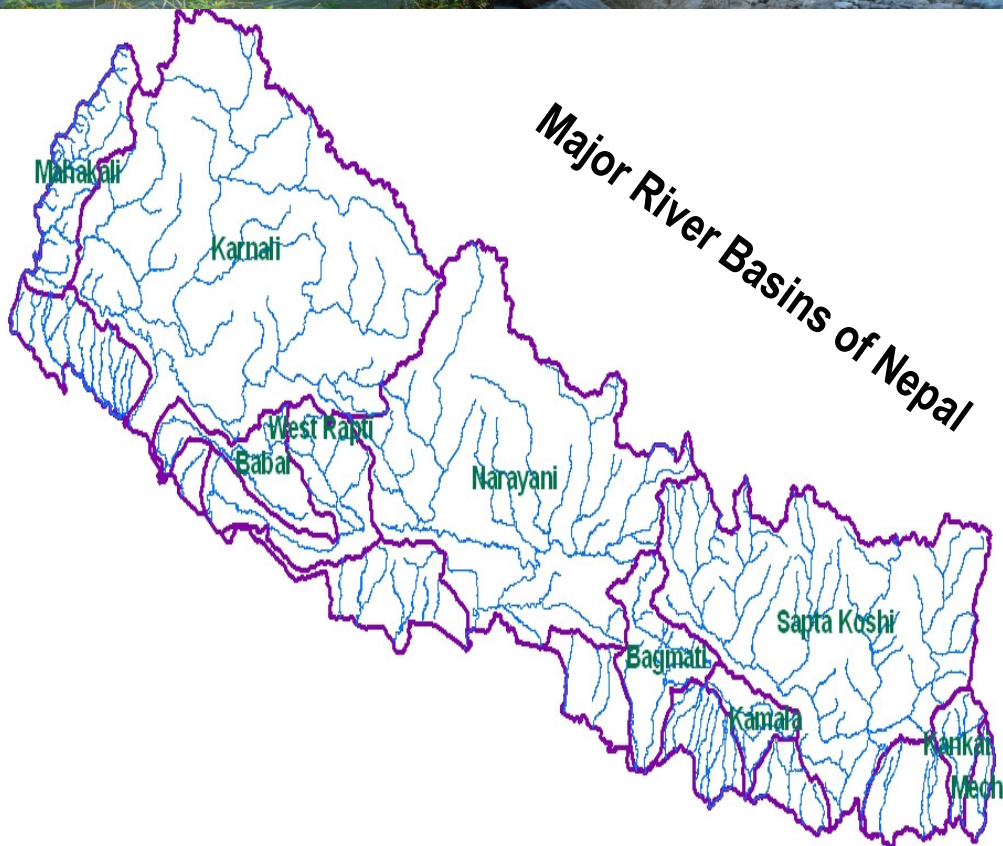
- Area – 147181 Km²
- 3 Ecological zones : Himalaya, Mountain & Terai
- Approx. 6000 Rivers and rivulets with drainage area 194471 Km² (76% in Nepal)
- 33 Rivers with CA > 1000 Km²
- Elevation – 8848 m to 64 m from AMSL

Nepal: Unique Country

- Inaccessibility
 - World's highest peak & deepest gorge with very high degree of inaccessibility
- Verticality
 - Extremely rugged terrain with high topographic variations within short distance
- Fragility
 - Youngest geological formation & fragile mountain ecosystem
- Diversity
 - Diverse physical climatic & social Conditions



