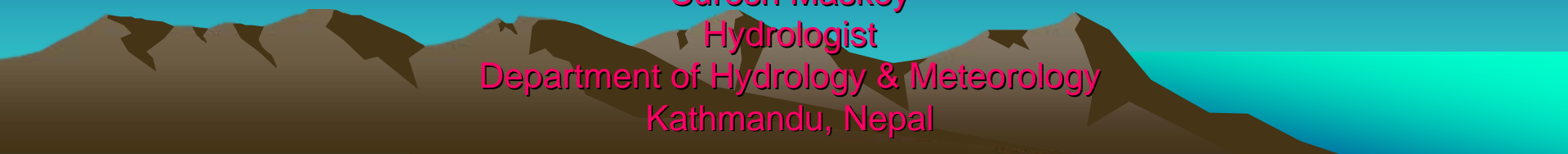


International Workshop on Socio-Economic Benefits of Hydrological & Meteorological  
Services  
21-28 September 2009

Presentation on  
**HYDROLOGICAL & METEOROLOGICAL  
SERVICE OF NEPAL**

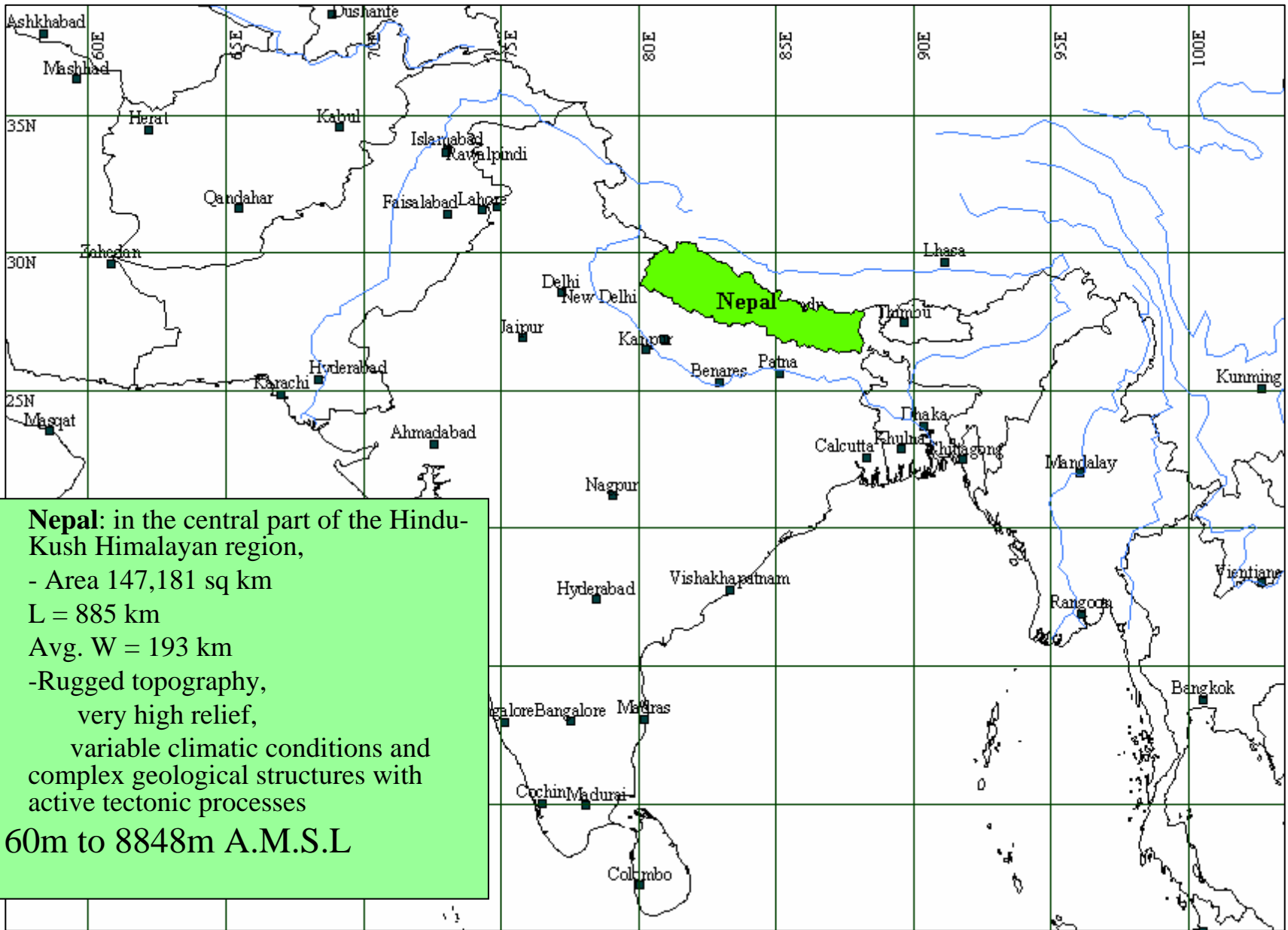
by  
Suresh Maskey  
Hydrologist  
Department of Hydrology & Meteorology  
Kathmandu, Nepal

A stylized, low-poly silhouette of a mountain range in shades of brown and tan, positioned at the bottom of the slide against a blue gradient background.

# PRESENTATION TOPICS

- General Features of Nepal
- Hydrological & Meteorological Scenario
- Activities of DHM :
  1. Hydrology Service
  2. Meteorology Service
  3. Weather Forecasting
  4. Flood Forecasting
  5. Snow & Glacier Hydrology





- **Nepal:** in the central part of the Hindu-Kush Himalayan region,
- - Area 147,181 sq km
- L = 885 km
- Avg. W = 193 km
- -Rugged topography,
- very high relief,
- variable climatic conditions and complex geological structures with active tectonic processes
- - 60m to 8848m A.M.S.L

