Climate Change in the Himalayas: Challenges and Opportunities

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Outline of presentation

• Global significance of the Himalayas
• ICIMOD – a brief introduction
• Multiple challenges facing Himalayan countries
• Key issues and opportunities for collaborative work with academia
• Conclusions
Himalayan glaciers are sources of freshwater reserves which provide headwaters for major river systems in Asia – a lifeline for almost half of humanity.

Himalayan Region: Source of ten river basins – the water tower of Asia

- Himalayan glaciers: 17% of the global glacial area (> 15,000 glaciers)
- Largest body of ice outside the Polar caps;
- Store about 12,000 km³ of freshwater

Himalayan glaciers are sources of freshwater reserves which provide headwaters for major river systems in Asia – a lifeline for almost half of humanity.
The region is rich in biodiversity...Himalayas due to high altitudinal variations...are rich in biodiversity...hosts 4 of the 34 Global Biodiversity Hotspots; 488 protected areas and 330 Important Bird Areas...has a large number of water retaining wetlands, 28 of them are Ramsar sites
VISION OF ICIMOD: The mountain people of the greater Himalayas enjoy improved well-being in a sustainable global environment.
Strategic goals of ICIMOD

1. Build regional institutional capacity of member countries to reduce poverty;
2. Mobilise research and analytical capacity to deal with climate and global changes;
3. Build strategic regional and global knowledge partnerships;
4. Promote dialogue, networking and the exchange of information and experiences; and
5. Provide professional services, technical advice and management expertise.
ICIMOD’s Capacity

- State-of-art Geo-based solutions; Platform for collaboration, capturing and exchanging information & knowledge,
- Common regional database
- Mountain knowledge centre and a virtual Learning Centre
Strategic Programs, Action Areas and expected Impacts

Information and knowledge management

Implementations through Action Areas

Participatory watershed management
Biodiversity conservation
Glaciers, climate change
Rangeland management, community forestry

Rangeland management, community forestry

Monitoring and impact assessment

Livelihoods more sustainable
Stable ecosystem services
Equitable, sustainable water mgmt.
Research and development thrusts

Environment Change & Ecosystem Services:
- Transboundary landscape conservation and management
- Monitoring of land use changes and sustainable management of natural resources
- Community and livelihood forestry

Sustainable Livelihood & Poverty Reduction:
- Rewarding poor for eco-system services
- Value chain development of high value products
- Community adaptation and resilience

Integrated Water & Hazards Management:
- Monitoring of snow, ice and water for long-term water management
- Regional flood information and management
ICIMOD Research Sites

- Consistent data generation
- Centres for long-term monitoring of climatological and ecological information
- Systematic research for ecosystem mgmt. & biodiversity conservation
- Part of the landscapes nested in transects
Example: Brahmaputra-Salween Landscape

Assessment Areas:

- Natural connectivity
- Biodiversity review and gap analysis
- Land use cover change
- Transboundary issues including illegal trade
- Policy analysis
- Regional Cooperation Framework elements
What can ICIMOD offer?

- Regional, facilitator and knowledge broker with a mountain perspective
- Promoting application of knowledge to solve local, national and trans-boundary approaches
- Customising international knowledge
- Regional capacity development, regional database management, monitoring, and quality control
1. Rapid rate of glacier melting & its impact on region’s water resources
Snow-cover in the Himalayas (1975)

Landsat MSS image 15 Oct 1975
Snow-cover in 2006

ASTER image of Feb 2006
Glacier Mass Balance

- Himalayan glaciers are shrinking more rapidly than elsewhere

Source: Dyurgerov and Meier, 2005
Glacial melting in the Himalayas

India

- Deglaciation is widespread in HKH
- Some advances in Hindu Kush and Karakorum

Tibet

Data mostly on terminus fluctuation or areal change—no data on mass change

J. Kargel, USGS

Tandong et al., 2004
Melting of Glaciers in China Himalaya

Glacier retreat and growth of lakes in Poiqu Basin, Tibet Autonomous Region of Peoples’ Republic of China