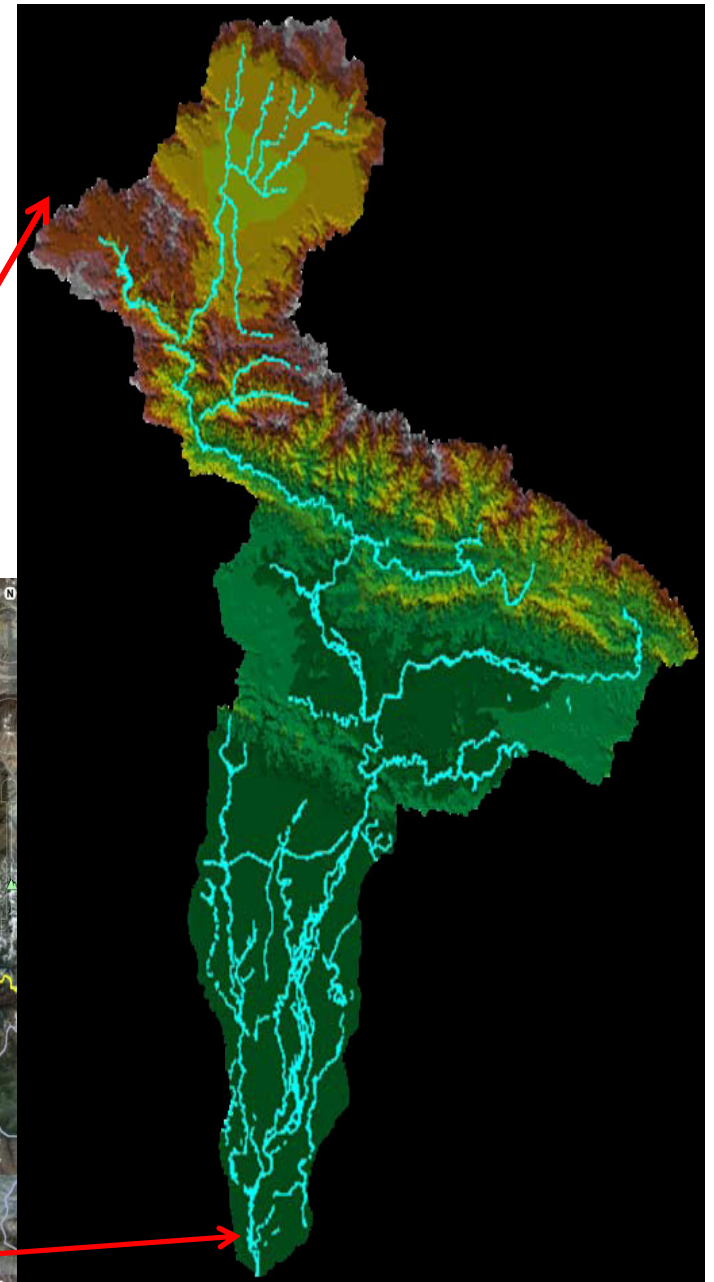
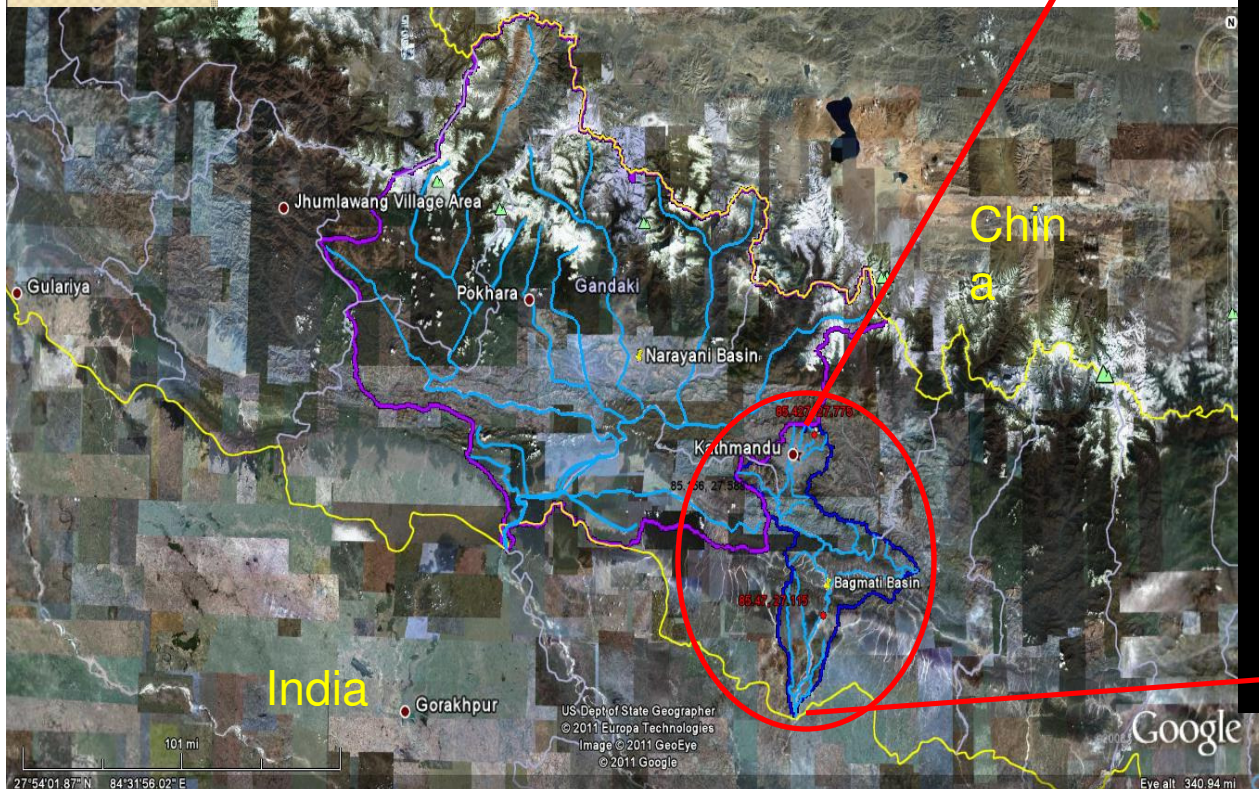
Nepal : Water Resources