# CLIMATE

Tropical to Alpine

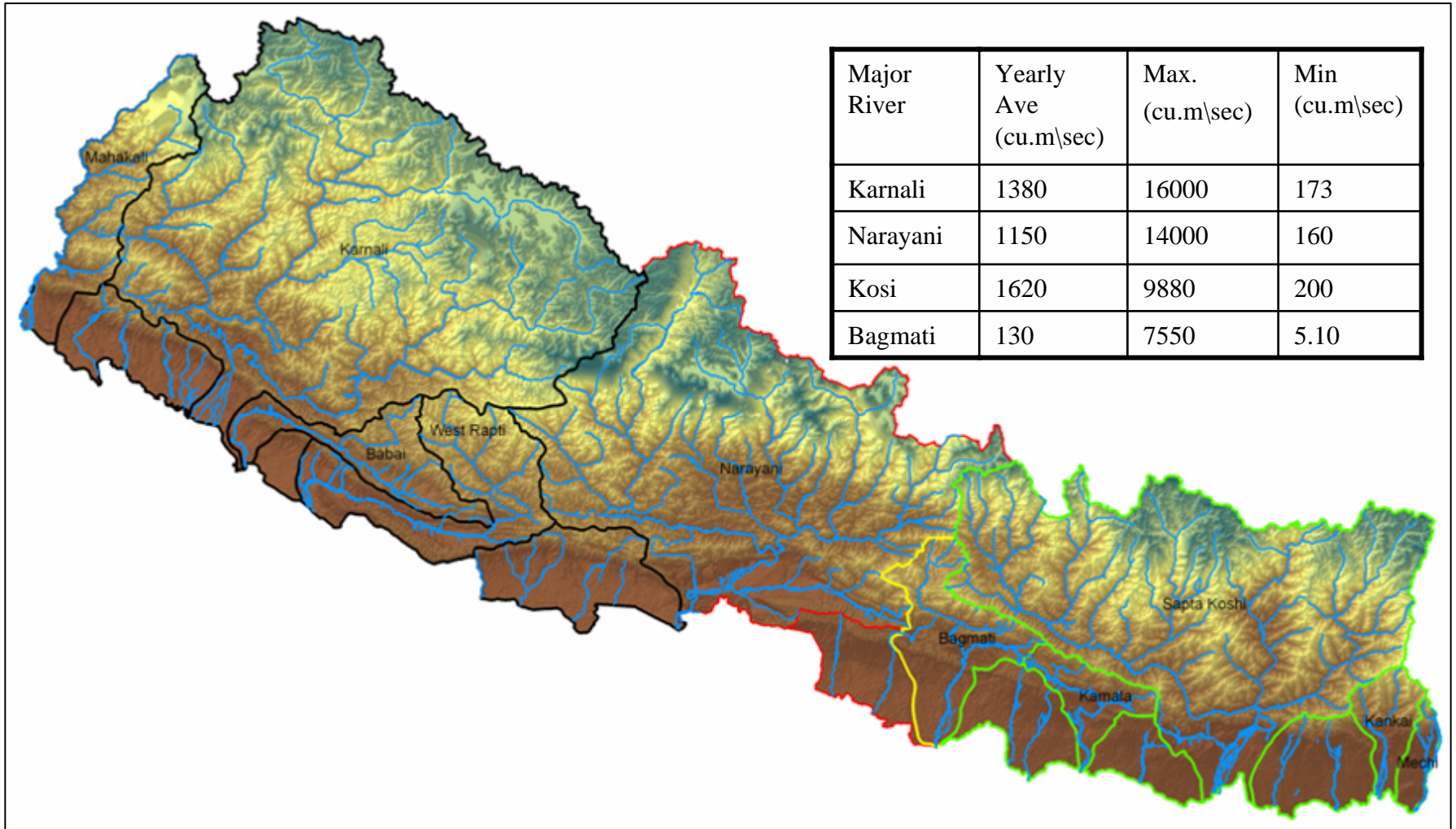
+40 to -50 C

Wet to Dry

250 to 6000 mm

80% Precipitation during Summer Monsoon

# Major River Basin of Nepal

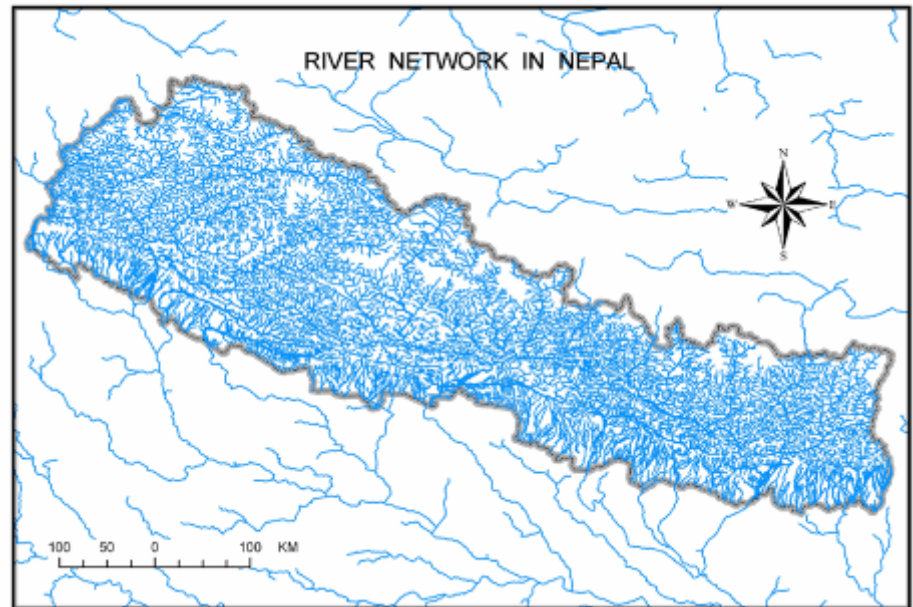


# HYDROLOGY

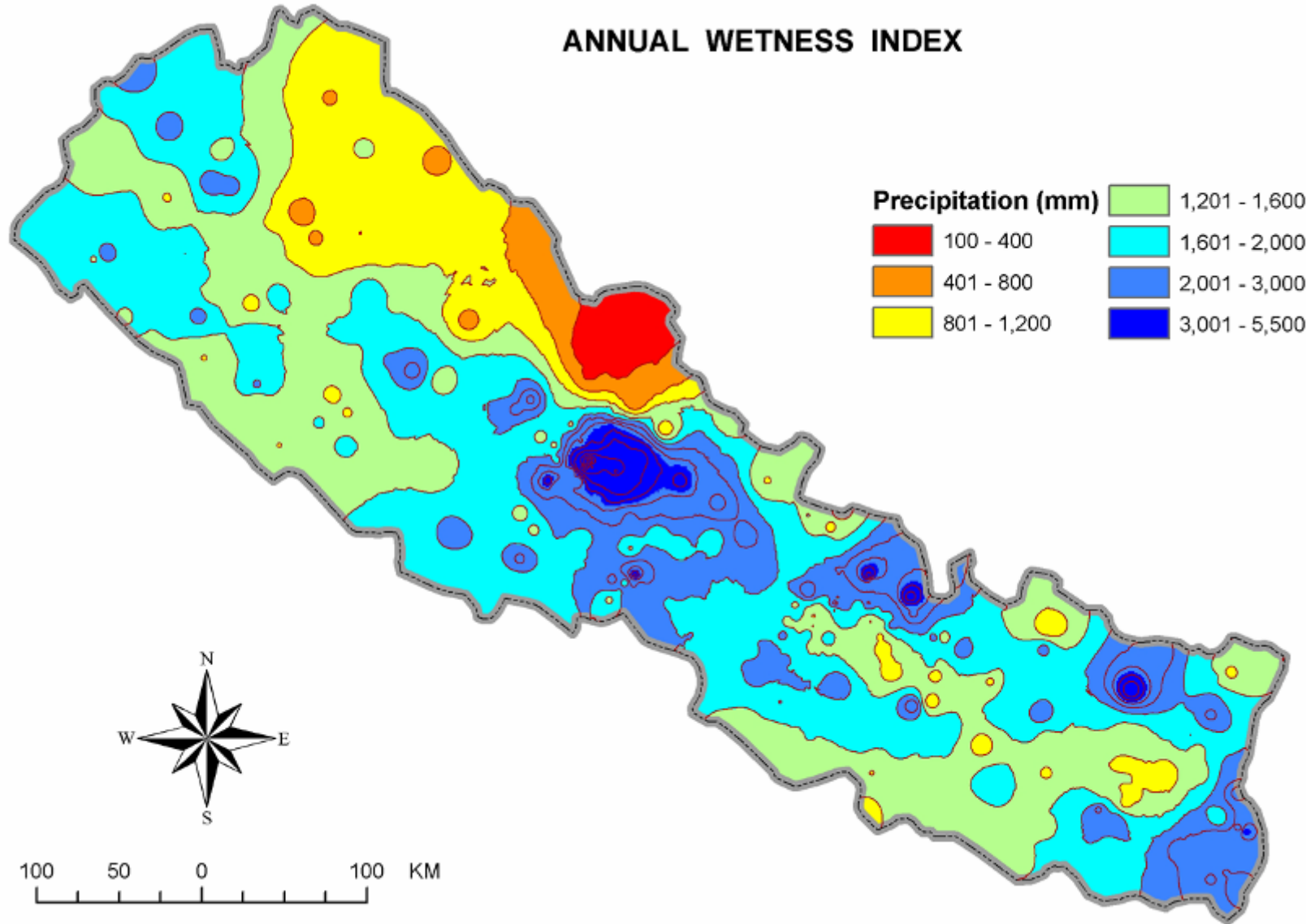
- 6,000 Rivers & Rivulets

Drainage Area = 194,000

- Three classes of Rivers
  - Snowfed
  - Rainfed
  - Seasonal



# ANNUAL WETNESS INDEX



# HYDROPOWER

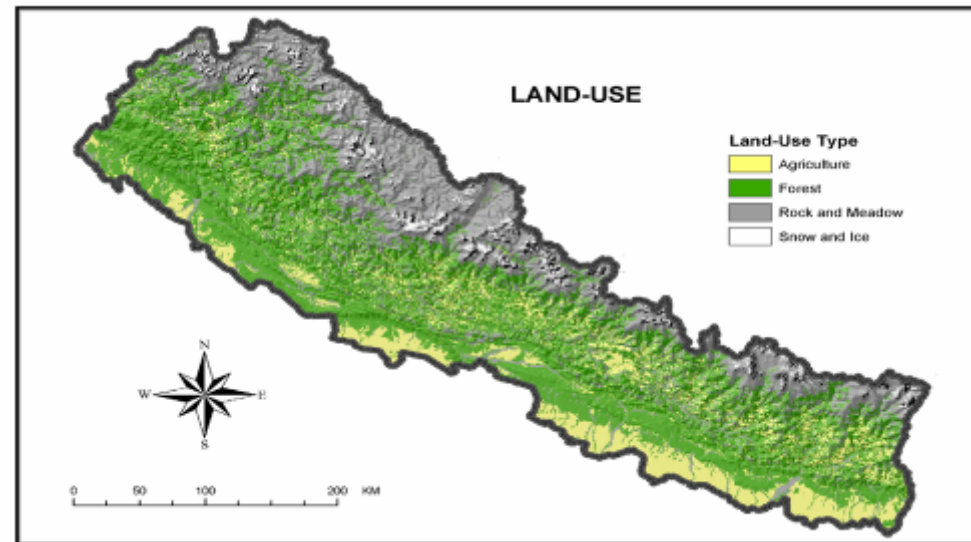
- 83,000 MW potential
- 43,000 MW feasible
- 527 MW exploited
- Meets only 2005 demand
- Access to 40% population





# Land use of Nepal

Type of land use	Area (sq. km)	%
Forest	55334	37.6
Agriculture	26533	18.0
Snow	22463	15.3
Pasture	19785	13.4
Water	4000	2.7
Settlements and Roads	1033	0.7
Others (waste land, etc)	18033	12.3
Total	147,181	100



Ministry of Environment  
**Department of Hydrology and  
Meteorology**

Babar Mahal



# Division

\* Meteorology Division

\* Weather Forecasting Division

\* Hydrology Division

Total staff: 237

# \* Meteorology Division

## Activities

- Collection, processing and publication of meteorological data
- Climate change study
- Solar and Wind Study
- Agro-meteorological study



