Transboundary floods: Regional Flood Outlooks and Community Based Early Warning Systems

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HKH is a multi-hazard environment

(Source: EM-DAT – The OFDA/CRED International Disaster Database)
One-third of disasters are floods

Transboundary floods - shared vulnerability across national borders

(Source: EM-DAT – The OFDA/CRED International Disaster Database)
Increasing trend of disasters in the HKH threatening sustainable development

Why: climate change, population increase, haphazard urbanization, inadequate implementation of policies, plans, preparedness, investments, institutional capacities and governance arrangements.

Economic loss of US$597 billion

Source: EM-Dat Database
Vulnerability across borders

- 9 April 2000: landslide blocked Yigong River, a tributary of the Yarlung Zangbo (Brahmaputra) River
- The outburst occurred on 10 June 2000 and created a huge flash flood of up to $1.26 \times 10^5$ m$^3$/s
- Extensive damage but no casualties in China
- India: 30 dead, >100 missing, >50,000 homeless, damage of $22.9$ million US dollars

**Upstream / downstream linkage**
Need for transboundary cooperation
HKH-HYCOS: Setting up monitoring stations and establishment of real-time flood information systems

‘Making Information Travel Faster Than Flood Waters’

Establishment of a Regional Flood Information System in the HKH-Region - Timely exchange of flood data and information through an accessible and user friendly platform

HYCOS is a vehicle for technology transfer, training, and capacity building
Modernization of observation network and real-time data transmission

- 38 hydrometeorological stations upgraded in four countries: Real-time transmission of data (Bangladesh, Bhutan, Nepal, Pakistan)
- Access to > 300 Global Telecommunication Stations of WMO
- Use of latest technology for data collection and transmission (GPRS/GSM)
Developed a flood outlook system for the Ganges-Brahmaputra basin utilizing freely available data and weather forecasts. A mathematical model describing the precipitation-runoff process in the catchments and hydrodynamic flood routing along the river system.
Data/ tool used for modeling

**Observed data**
- Rainfall (Bangladesh, Bhutan & Nepal)
- Temperature (Nepal)
- Discharge (Bangladesh, Bhutan & Nepal)

**Topography**
- STRM 90m images
- Cross section (India & Nepal -Koshi only)

**Software/ tool**
- ARC VIEW, Google earth
- Excel, Visual Basic, Python & R script

**Satellite data**
- TRMM Rainfall (3B42) & (RT)
- APHRODITE Temperature (V1204)
- Global ET (GDAS)
- MODIS Snow accumulation
- GFS Rainfall/Temp
Performance of model
Evaluation of flood forecast on Koshi

- 24 hour accuracy is very good
- Need to improve accuracy beyond 24 hours

- Flood outlook information is provided to the hydromet services to improve national flood forecasts for timely flood warning
Dissemination of information
Web-based charts and tables
Lessons learnt

- Latest development in the technology has enabled us to develop flood information system at basin scale
- Utility of data and information for developing flood outlook demonstrated the value of real-time data
- Capacity building and training enhanced cooperation and partnerships
- Limited networks in the region – need further strengthening and sharing
- Flood forecasting and warning needs to be integrated with the disaster risk management activities for an effective end to end flood early warning system
- Efforts need to be made for risk communication, awareness and better preparedness
- Institutional mechanisms for provision of flood warning to communities need to be strengthened
- Regional cooperation is a long term process which requires building trust and confidence between and amongst countries
Moving ahead: User phase

- Strengthening of end user interface as a means for adapting to changing climate
- Utility of data and information
- Education, capacity building and training
- Strengthening national flood forecasting capabilities
  - Flood forecasting models and tools
  - Flood outlooks at national and regional levels
- Observation networks
  - State of the art technologies for expansion
  - Discharge measurements
- Strengthening international and regional cooperation
Significance of CBFEWS

Reaching the most vulnerable communities

1. People centered
2. Upstream/downstream linkage
3. Almost real time information
4. Provide guidance on how to act on warnings
5. Innovative use of low cost ICT tools
CBFEWS in HKH

Pakistan
Indus basin

Nepal
Ratu Kholo, Koshi

Afghanistan
Baghlan and Badagshan (potential)

India
Jiadhal and Singora rivers, Assam
Four elements of CBF EWS
More than just a prediction…

<table>
<thead>
<tr>
<th>1. RISK KNOWLEDGE AND SCOPING</th>
<th>2. COMMUNITY BASED MONITORING AND EARLY WARNING</th>
<th>3. DISSEMINATION AND COMMUNICATION</th>
<th>4. RESPONSE CAPABILITY AND RESILIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematically collect data and undertake risk assessments and scoping</td>
<td>Install early warning instrument and flood monitoring by upstream communities</td>
<td>Communicate flood information by upstream and provide early warnings to downstream communities</td>
<td>Enhance community response capabilities and build resilience</td>
</tr>
</tbody>
</table>