- Three types of Rivers
 - Perennial with snow fed: Koshi (60400 Km²); Narayani (34960 Km²) ; Karnali (43679 Km²) & Mahakali (15260 km²)
 - Rivers Originated in mid hills, fed by precipitation & GW
 - Small rivers originated in southern siwalik range, flow during monsoon
- Annual surface Water availability : 225 BMC
- Annual rechargeable GW: 11.5 BMC
- Annual Avg. Precipitation: 1857 mm
- Avg. drainage density: 0.31/km² and total length of streams: 45000 Km

NEPAL: Demonstration Basin

- AWC Demo Basin: Bagmati River Basin
- CA : 3700 Km² up to Indo – Nepal Border, 14384 Km² up to Khormaghat in Koshi River



Demonstration Basin: Bagmati River Basin

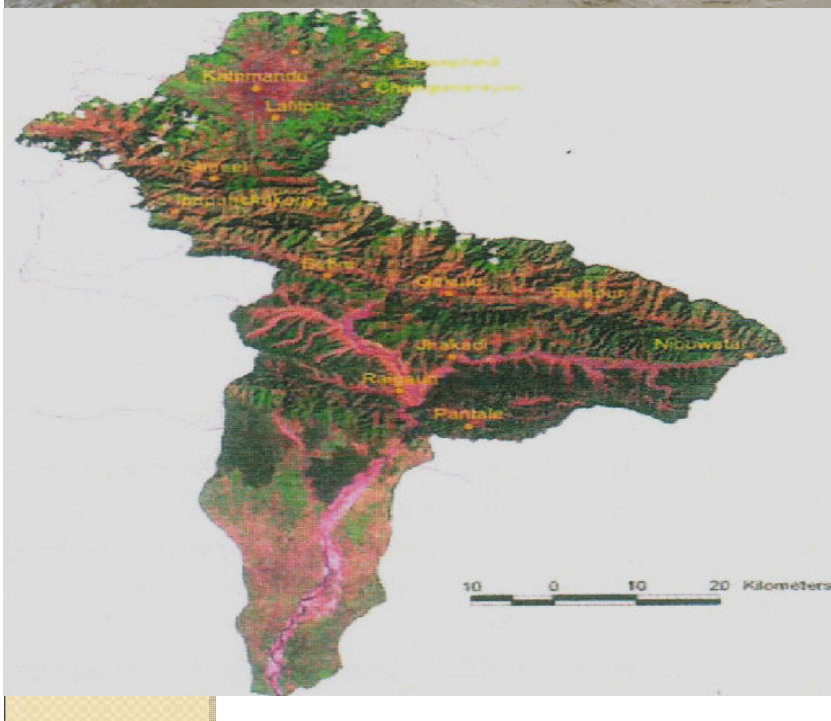


- Geographically extends between $20^{\circ} 42'$ to $27^{\circ} 50'$ N latitude & $85^{\circ} 02'$ to $85^{\circ} 58'$ E longitude
- Originate from Shivapuri Hill (2731 m) & flow down to south (75 m)
- Major tributaries: Nakhhu, Kulekhani, Kokhajor, Marin & Chandi River
- The Climate of the basin : 3 climate zones
 - Subtropical sub humid zone < 1000 m – 35%
 - Warm temperate humid zone (1000 – 2000 m) – 60%
 - Cool temperate humid zone > 2000 m – 5%