DEPARTMENT OF HYDROLOGY & METEOROLOGY  
 EXISTING HYDROLOGICAL & METEOROLOGICAL  
 STATIONS  
 1994

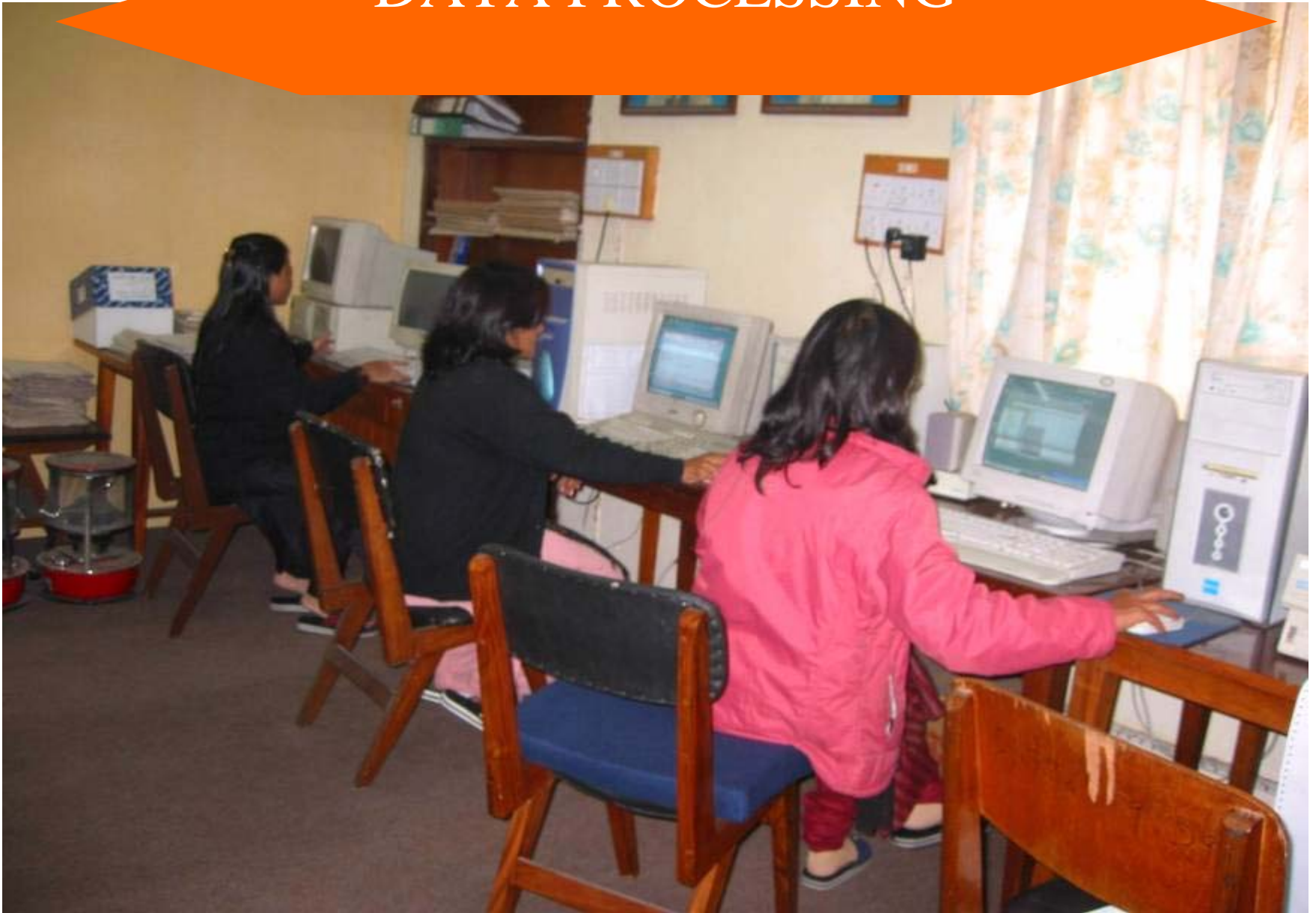
Meteorological Stations

- PRECIPITATION -337
- CLIMATOLOGY - 68
- AGROMETEOROLOGY - 22
- SYNOPTIC - 9
- AEROSYNOPTIC - 6
- AWS - 18

Total

460

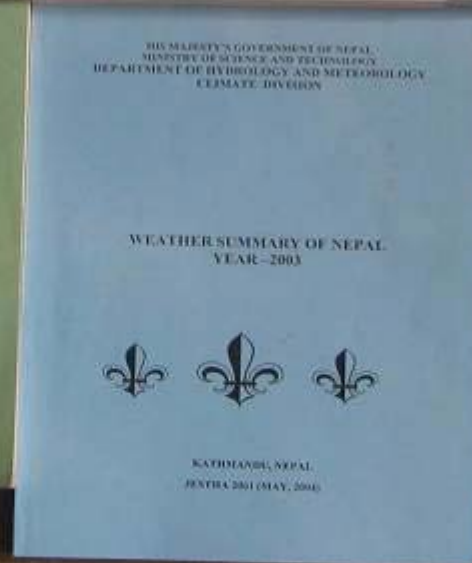
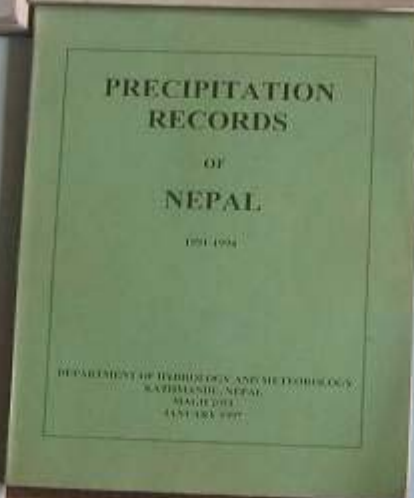
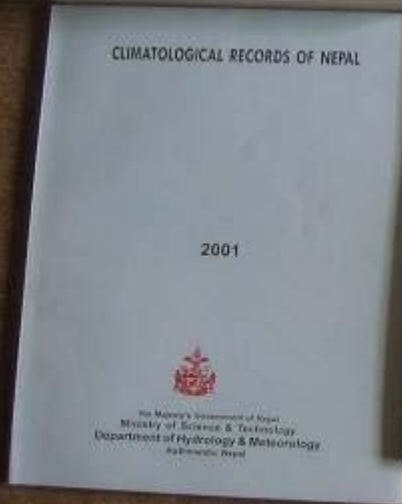
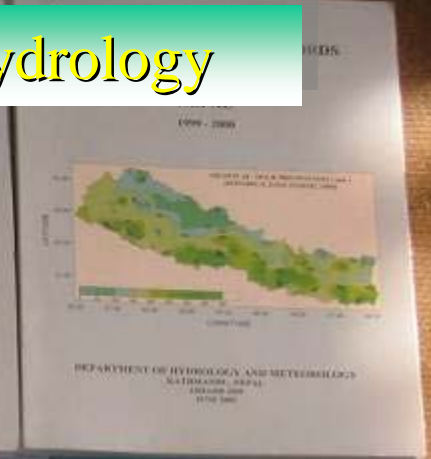
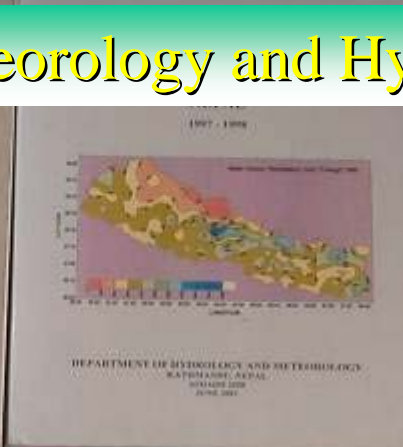
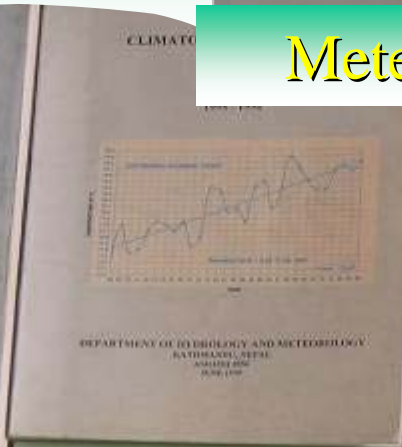
# DATA PROCESSING

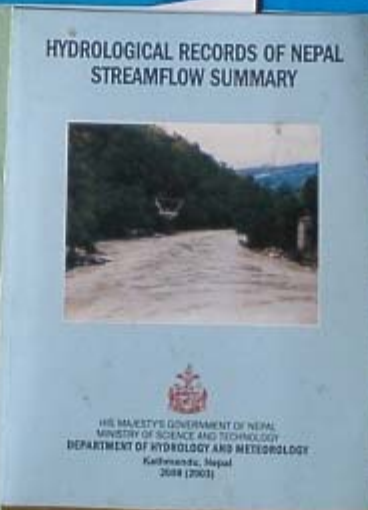
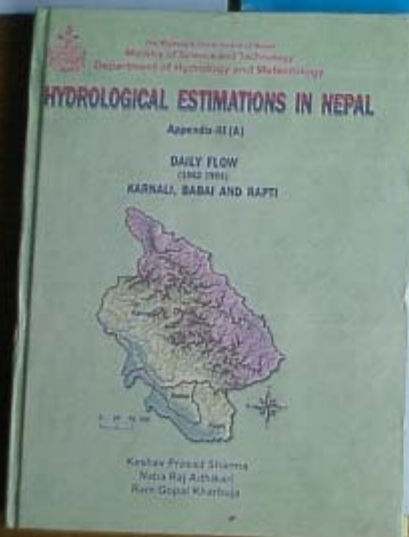
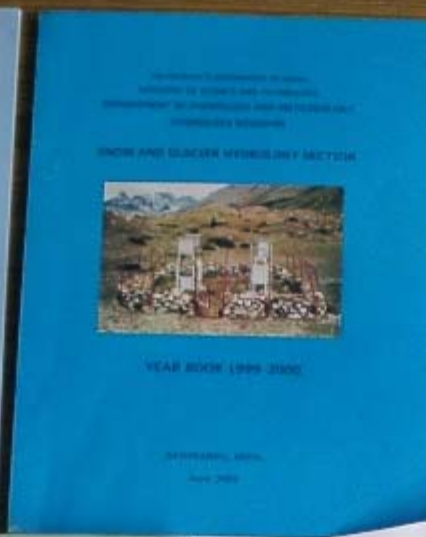
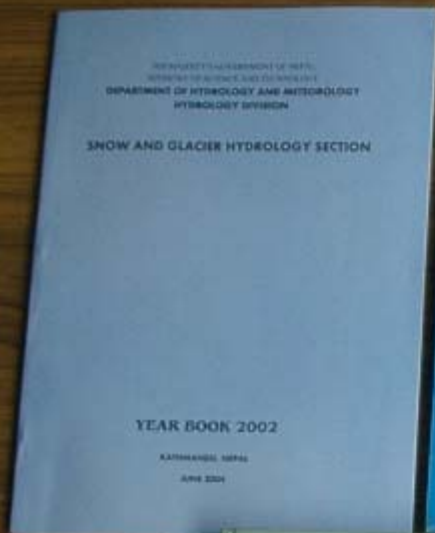


