Use of climate information in Nepal for water and food security

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Country Background:

Use of climate information in Water:
1. Flood early warning system
2. Assessing water in glacierized river basin using glacio-hydrological model for hydro power production and fisheries

Food:
1. Nepal Agriculture Management Information System
Country Background - Nepal

Nepal's Physiographic Division

Terai: < 500 m
Siwalik Hills: 500-1000 m
Mid-Hills: 1000-2000 m
High Mountains: 2000-5000 m
High Himalaya: > 5000 m

(Source: LRMP, 1986)
• **Altitude range**: 64 m to 8848 m asl

• **East-west length**: about 850 km

• **North-south span**: less than 200 km

• **Climates**: From subtropical to Alpine types

• **Monsoon**: June to Sept. accounts 80 % ppt.

  More ppt. in the east than in the west
Climatic Conditions of Nepal

<table>
<thead>
<tr>
<th>Ecological Belt</th>
<th>Climate</th>
<th>Avg. Annual Ppt. (mm)</th>
<th>Mean Annual Temp. (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain</td>
<td>Arctic/Alpine</td>
<td>Snow/150-200</td>
<td>&lt;0 - 10</td>
</tr>
<tr>
<td>Hill</td>
<td>Cool/warm temperate</td>
<td>275-2300</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Terai</td>
<td>Sub-tropical</td>
<td>1100-3000</td>
<td>20 - 25</td>
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</table>

Avg. annual ppt. of Nepal: 1530 mm
Forest area: 39.6 % (18 % protected areas) (NWP, 2005)
Biodiversity: Very rich (5833: flowering plants, 185: mammals, 645: butterflies, 170: fishes)
• **Rivers:** more than 6000 (north to south flowing)  
  (Saptakoshi, Gandaki, Karnali and Mahakali)

• **Total avg. annual runoff:** 225 billion cubic meters (BCM)  
  Only 15 BCM has been utilized (NWP, 2005)

• **Poverty:** 25.2 % of the population (26.5 million in 2011, CBS, 2018)

• **per capita GDP:** US $ 1004 in 2017/18 (CBS, 2018)

• **Livelihood:** Agriculture 35 % in GDP (65 % population)  
  • Industry: 20 %  
  • Services: 45 %  
  (CIA World Fact Book, 2018)
Network of Meteorological Station
438 (AWS 75)

Legend
- Meteorological Station

CHINA

INDIA
Glacierized-sub river basins of Nepal
Climate Change in Nepal

All Nepal Climate Trend (1971-2014)

- Annual maximum temperature trend: +0.056 °C/yr
- Annual minimum temperature trend: + 0.002 °C/yr

(DHM, 2018)

During a period from 1977 to 2010

24 % of glacier area (38 km²/yr) decreased
29 % ice reserve decreased

(Bajracharya et al. 2014-ICIMOD)
Glaciers are retreating

Glacier AX010 in Shorong Himal, east Nepal
Tsho Rolpa Glacial Lake (Dolakha)
Use of Climate Information in Water

- **Flood early warning system**

![](image)

among the top weather-related hazards, Flash Floods have the highest mortality rate globally ...

Source: [www.preventionweb.net](http://www.preventionweb.net)
Major works of Flood Forecasting Section, DHM
Communication
Telemetric Stations (Rainfall/Water level)
<table>
<thead>
<tr>
<th>S.N.</th>
<th>Basin Name</th>
<th>Station Index</th>
<th>Station Name</th>
<th>1 hour (09-10)</th>
<th>3 hour (07-10)</th>
<th>6 hour (04-10)</th>
<th>12 hour (22-10)</th>
<th>24 hour (10-10)</th>
<th>Status</th>
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<td>Karnali</td>
<td>280</td>
<td>Karnali at Chisapani</td>
<td>13.40</td>
<td>27.40</td>
<td>39.00</td>
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<td>4.60</td>
<td>4.60</td>
<td>4.60</td>
<td>7.00</td>
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<td>Babai</td>
<td>239.95</td>
<td>Babai at Chepang</td>
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<td>Ghorahi</td>
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<td>145.60</td>
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<td>Water Level (m)</td>
<td>Flow (m³/sec)</td>
<td>Warning Level (m)</td>
<td>Danger Level (m)</td>
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<td>West Rapti at Kusum</td>
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<td>5.00</td>
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<tr>
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<td>Seti</td>
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</tbody>
</table>