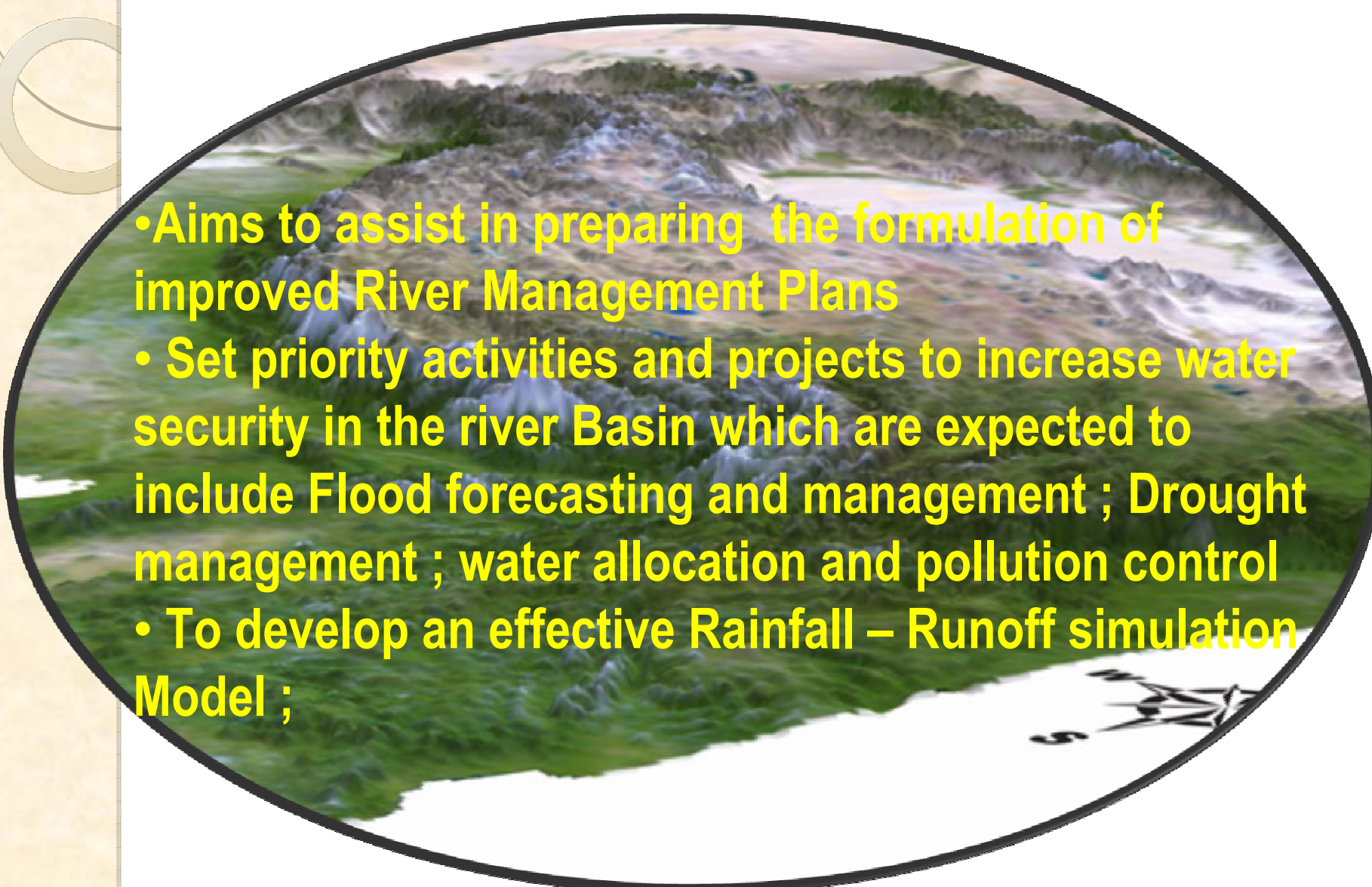
Bagmati Basin



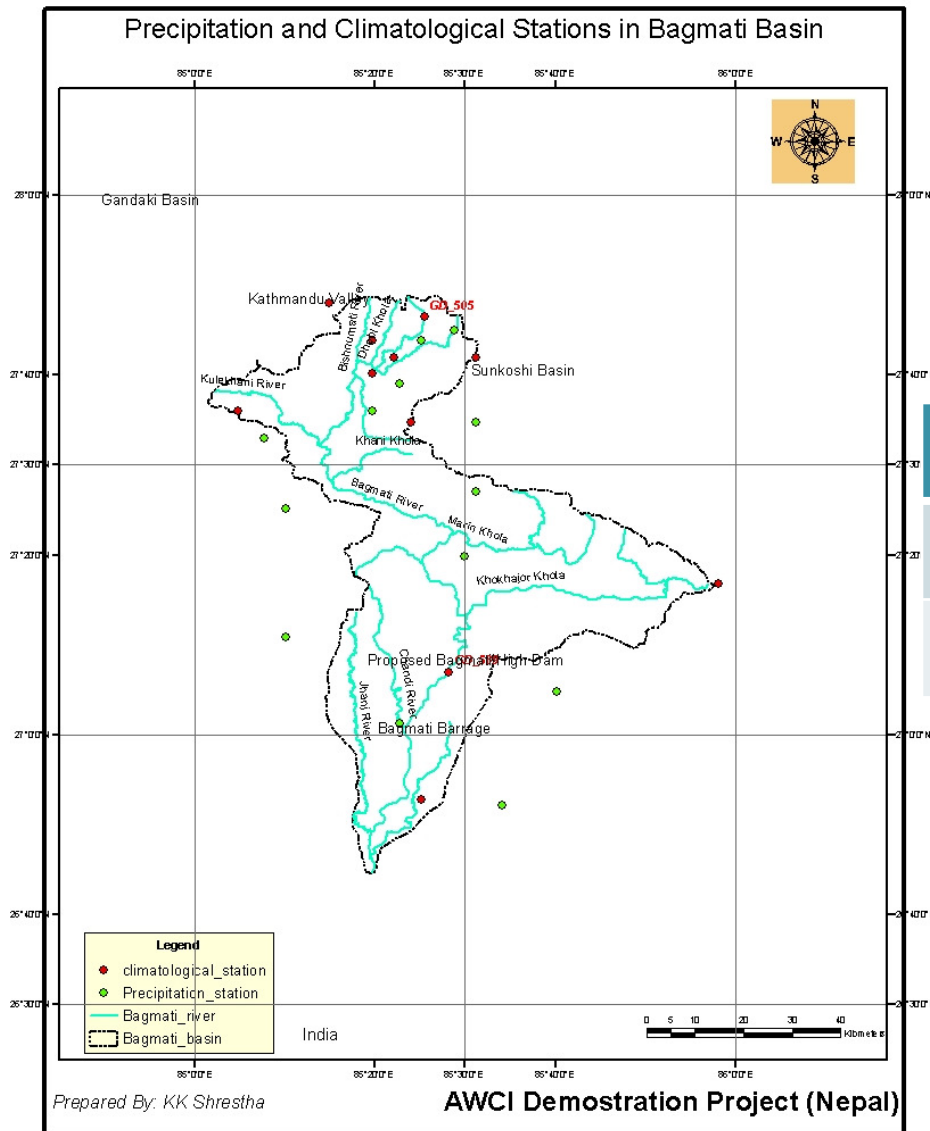
- Rainfall influenced by south west monsoon;
- Avg. Annual Precipitation - 1500 mm in the southern part and 2000 mm in the northern part of basin
- Observed instantaneous peak flood – 16000 m³/s at GD site 589 (July 21, 1993)