Enhanced technology

With wire

Telemetry based

Wireless technology
Community Based Monitoring and Early Warning
Function

Transmitter Unit

Receiver Unit

<table>
<thead>
<tr>
<th>Warning Level</th>
<th>Color of LED Light</th>
<th>Siren Signal</th>
<th>Interpretation</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>1</td>
<td>No siren</td>
<td>High probability of flood</td>
<td>Be Alert and Standby</td>
</tr>
<tr>
<td>Level 2</td>
<td>2</td>
<td>Beeping sound</td>
<td>Flood is inevitable in few</td>
<td>Be Prepared</td>
</tr>
<tr>
<td>Level 3</td>
<td>3</td>
<td>Continuous ringing</td>
<td>Flood is coming</td>
<td>Evacuate for safety</td>
</tr>
</tbody>
</table>
CBFEWS with telemetry: Conceptual Diagram

Transmitter (River bank)
- Ultra sonic sensor
- Processor / transmitter

Care-Taker
- Primary Receiver
- Display
- Data uplink
- Alarm

Internet Cloud
- Refined data
- Raw data
- District Administrative Office
- Cloud Connection Computer
- Display Monitor
- Alarm

Data server
- Telecom (Ncell/ NTC)

Fig. Process Flow Chart

Alarm
Vulnerable Community 1

Alarm
Vulnerable Community 2
Hands-on training on CBF EWS
(Conducted as per demand)

Training methodology:
- Classroom lectures
- Group work
- Instrument handling
- Field installation/testing

Training materials:
- Resource Manual
- Visual guide
Early warning can minimize the devastation of flash flood

By Monaj Gogoi

DHNARJ, Oct 3. The frequency and intensity of flash flood is rapidly and noticeably increasing year by year in the eastern part of Assam and Arunachal Pradesh, particularly in the Lakhimpur and Dibrugarh districts of Assam and Lohit, Lower Subansiri and Arunachal Pradesh.

Many people believe that the root cause of this rapid increase in flash flood in these areas may be attributed mainly to erratic rainfall in the upper catchment areas due to climate change and other variables.

The flash flood is different than the common monsoon flood as it carries huge amount of water loaded with debris and sediment to the plains affecting people, livestock, crops and livestock. The recent flood spelt disaster to the floodplain area, especially in the floodPradesh hills as well as the geophysical conditions in upper catchment. Based on such information forecast and warning of flash flood could be provided.

Dr. Partha J Das, a river researcher and environmental activist, said this correspondence that in this context it was very important to monitor smaller system, especially in those areas that are likely to suffer very high rainfall in the upper catchment in Arunachal Pradesh hills as well as the geophysical conditions in upper catchment. Based on such information forecast and warning of flash flood could be provided.

He also suggested that with high resolution digital data the real time data, it was highly possible to monitor the weather system and rainfall events and calculate conditions in the floodplain area. This information could be disseminated upstream to the affected communities in Arunachal Pradesh through a community network using mobile phones.

It may be mentioned that a community based flood early warning system has been introduced experimentally in some of the flood-prone areas, particularly in the Jaldhara river basin in Dhemaji and Lakhimpur districts.

For the present approach of the government to flood management he said it was reactive in nature. To deal with, possibilities of such events should be disseminated from upstream to the potentially affected people in the downstream in the form of flood forecast and warning, especially for the north bank tributaries of Assam. While assessment of flood forecast and warning for the Brahmaputra, there was hardly any forecast or flash warning for its tributaries, he added.

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Major highlights

Saved assets, including livestock, worth USD 3,000 in Sept 2013 flood, Dihiri, Assam, India

Awarded UNFCCC’s Momentum for Change 2014 Lighthouse Activity Award in COP 20

Out scaled in the HKH region (Nepal, Afghanistan, and Pakistan)

Engaged with local and state level disaster management authorities for joint implementation and upscaling
Managing transboundary floods

- Hi-tech approach of regional flood outlook and sharing of real time information across boundaries

- Can be coupled with low-tech community based approaches for reaching out to the most vulnerable communities

- For successfully managing transboundary floods

- Regional co-operation is not only about countries cooperating with each other; but it can also mean communities across the border sharing information and help each other cope
Thank you

Contact Dr. Mandira Singh Shrestha (mandira.shrestha@icimod.org) for more information on Regional Flood Outlook

Contact Ms. Neera Pradhan (neera.pradhan@icimod.org) for more information on Community Based Flood Early Warning Systems