# Publications

# Yearbook

## Meteorology and Hydrology

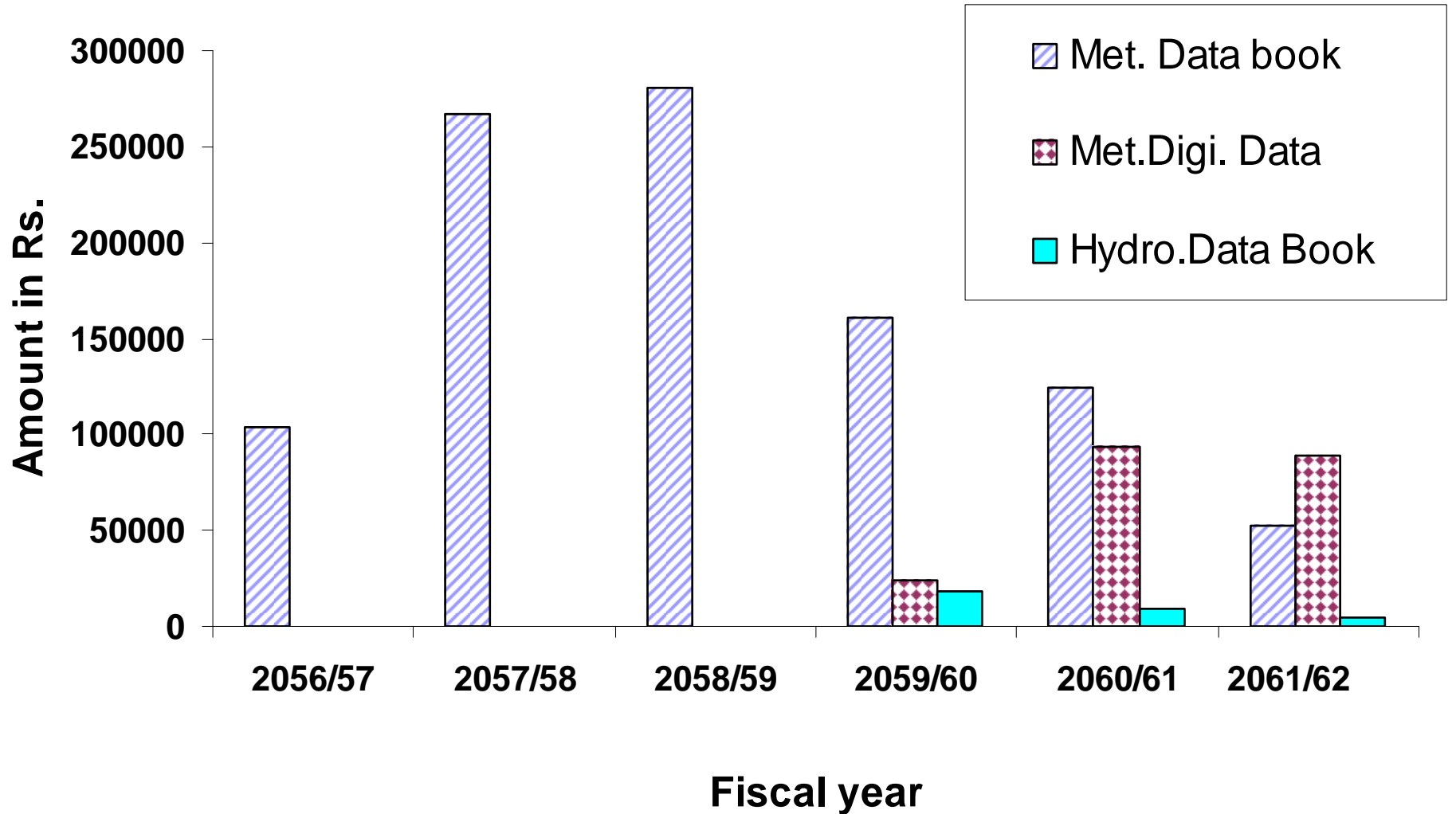




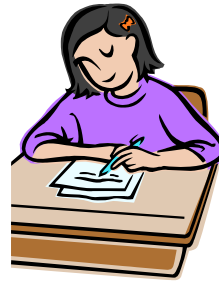


# REVENUE

## Revenue from Data book & Digital data



# DATA USERS



- **STUDENTS/RESEARCHERS: 74 %**
- **CONSULTANT: 12 %**
- **INSURANCE : 4 %**
- **OTHERS: 10 %**

# Weather Forecasting Division

**Weather Forecasting Division**  
**Airport, Kathmandu**

# Synoptic Station

Airport, Kathmandu

• 15 Synoptic Stations

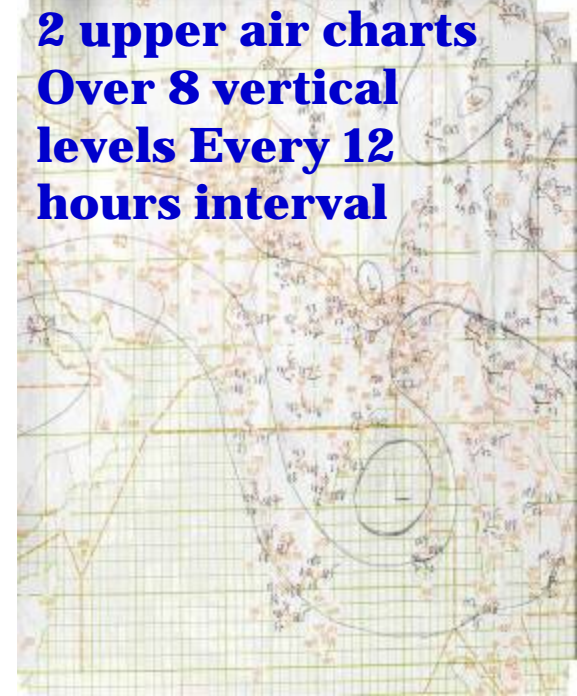


# Data Collection & Distribution System

- Tele-printer
- Radio
- AMSS
- SADIS



# Plotting & Analysis



# Weather Forecasting

## Weather forecasting process

- Collection of weather data from various parts with the country
- Collection of weather data from neighboring countries as well as from different parts of world.

## Weather forecasting tools:

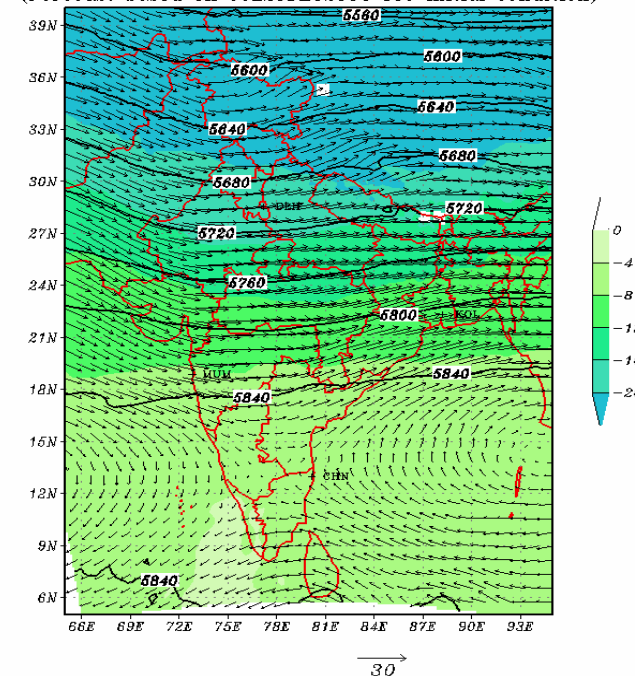
- Weather data from various parts of world
- Satellite imagery
- SADIS
- Numerical weather prediction outputs from India and other countries
- Weather information from different parts of world



## Tools

- Synoptic Charts
- Satellite Images
- NWP Guidance

MMS MODEL 500hPa TEMP, GEOP. HT & WINDS  
DAY 2 FCST VALID FOR 00Z25DEC2004  
(Forecast based on 00Z23DEC2004 T80 initial condition)

