

Asian Early Warning Systems: A View



Photo: AIDMI

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ABOUT THIS ISSUE

Early warning has been recognized as an effective approach for reducing disaster risk and the loss of life. At the institutional level, there has been a paradigm shift from single hazard to multi-hazard early warning and from providing hazard information to providing risk and impact information. Acknowledging the importance of early warning in reducing disaster risk, the Sendai Framework's Target 7 calls to substantially increase the availability of, and access to, multi-hazard early warning systems and disaster risk information and assessments to the people.

This issue of *Southasiadisasters.net* is titled "Early Warning Systems" and highlights the importance of such systems in helping to minimize the detrimental impact of disasters on communities and assets. The effectiveness of such systems depends upon the active involvement of at-risk communities, facilitation of risk awareness and dissemination of alerts and warnings to ensure a constant state of preparedness.

This issue highlights the various aspects of early warning systems in India and South Asia such as leveraging social media for early warning, early warning in hilly regions, community participation in early warning, etc. This issue also highlights how there are gaps in effective implementation of people-centred, multi-hazard warning systems and what can be done to seamlessly integrate risk knowledge and impact information into such early warning mechanisms. ■

- Kshitij Gupta

INTRODUCTION

Asian Early Warning Systems: A View

The Asia-Pacific region continues to be the most disaster prone region in the world. According to latest UN figures, between 1970-2016 disasters killed over 2 million people in the region and destroyed assets worth US\$ 1.3 trillion. In 2017 alone, 6,543 people lost their lives resulting from over 200 disasters of a major scale affecting 66.7 million people. In fact, in the last decade, the Asia-Pacific region has accounted for half of the global disaster mortality and over 80% of the total disaster affected population.¹

The enhanced vulnerability and exposure of communities in Asia-Pacific to various disaster and climate risks makes it imperative for the region to address the causes of its underlying vulnerability. Early warning systems can go a long way in reducing Asia's vulnerability and exposure. UNISDR defines an Early Warning System (EWS) as an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events.

Given the uniqueness of the Asian experience with disasters, it becomes important to evolve EWS that are rooted in the region's socio-economic realities. There are some very interesting questions that arise from this position. Firstly, the Asia-

Pacific region needs an accelerated evolution of EWS to catch up with the rest of the developed world. Asian countries like China, Japan and India have made considerable progress in evolving EWS technology through advances in satellite imagery. Secondly and more importantly, we should not view EWS in a separate silo of complex and quantitative weather models and simulations. Instead, EWS should be viewed as a much larger and holistic platform that not only provides opportunities to convey early warning to at-risk communities but also enables these communities to prepare themselves against multiple hazards by enhancing their response capacities.

As the leaders of the various Asian countries congregate in Ulaanbaatar for the upcoming Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR), the importance of EWS for the region should be highlighted. Community based EWS for relaying information to floods in remote and high altitude areas is also a uniquely Asian innovation that should be scaled up and replicated in other areas as well. Most importantly, EWS in Asia-Pacific region will not only protect the robust economic growth experienced by the region in the recent decades, but will also help in the effective resolution of several trans-boundary DRR issues by improving regional collaboration among the various countries of this region. ■

- Mihir R. Bhatt

¹ The International Disaster Database, <https://www.emdat.be/>.

Regional Collaboration for better Flood Early Warning and Resilience in India

India is increasingly threatened by floods, and its resilience depends on successful trans-boundary early warning systems. During a national workshop, organized by Practical Action, key stakeholders came together from across the region to discuss how a successful flood early warning system could be designed and implemented. Here they share their insights and actions for the future:

India's Vulnerability to Floods

According to the United Nations Global Assessment Report on Disaster Risk Reduction 2015, India's average annual economic loss due to disasters is estimated to be US\$ 9.8 billion. This includes more than US\$ 7 billion loss on account of floods. The country also plans to invest US\$ 3 trillion on infrastructure projects, in next five to ten years. Thus, the country will need to make substantial efforts to ensure that these investments are sustainable. In India, the devastation caused on account of the floods in rivers flowing from the Himalayas, is substantial and this would need to be adequately factored into our efforts in disaster risk reduction, especially through early warning systems.

Poor Regional Cooperation

The regional cooperation across the countries of the region, primarily India, Nepal and Bangladesh, on riverine floods across South Asia is a major concern that merits immediate attention. Often the destruction from floods happens due to the inability to obtain timely information from the various institutions that are designed to generate, analyse, disseminate and communicate the information to a



Building on years of experience working in Disaster Risk Reduction in South Asia, Practical Action India took a decision to organise a day-long national workshop on Early Warning Systems and Flood Resilience in EWS Workshop, JNU on April 27, 2018 at New Delhi.

range of stakeholders at different levels on a trans-boundary basis. Often the government to government interfaces happen in a formal and straight jacketed manner, providing limited scope, space and opportunities to communities to express their needs, demands and concerns, especially on matters which govern their lives.

Regional Workshop for a Better Early Warning System

Building on years of experience working in Disaster Risk Reduction in South Asia, Practical Action India took a decision to organise a day-long national workshop on Early Warning Systems and Flood Resilience in New Delhi on 27th April 2018. The event was organised in partnership with International Water Management Institute, Christian Aid, Oxfam and the Special Centre of Disaster Research JNU and National Institute of Disaster Management, New Delhi.