- Glacier on 5 Dec, 2003
- Glacial Lake on 1 Jan, 1977
- Glacial Lake on 9 April, 1984
- Glacial Lake on 21 Dec, 1990
- Glacial Lake on 18 Oct, 1996
- Glacial Lake on 22 Nov, 2000
- Glacial Lake on 5 Dec, 2003
Estimated contribution of glaciers in water resources of the HKH rivers

<table>
<thead>
<tr>
<th>River basin</th>
<th>Mean discharge (m$^3$/s)</th>
<th>Contribution of glacial melt in river flow (%)</th>
<th>Water availability per person (m$^3$/person/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indus</td>
<td>5,553</td>
<td>44.8</td>
<td>978</td>
</tr>
<tr>
<td>Ganges</td>
<td>18,691</td>
<td>9.1</td>
<td>1,447</td>
</tr>
<tr>
<td>Brahmaputra</td>
<td>19,824</td>
<td>12.3</td>
<td>5,274</td>
</tr>
<tr>
<td>Irrawaddy</td>
<td>13,565</td>
<td>Unknown</td>
<td>13,089</td>
</tr>
<tr>
<td>Salween</td>
<td>1,494</td>
<td>8.8</td>
<td>7,876</td>
</tr>
<tr>
<td>Mekong</td>
<td>11,048</td>
<td>6.6</td>
<td>6,091</td>
</tr>
<tr>
<td>Yangtze</td>
<td>34,000</td>
<td>18.5</td>
<td>2,909</td>
</tr>
<tr>
<td>Yellow</td>
<td>1,365</td>
<td>1.3</td>
<td>292</td>
</tr>
<tr>
<td>Tarim</td>
<td>146</td>
<td>40.2</td>
<td>571</td>
</tr>
</tbody>
</table>

(Source: Xu et al. 2007)
IPCC (2007) forecast:

- Glaciers in the Himalayas are receding faster than in any other parts of the world;
- At the current trends, 80% of Himalayan glaciers will be gone in 30 years (although this is questioned);
- In Northwest China, 27% of the glacier area will decline by 2050;
- Likely water shortages for downstream agriculture in dry season;
- Up to 750 million people in the region are vulnerable.
Key issues and research gaps

• IPCC has termed Himalayan region as a ‘data deficit’ region; how to gather long-term scientific data and reduce the knowledge gap?

• How to build regional climatic models and scenarios to help prepare robust water management plans?

• What would be the global impact of the cryospheric changes in the Himalayas?
2. Flood disaster due high intensity rainfall, land slide and glacial lake outburst floods (GLOF)
Impacts on temperature and rainfall patterns

- 0.15 - 0.34 °C/decade warming trend is found over the HHK with maximum warming over areas in the western Himalayas of ~1°C since 1979 which significantly exceed the global rate.

- Higher temperature shifting Asian monsoon's path towards the foothills of the Himalayas resulting extreme rainfall patterns (Lau et al, 2006).
Increased risk of flash flood (Imja Glacier, Everest area Nepal)

1956 photograph of Imja glacier
(Photo: Fritz Muller; courtesy of Jack Ives)

2006 photograph of Imja glacier
(Photo: Giovanni Kappenberger; courtesy of Alton C Byers)
Water related hazards

- Flash flood has the highest mortality rates

- Flood
- Landslide/Avalanche
- Famine
- Water rel. Epidemic
- Drought

Jonkman, 2005
Increasing trend of flood disasters

People killed per region 2000-2007

Asia: 70% Water-induced disasters (1980-2005)
Himalayan countries are vulnerable to floods

Average annual deaths, 1980 - 2000

Average population exposed to floods, 1980 - 2000

Source: The BMDAT ORDA/CRED International Disaster Database and UMEP/GRID-Geneva
Key issues and research gaps