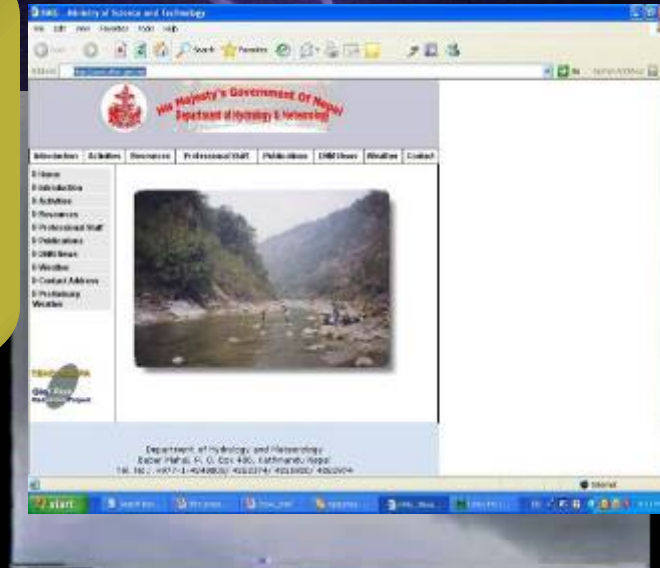


# Services



## Aviation Sector

- METAR (every half hour)
- TAF (every six hours)
- En-route Forecast
- Weather Briefing to pilots



## Mountaineering Forecast

- Daily Special Forecast for mountaineers



## Forecast to General Public

- Twice daily through media
- Daily update in home page
- Weather bulletins
- Briefing to journalists



# Hydrology Division

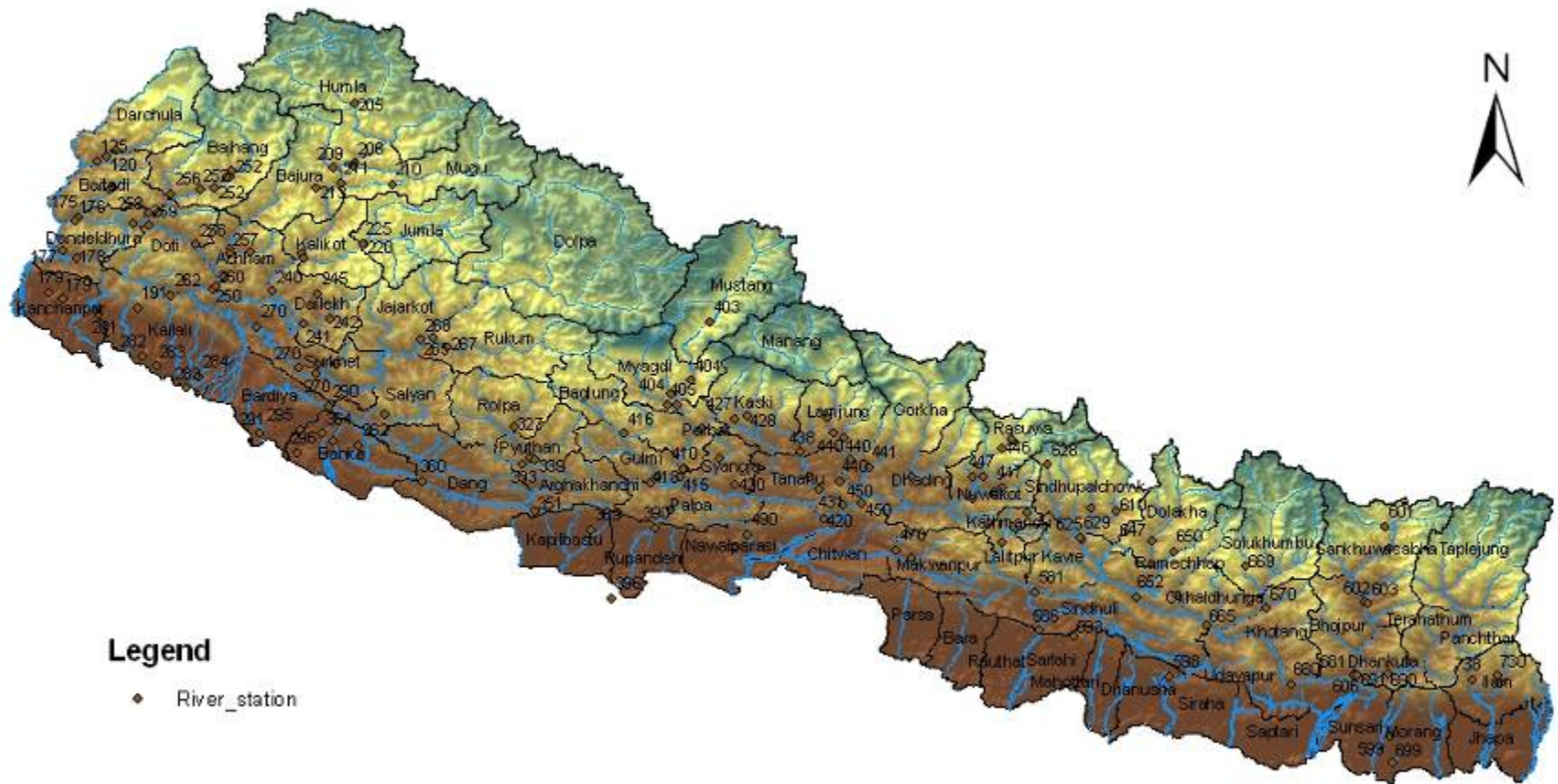
- River Hydrology
- Flood Forecasting
- Snow and Glacier Hydrology
- Water Quality & Sediment

# River Hydrology

## Main Activities

- Operation of 164 hydrological stations
- Collection and Publication of Hydrological Information
- Lake Study