Objective of the Study: Bagmati Basin

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- Aims to assist in preparing the formulation of improved River Management Plans
 - Set priority activities and projects to increase water security in the river Basin which are expected to include Flood forecasting and management ; Drought management ; water allocation and pollution control
 - To develop an effective Rainfall – Runoff simulation Model ;

Bagmati Basin: Hydro Meteorological Data



- Gauge Discharge Station: two
 - St. No: 505
 - St. No: 589
- Details of Stations:

GD Site	Area sq. km	River L (km)	Avg. slope	BF	Avg. Ele	P ann	P mon
505	17	5	13%	1.16	2060	2174	1828
589	2922	113	11%	1.59	1058	1749	1426

- Meteorological Stations:
 - Climatological Stations: 9
 - Precipitation Stations: 12
- T_{max} , T_{min} , P, RH, WS

Bagmati Basin

- Available data – registered to DIAS Database
- Meta data registration – yet to be completed (Partial)
- Radiation, heat flux , pressure, CO₂ flux data – not available

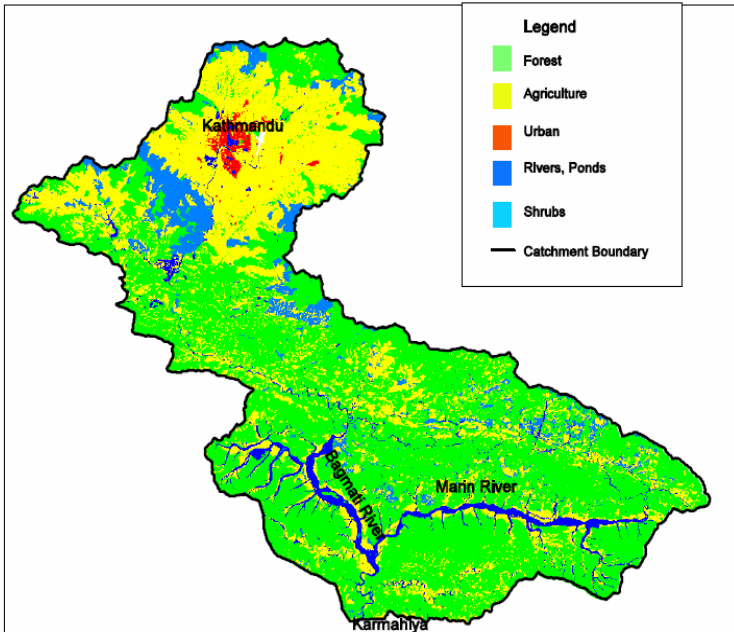
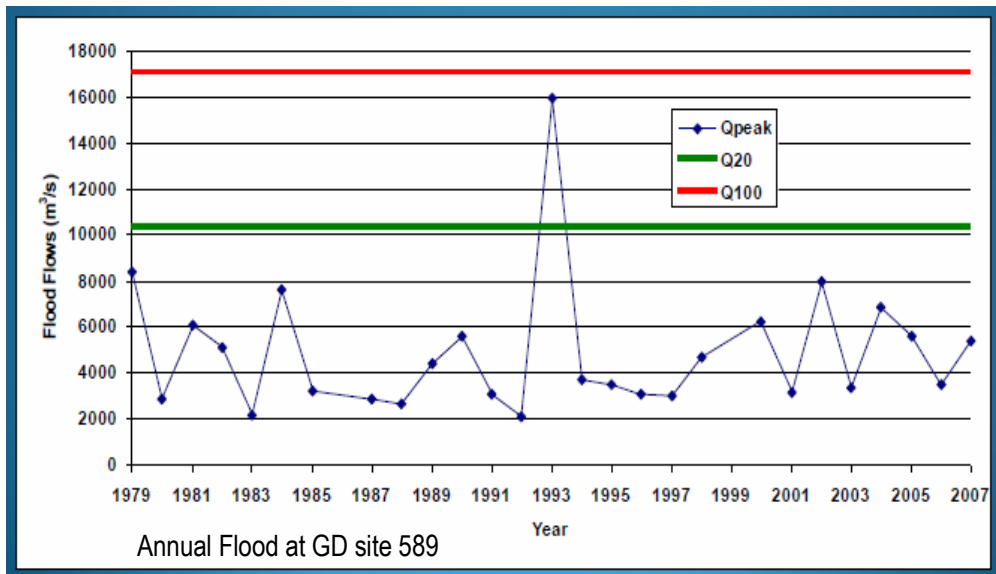