• How to build regional hydrological and meteorological database for effective transboundary information sharing?
• How to establish early warning system to prepare downstream communities for disaster management?
• How to build capacity to mitigate and adapt to flood disasters?
• What kind of institutional and financial (insurance) measures can enhance resilience?
Climate change challenges and issues

3. Environment Change & Forest/ Biodiversity Conservation
Increased vulnerability of the ecosystem services

- Himalayan countries are facing unexpected risks due to degradation of forests, biodiversity, rangelands and pasture;

- People’s high dependence on these ecosystems make them vulnerable and exposed to various risks and uncertainties.
Vulnerability assessment results:
Ecosystems
Climate change impact scenario on vegetation

Large change in natural vegetation pattern is predicted: a) a northward shift of vegetation types; b) occurrence of invasive species

Key research questions:

• What will be the impact on forests and biodiversity species composition?

• What will be the impact of increased moisture stress on forest and agriculture ecosystem services?

• Degree of community’s vulnerability to the impact on supply of ecosystem goods and services.
Climate change challenges & issues

4. Livelihoods and food security
Issues & Challenges: Climate Change

Expected Impact of Climate Change on cereal production.

<table>
<thead>
<tr>
<th>Region</th>
<th>1990-2080 (% of change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>0.6 to -0.9</td>
</tr>
<tr>
<td>Developed Countries</td>
<td>2.7 to 9.0</td>
</tr>
<tr>
<td>Developing Countries</td>
<td>-3.3 to -7.2</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>-2.5 to -7.8</td>
</tr>
<tr>
<td><strong>South Asia</strong></td>
<td><strong>-18.2 to -22.1</strong></td>
</tr>
<tr>
<td>Sub-Saharan</td>
<td>-3.9 to -7.5</td>
</tr>
<tr>
<td>Latin America</td>
<td>5.2 to 12.5</td>
</tr>
</tbody>
</table>

- Climate change > water stress, reducing water availability for irrigation
- Climate change may further reinforce the pressure on available resources & ecosystem services > trigger the spiral of resource degradation, poverty, social unrest

Source: IFPRI, 2007
## Options & Opportunities

### Cereal Productivity in Selected Countries in Asia: Potential for increase yield

<table>
<thead>
<tr>
<th>Country</th>
<th>Cereal yield kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>N/A</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>3,551</td>
</tr>
<tr>
<td>Bhutan</td>
<td>1,614</td>
</tr>
<tr>
<td>India</td>
<td>2,367</td>
</tr>
<tr>
<td>Nepal</td>
<td>2,282</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2,562</td>
</tr>
<tr>
<td>Maldives</td>
<td>1,000</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>3,432</td>
</tr>
<tr>
<td>China</td>
<td>5,106</td>
</tr>
</tbody>
</table>

Levels of productivity in South Asia have remained much lower than in neighbouring regions: e.g., China.
Key issues and research questions

• How can we improve efficiency of water use, soil management, capacity to withstand extreme events (floods, drought), and carbon sequestration?
• Can forests and biodiversity contribute in long-term adaptation and community resilience building?
• How can we transfer knowledge and technologies to end-users?
Conclusions

• Climate change is one of the most complex and difficult challenges for the Himalayan countries;

• ICIMOD offers a common venue for academia to research and study people-resource dynamics in the context of climate change;

• Academic collaboration is needed to reduce the scientific uncertainty and knowledge gap;

• ICIMOD has access to the policy makers and development partners
Conclusions

• Scientific data to monitor and climate and environment change are lacking; IPCC has identified HKH region as the `data deficient’;

• Long-term research and comprehensive data are needed to plan adaptation and mitigation program to deal with future changes;

• ICIMOD as a regional knowledge centre has defined protocols and organizing capacity;

• UNM faculty, graduate students and researchers, NSC scholars have scope for doing collaborative regional and global research.
Thank you