# HYDROLOGICAL NETWORK OF NEPAL



Staff Gauge



Gauging Station of  
Manahari Khola



Current Meter  
Velocity Measurement



Staff Gauge &  
Gauge House



Discharge Measurement  
by wading



Discharge measurement from cable car

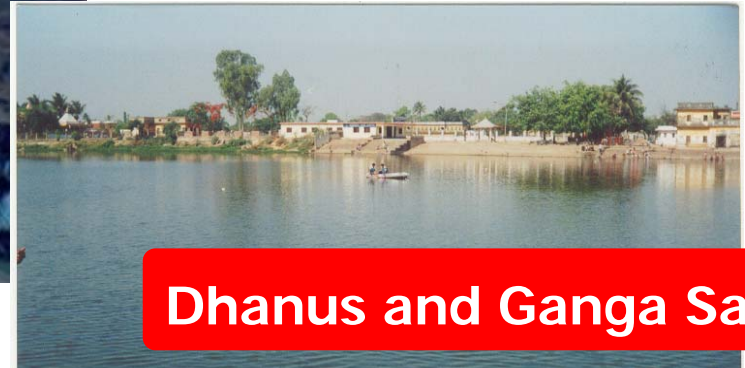


# Cable way site at Melamchi at Helambu

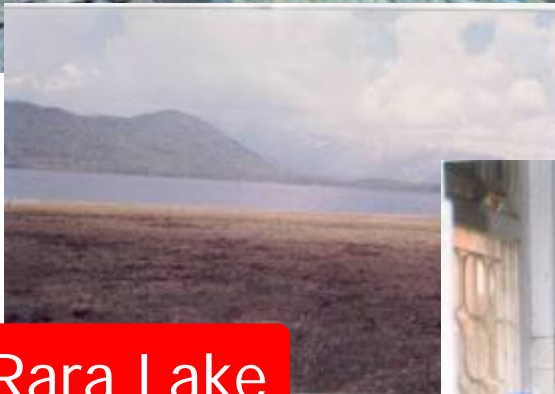


# Lake Study

Tilicho Lake



Dhanus and Ganga Sagar



Rara Lake



Water Quality of Rivers & Lakes



Kathmandu and Pokhara

Monitoring 52 Stations

# Flood Forecasting

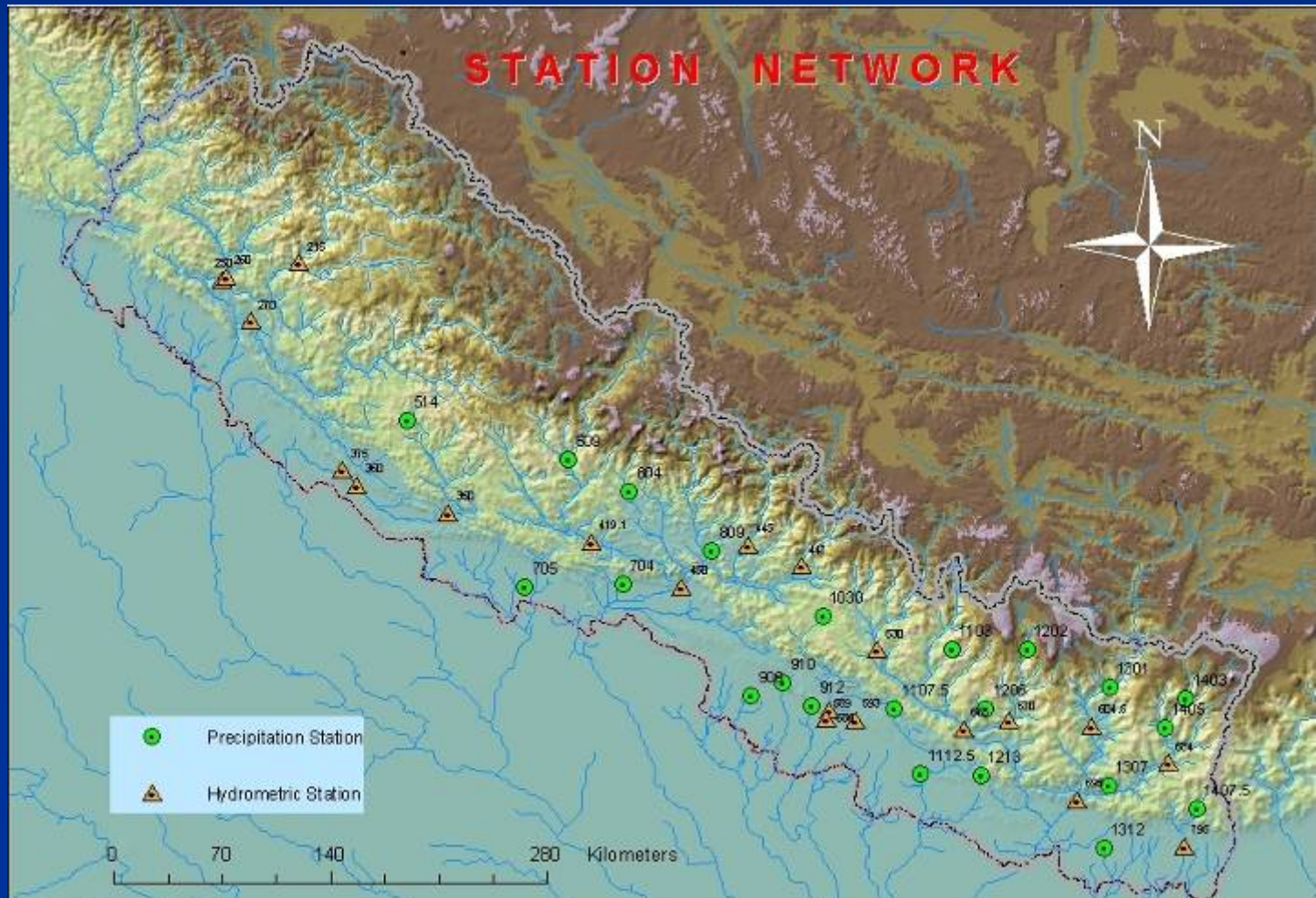
## Activities

- Operation of 20 hydrological and 16 rainfall stations
- Collection and Publication of data
- Flood Risk Mapping
- Model development for Flood forecasting
- Flood Forecasting in major rivers of Nepal

# Flood Forecasting Station Network

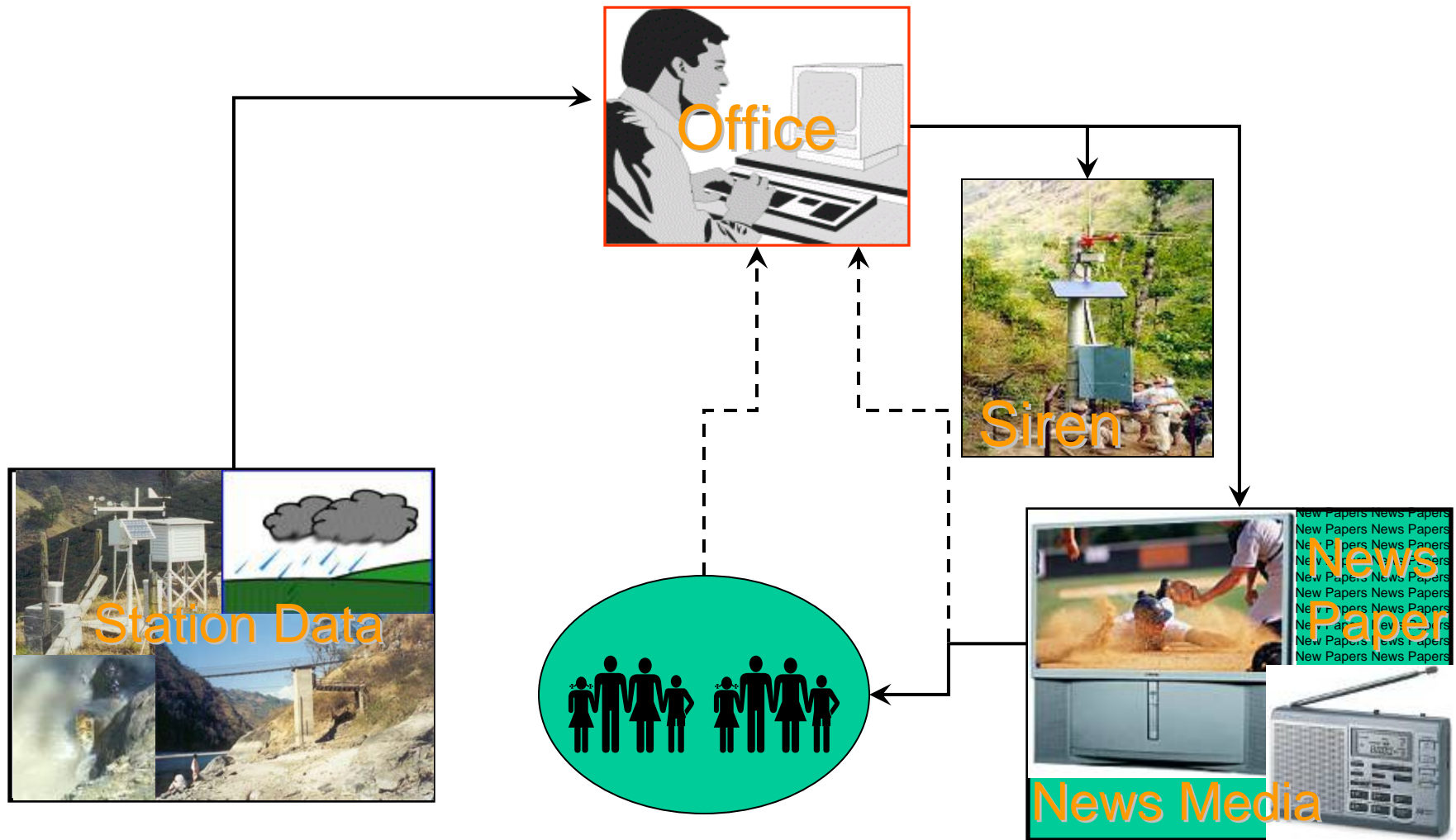
Flood Forecasting Project has now a network of 43 stations in operation:

- 15 hydrometric stations (Water level + Rainfall)
- 27 meteorological stations
- One hydrometric station (Portaha-Bandipur): Rainfall only





# Flood Forecasting Process



# Communication Systems



# Real Time Data Acquisition System

- Existing HF Transceiver system isn't adequate
- Less reliable in bad weather conditions
- Recently, DHM has installed 10 rainfall and 3 water level data loggers in Narayani River basin with Code Division Multiple Access (CDMA) wireless communication system for high speed data transfer.
- It uses M2M communication technology with CDMA wireless modem to transmit data from sensors placed at different parts over the internet to a database server.
- The data have been posted on the following website: <http://www.hydrology.gov.np>


# Transmitted Data

Flood Forecasting - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites

Address [http://www.hydrology.gov.np/index.php?option=com\\_content&view=article&id=23&Itemid=27](http://www.hydrology.gov.np/index.php?option=com_content&view=article&id=23&Itemid=27) Go



Government of Nepal  
Ministry of Environment, Science and Technology  
Department of Hydrology and Meteorology  
Hydrology Division

[Check Mail](#) [Login](#)

River Hydrology | Snow and Glacier Hydrology | Sediment and Water Quality | **Flood Forecasting**

July 29, 2009 - 15 Hr.

## Narayani basin

Station no.	Station	Longitude (E)	Latitude (N)	Hourly Rainfall (mm)	Daily rainfall till 08:45 am NST (mm)	Waterlevel (m)
810.5	<a href="#">Ansiq</a>	83° 48' 00"	27° 53' 2"	0	20.32	
1002	<a href="#">Arughat</a>	84° 49' 12"	28° 03' 00"	0	2.54	
609	<a href="#">Beni</a>	83° 36' 00"	28° 16' 12"	0	11.18	
1004.5	<a href="#">Betrawati</a>	85° 10' 48"	27° 58' 12"	N/A	N/A	
704.5	<a href="#">Danda</a>	84° 12' 00"	28° 03' 00"	N/A	39.88	
809	<a href="#">Gorkha</a>	84° 37' 12"	27° 58' 12"	0	4.80	
601	<a href="#">Jomsom</a>	83° 43' 12"	28° 46' 48"	N/A	N/A	
450	<a href="#">Narayanghat</a>	84° 25' 48"	27° 42' 36"	0	0	5.49
804.5	<a href="#">Pokhara</a>	84° 00' 00"	28° 13' 12"	0	10.80	
925	<a href="#">Rajaiya</a>	85° 03' 00"	27° 25' 12"	N/A	N/A	