Figure 4: Landuse Map of the Upper and Middle Bagmati River Basin



CCAA Study Basin: Narayani Basin



- Total C. Area : 34960 Km²
 - In Nepal: 29626 Km²
 - In China: 5334 Km²
- Geographically extends between 27⁰ 21' to 29⁰ 52' N latitude & 82⁰ 53' to 85⁰ 48' E longitude
- Major Tributaries: Budhi gandaki, Trishuli, Marsyandi, Kaligandaki, Seti
- Originated from Nhubine Himal Glacier (6268 m) in Tibet – Nepal Boarder

CCAA Study Basin: Narayani Basin

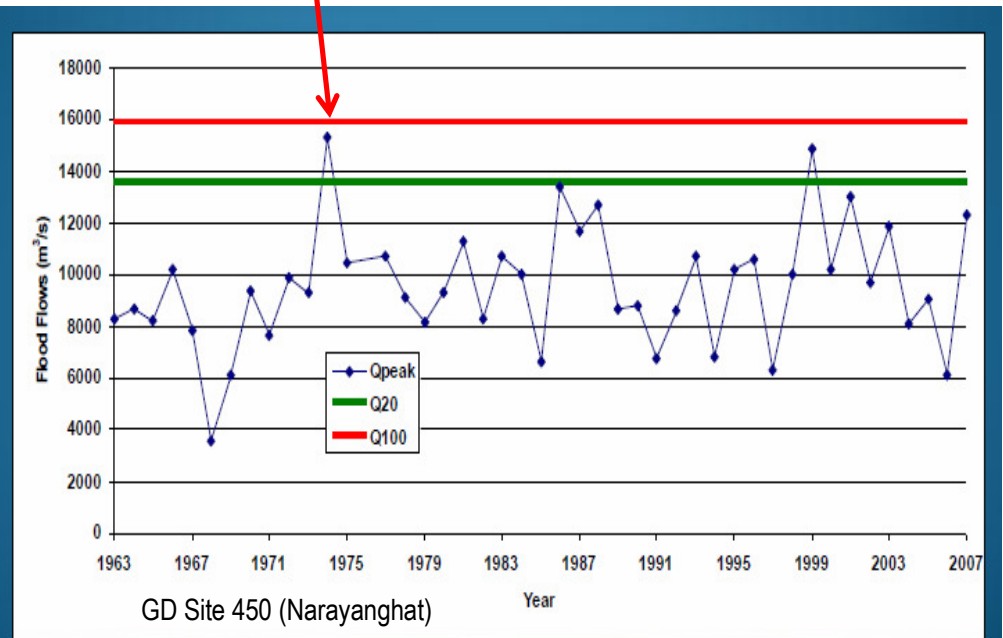


- Elevation variation from 8167 m (Dhaulagiri) to 106 m at outlet point
- Narayani Basin contains about 1025 glaciers and 338 lakes
- Tremendous variation in climate of the Basin:
 - Fully Tropical climate < 500 m;
 - Sub tropical climate between 500 – 1200 m
 - Warm temperate climate (1200 – 2400 m)
 - Cold climate zone (2400 – 3600 m)
 - Sub Arctic or Alpine zone up to 4400 m
 - Fully Arctic zone > 4400 m