Early warning system: Case study of Banke District

Display board at DAO, Banke showing water level of Rapti River at Kusum (above danger level)

Source: [www.hydrology.gov.np](http://www.hydrology.gov.np)

CDO, Banke taking flood level information

Photo: Community people shifting their belongings to safe place
Assessing water in glacierized river basin using a glacio-hydrological degree-day model for hydro power production and fisheries
Recent paper

An Integrated Assessment Approach for Estimating the Economic Value of Climate-led Change on energy water nexus: An Application in a Himalayan River, Trishuli

Shruti Khadka Mishra, John Hayse, Thomas Veselka, Eugene Yan, Rijan Bhakta Kayastha, Kirk LaGory, Kyle McDonald, Nicholas Steiner

(Environmental Science and Policy, 2018)
Most of the RCP85 Increase above ROC45 Occurs in Early Spring.

During Much of the Year Flows are always above the Maximum Power Plant Level.
Annual Generation (MWh)

RCP85 Generation Increases by 4,000 MWh above Current Levels

RCP85 Generation Increases by 1,000 MWh above current levels

RCP85 Generation Increases Accelerate after 2050

RCP85 3,000 MWh Higher
• The estimated economic value of electricity generated from the Trishuli hydropower plant under RCP 4.5 and RCP 8.5 was projected to be 3.7% to 7.5% higher for the month of March, while for the months of April and May the values were 1.5% to 9.4% lower.

• As compared to the estimated total mean annual fisheries revenue for 1977–2014, the projected average annual revenue for 2020–2050 is higher by 0.1% to 6.1% under RCP 4.5 and RCP 8.5.

• The framework can be applied to support decisions on investment and designs of hydropower infrastructure as well as fisheries conservation in the upstream of High Mountain Asia basins from Afghanistan through Bhutan.
Use of climate information in Nepal Agriculture Management Information System

- Drought
- Floods
- Landslides
- Windstorms
- Hailstorms
- Hot wave/Cold wave

Climatic Hazards in Agriculture

Blocked huge river Bhotekoshi by recent landslide

Bhotekoshi river
Agriculture Management Information System (AMIS)

- Provide open data access for information and web portals
- Build ICT assisted communication opportunities to strengthen the voice of the farmer on agricultural issues
Information Generation Modality (Institutional level)

DHM
- Real time weather
- Weather forecast
- Climatology
- Seasonal climate outlooks

NARC
- Assessment of daily weather and seasonal climate patterns on crop production

MoAD
- Information production and dissemination
- Management of databases, geo spatial data and web portal

Farming community and agricultural industry

Figure: An integrated information system composed of the meteorological (DHM), agricultural research (NARC) & agricultural planning and extension (MoAD) institutions working together to develop and provide relevant weather & climate information to farmers in Nepal
For FY 2014/15
1. Dhankuta
2. Sunsari
3. Siraha
4. Bara
5. Kavre
6. Rupandhei
7. Jumla
8. Banke
AMIS Infrastructure

- Mobile (Smart Phone)
- Climate Smart Agriculture (Mobile Application)
- SIM Card
- Rain gauge
- Thermometer

Farmer Community
I. Agriculture Data Digitizing & Archiving
   A satellite image based digital agriculture area map, Crop production parameters, Optimal crop advisory package

II. Weather & Climate Informed Agriculture Crop Map

III. Crop/Livestock Monitoring System
   Seasonal cultivated area assessment, Crop growth assessment, Monitoring & assessment of natural disasters in agriculture, Livestock disease assessment

IV. Climate Information Products
   - ENSO based climatology-to detect expected rainfall and temperature during different phases including expected anomalies in rainfall & temperatures
   - Seasonal climate projections
   - Seasonal climate outlooks- highlighting expected climate for the season & potential impacts on crops
**Agromet Advisories(Products)**

V. Weather Information Products - depend on the availability of real time information from the proposed upgrading of the monitoring system.

- Study on “agriculture insurance” schemes and “risk transfer” instruments for Nepal
- Early Warning System for Drought & Floods

**Early weather forecasts**
Mostly used for tactical or operational decisions e.g planting when adequate soil moisture is present or forecast; harvesting before damaging rainfall, or hailstorms, crop protection measures when risk of pests is elevated; planning of perishable produce transportation to markets.
THANK YOU!