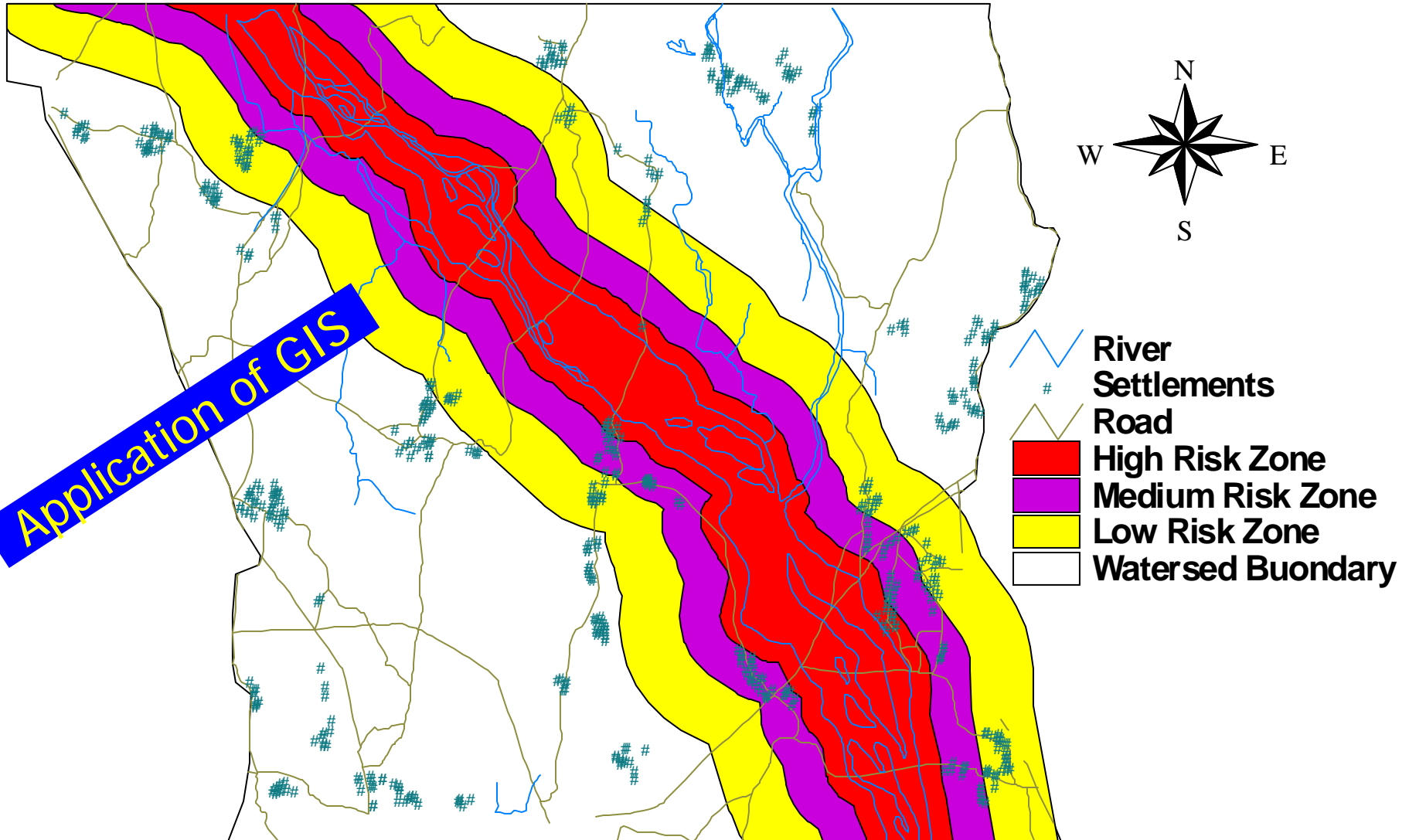
Home  
About Us  
Data Dissemination  
Hydrological Stations  
Resources  
Personnel  
Training  
Feedback  
Contact

Error on page. Internet



Near Sundari Ghat, Bagmati

# Flood Risk Map of Khando Khola (Saptari)



# Snow and Glacier Hydrology

## Activities

- Operation of 6 hydrometeorological stations
- Collection and Publication of data
- Glacier and glacier lake studies
- Model development for snow and glacier melt runoff

# Snow and Glacier Hydrology

## Activities

Hydrological and meteorological data collection from high Himalayas  
(Elevation 2700 - 4300 m)

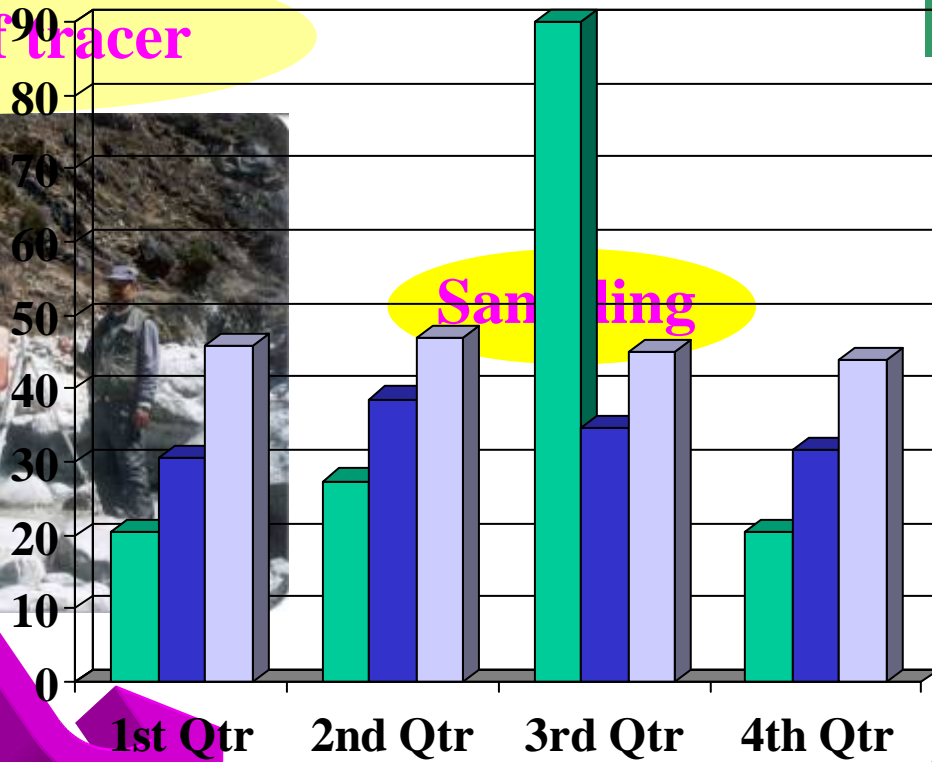
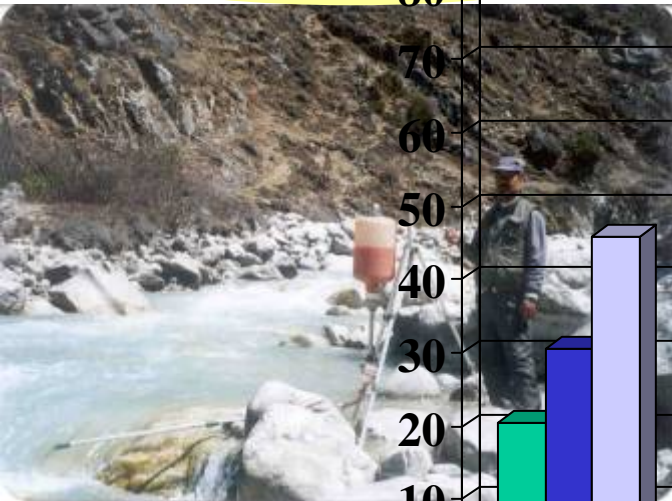
Station Elevation	River
• Langtang – 3800 m.	Langtang
• Khumbu – 4335 m	Imja
• Annapurna – 3470 m	Modi
• Makalu – 3980 m	Barun
• Kanjiroba – 3770 m	Sanu Bheri
• Humla – 3800 m	Panchamukhi Khola

- (i) Temperature
- (ii) Relative Humidity
- (iii) Precipitation
- (iv) Solar radiation
- (v) Wind speed/ direction
- (vi) River stage/discharge
- (vii) Water equivalent of snow



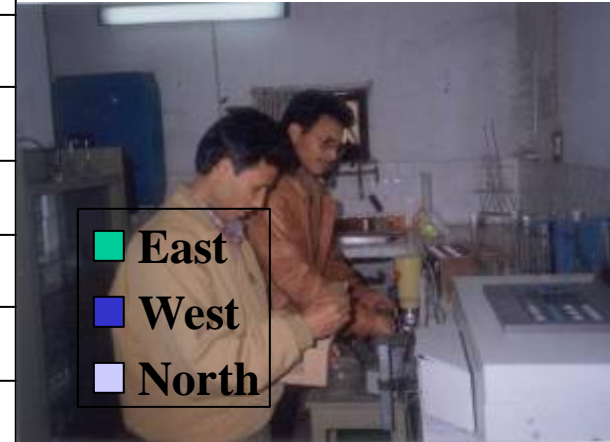
# Discharge Measurement by Tracer Technology

Injection of tracer

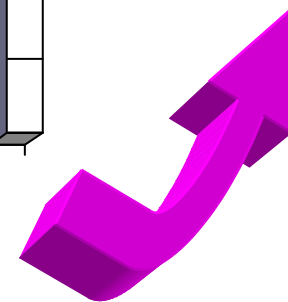
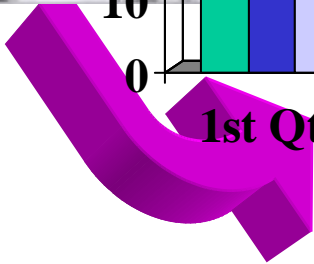