CCAA Study Basin: Narayani Basin



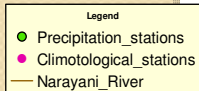
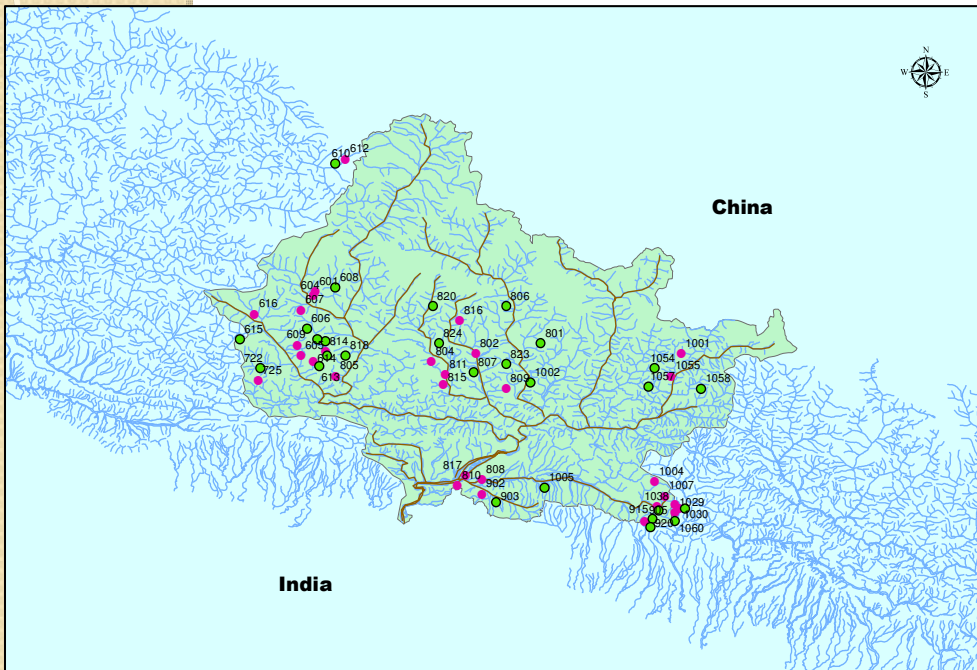
- Narayani River outlets to the mighty Ganges at Sonapur India traversing 630 Km south east from its origin
- Max Observed discharge at GD Site 450 (Narayanghat) is 15400 m³/s in Aug 05, 1974



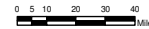
Objective of CCAA Study

- To set up a methodology for quantifying uncertainty of climate project
- To set up a methodology for correcting bias of the projected forcing variables
- Produce projections of water resources and water hazard related variables by employing a proper hydrological model using corrected projected forcing
- Assess the impacts of climate change on changes in water resources and water related hazards
- Recommendation for adaptation strategy