Sampling

Tracer Laboratory



- East
- West
- North





Snowfall

# Snow survey for determination of water equivalent of snow

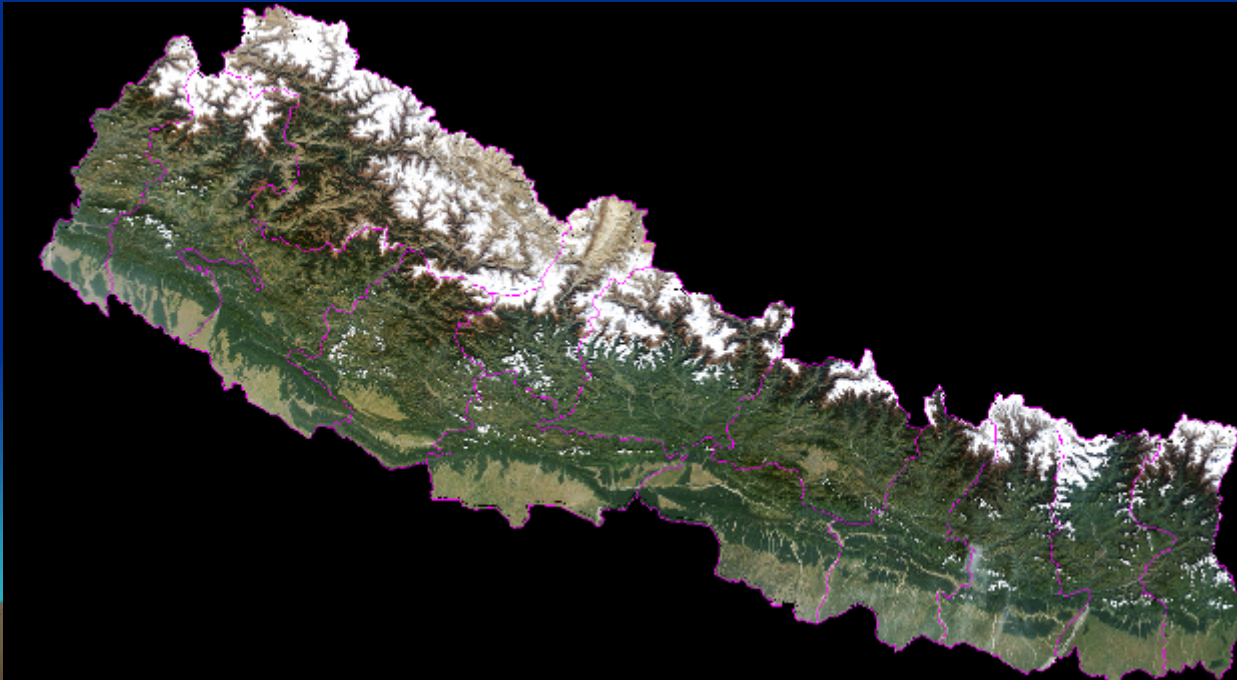
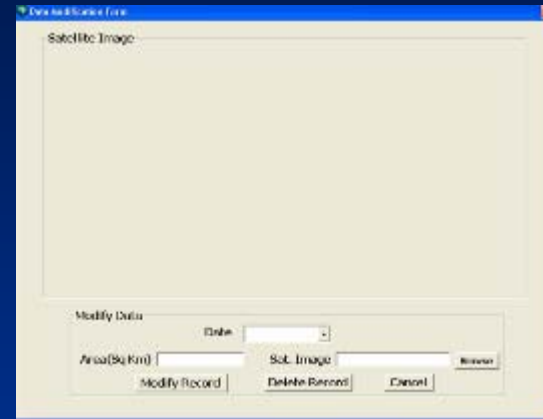
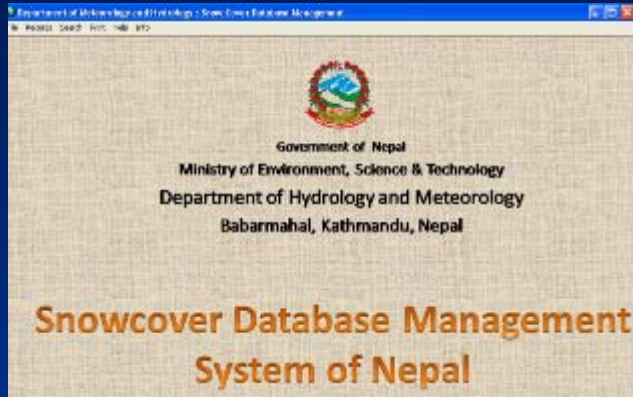


Snow pit

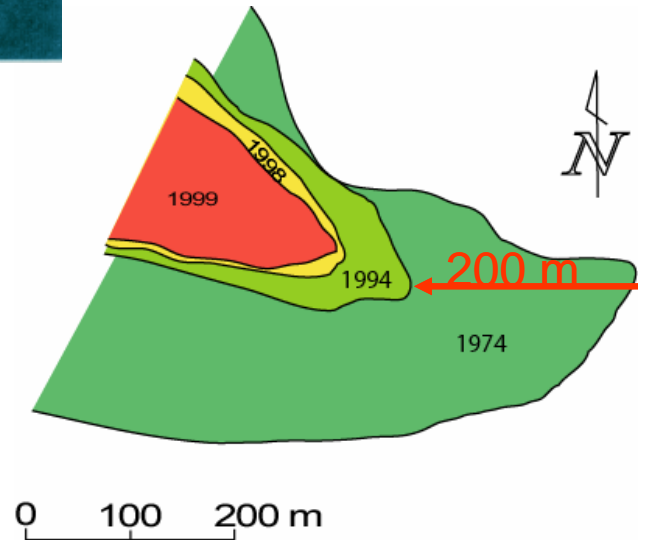
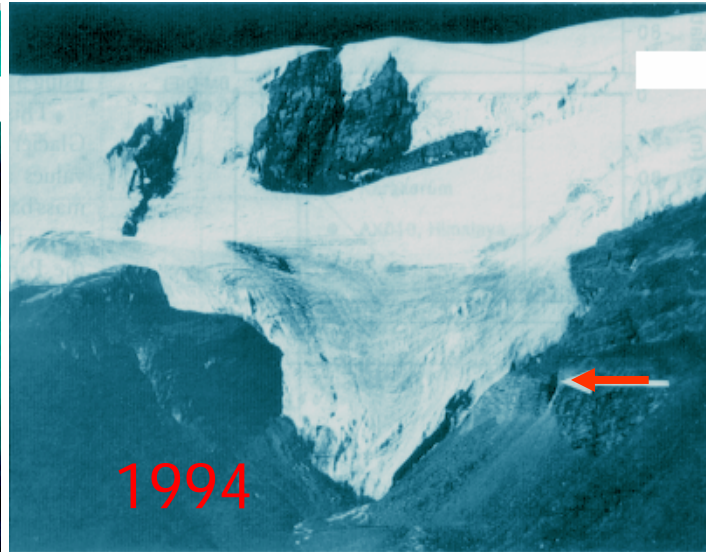
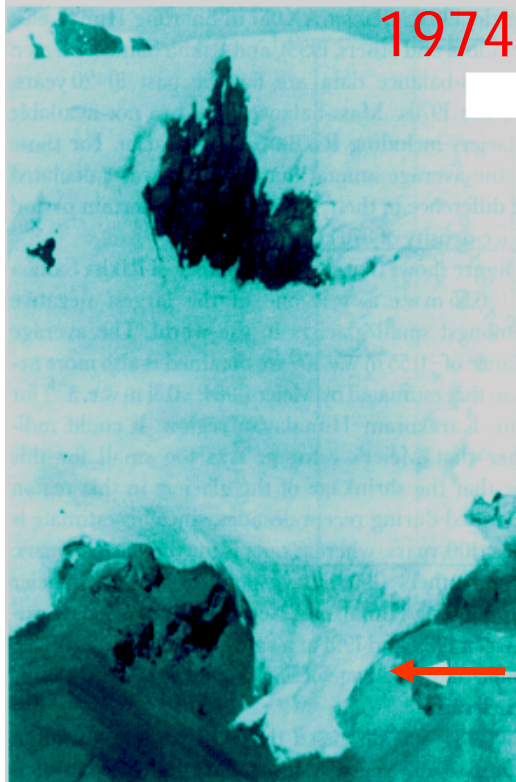


Snow sampler

# Snow cover Database Management



## Rika Samba Glacier, Hidden Valley, Dhaulagiri



Glaciers in Nepal are in general condition of retreat due to climate change

SOURCE: GEN/DHM RESEARCH

## Glaciers and Glacial Lakes of Nepal

3252 Glaciers (5323 sq.km.)

2315 Glacial lakes (75 sq. km.)

ICIMOD/UNEP (2000)



Mountain Environment and Natural Resources' Information Systems  
International Centre for Integrated Mountain Development

ENVIRONMENT ASSESSMENT PROGRAMME - ASIA AND PACIFIC  
United Nations Environment Programme

# Glaciers of Nepal

Major Basin	Glacier number	Area,km <sup>2</sup>	Lake number	Area,km <sup>2</sup>	Ice Reserve,km <sup>3</sup>
Koshi	779	1409.8	1054	24.8	152.1
Gandaki	1025	2030.1	338	12.3	191.4
Karnali	1361	1740.2	907	37.7	127.7
Mahakali	87	143.2	16	0.4	10.1
Total	3252	5323.3	2315	75.2	481.3

# Training

Butwal

Tinau Khola



2004 1 8



Bedload sampling

2004 1 10



Suspended sampler



2004 1 10

# Air Pollution(Babarmahal):

WHO Normal:150-230 $\mu\text{g}/\text{m}^3$

NEPAL Normal: 150  $\mu\text{g}/\text{m}^3$

Max.: 727  $\mu\text{g}/\text{m}^3$  in May 1995

Min.: 31  $\mu\text{g}/\text{m}^3$  in July 1996

Annual Normal: 206  $\mu\text{g}/\text{m}^3$





# Conclusion

- Extension of Hydrological & Meteorological station as user demand
- Upgrade Manual Station to Automatic
- Real Time Data transmission System



***Thank You!***