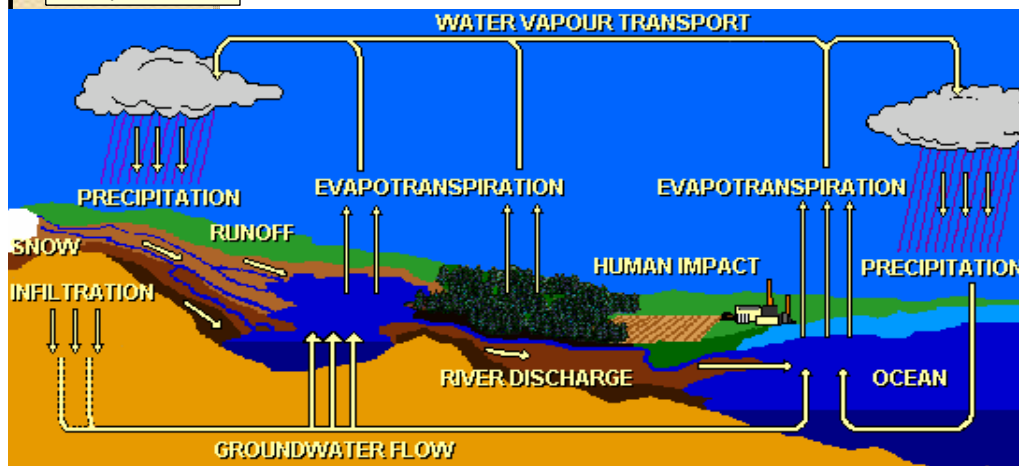
Narayani Basin: Meteorological Stations



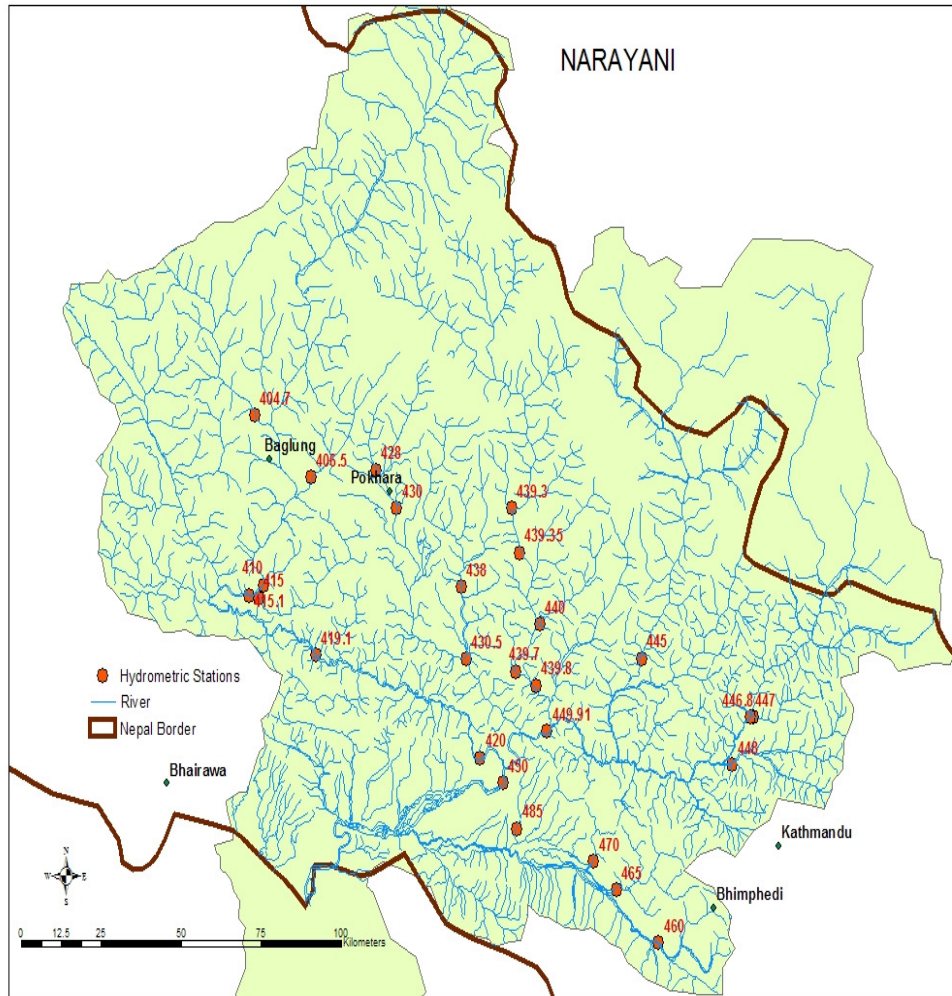
Narayani Basin



- Total Meteorological stations : 58 nos.
 - For precipitation: 58
- Climatological : 31
 - For T_{max} and T_{min} : 31



Narayani Basin: Hydrometric Stations



- Hydrometric station within Basin : 26
- Data submitted to DIAS

Nepal Involvement: AWCI next stage



Current Availability & Use of data

- Water related decisions for sectoral uses are being made by concerned line agencies: irrigation uses by DOI; Hydropower by NEA; Water supply by DWSS
- Effort is being recently made to set up a single institution which can take decision on water related issues in holistic approach
- Mostly observed in situ data (hydromet) is used in decision making; remotely sensed data use specially to assess land resources; disaster related modeling; HEC simulation model used

Nepal Involvement: AWCI next stage



- Gaps & difficulties in data – very common; data length & availability – less; baseline data – rare; Resolution & accuracy – poor; coverage & frequency of data – merely acceptable; Real time data yet to be introduced
- DHM is a sole responsible agency to acquire the water related data in the basin; extreme event like flood is frequent in the basin; flood forecasting system yet to be established; DHM is making effort to establish real time data
- Difficult to identify single impediment for successful management of the basin:

Nepal Involvement: AWCI next stage



- Impediment may be:
 - Lack of single basin wise institution which can take all water related decision based on IWRM principle
 - Lack of sufficient remotely sensed data and insufficient in situ observed data;
 - Lack of consorted effort from the line agencies of the government

[WCI framework; principles & Resources for pilot project](#)

- Climate modeling of overall basin may help to bring in together different kinds of water related information in single place

Nepal Involvement: AWCI next stage



- Help on decision making process for:
 - _allocation of water for different uses
 - Optimization of water use in case of conflicting situation
 - Disaster mitigation of extreme hydrological events
 - Planning for development of water resources development
 - Climate change projection
- Nepal has approved National Water Plan (NWP) on 2005. Doctrines of NWP are
 - Integration, coordination, decentralization, participation & implementation of water related programs within the frame work of good governance, equitable distribution & sustainable development

Nepal Involvement: AWCI next stage



- As per NWP, WECS is apex body in water sector
- River Basin Authority (RBA) is not yet established, DOI can be a good candidate to coordinate the study for time being because it has enough strength.
- DOI can avail Engineer with specialization on water resources development; hydrology; river engineering; irrigation and environment and can also avail some logistic supports.

Nepal Involvement: AWCI next stage



- There are number of Irrigation & hydropower projects within basin either developed or planned.
- Either problem resolution or infrastructure development project can be taken to ensure long term benefits
- Basin is chosen because of good accessibility, data availability, represent overall Nepalese climatic condition, size & coverage, populated area
- Basin has significant snow covered area, in-situ observation data is less in snow covered area, some part of basin lies in Tibet, data from Chinese counterpart

Thank you