The purpose of this workshop was to hold an interactive discussion

where policy makers, thinkers, practitioners, researchers and other stakeholders could come together and discuss the importance, potential impacts and feasibility of an effective and functional early warning system for floods and analyse how the community could be meaningfully engaged in these efforts, in the context of new technologies and changing climate.

The participants at the event explored key gaps among the different institutions working in flood risk reduction. They also discussed planning strategies, new innovative procedures for operation and management, capital/infrastructure improvements, innovations in forecasting methodologies, communication/dissemination challenges and the need for regional collaboration to achieve flood resilience.

By sharing case studies of community-based early warning systems in Nepal and India the workshop also helped the

participants to gather a better and more nuanced understanding of how an effective early warning system could be designed and implemented. Including operational, structural and policy-support requirements, and its eventual impact on community resilience.

What's next?

The needs and demands for appropriate institutional arrangements and facilitating protocols for regional coordination and cooperation among the Government/Non-Government Institutions were identified as high priority area of work to follow up. This workshop was the first step toward the collaborative approach to deal with floods and this needs to be followed up by inclusion of all relevant stakeholders who are responsible to generate and disseminate early warnings. The involvement of all stakeholders and other players, who are directly and indirectly involved in the flood disaster management programmes was considered essential.

The highlighted outcomes of the workshop included a cohesive understanding of the various dimensions of early warning system and agreeing to initiate a proposal for organizing a regional level learning platform to advocate the institutional collaboration among different government and civil society organizations to work on EWS and Flood Resilience. The participating agencies also agreed to define an annual plan of action to advocate the cause of EWS and Flood Resilience and initiate the interaction with the state level disaster management authorities/disaster management departments especially in the two states of Northern India of Bihar and Uttar Pradesh. Other important outcomes were to strengthen the network of data collection mechanisms, aimed at accurate monitoring and effective forecasts. Other follow up actions include:

- To collaborate with SAARC (South Asian Association for Regional Cooperation) for

better flood information sharing with neighboring countries.

- Free flow of communication across borders should be streamlined.
- To develop more space based advance technologies for shifting from forecasting to now-casting.
- To build capacities of the communities to understand the implications of now-casting.
- To democratize the EWS for bridging the gap between technical departments and communities.
- Community based early warning system is possible with regional cooperation and collaboration.
- There should preferably be a single instrument of risk transfer mechanism rather than multiple ones as available now.
- Raising the community awareness of crop insurance scheme offered by the government. ■

– Mihir R. Bhatt

BREAKTHROUGHS IN EARLY WARNING

Reducing the Fear of Getting Isolated during Disaster Innovative solution by Oxfam India to ensure active participation of women in EWS for flood

While most of us wait with bated breath for monsoon and rains, in flood-prone areas the approaching season makes people anxious and nervous about their future. The fear of being isolated during the advent of disaster terrifies the poor and marginalized families, no information or warning about the approaching disaster further makes them vulnerable.

Early warning information can save lives, prepare communities and reduce the impact of the disaster. It is important to include women in establishing an early warning

process as they are active and resourceful disaster responders. Evidence shows that their seclusion from early warning information increases the vulnerability of communities and families. The Sendai Framework for Disaster Risk Reduction (SFDRR) also clearly targets a substantial increase in the availability and access to multi-hazard early warning systems and disaster risk information to the people at the community level.

Oxfam India implements all the DRR interventions with a focus on the active participation of women at all

levels of planning and implementation. Task Force Groups are formed and nurtured at community level to spearhead activities like Early Warning, Rescue, Water, Sanitation & Hygiene (WASH) and others. Women play a very crucial role in all these activities and their participation is ensured for all groups.

Our experience from the field suggests that the active participation of women in the Early Warning Group always acts as the key contributor towards ensuring efficient EWS and disaster resilience

of the community. This is not only because of the fact that women take proactive steps to collect and disseminate Early Warning information, but also because of the fact that the women remain present at the community level while the men folk migrate outside the village for work which renders their participation in EWS highly irregular.

In order to enhance the effectiveness of the community based EWS by using the updated technology, Oxfam India has taken an initiative in Odisha by establishing a Volunteer Network Management System (VNMS). The objective is to create a platform and introduce a system that works very effectively to collect accurate information from reliable sources and disseminate the same among the community members on a real time basis.

Local NGOs, CBOs and the women from Self Help Groups (SHGs) are

the member of this network of volunteers. The presence of women members in the volunteer network in the disaster-prone areas help in continuation of work related to EWS as they receive training to manage the related works.

The information regarding Early Warning is collected from the reliable sources, mostly the government departments dealing with disaster. In order to ensure real time dissemination, a technology enabled mobile Application is developed. The Early Warning messages are communicated through the mobile messages in vernacular language. This ensures that the volunteers who are from communities receive accurate information on real time basis. Accordingly, they communicate the Early Warning among the community members.

The VNMS is a manifestation of the belief that ensuring access to control

of information by women during a disaster situation can bring discernible changes in the form of reduction of loss of life and livelihoods for the poor and marginalized communities.

"Since our village is isolated and not well-connected with the gram panchayat, we have always lived in a constant fear that warning of flood will not reach us on time. During the 2013 floods, we faced huge loss of life and livelihood. With the VNMS in place, we now receive regular and accurate information regarding flood. This helped us to spend peaceful life even during rainy season, which was not possible earlier," said Padmavati Behra, a member of VNMS from Chandnamkhana village in Odisha. ■

- **Amitabh Behar,**
CEO, Oxfam India, and
Andrio Naskar,

Manager, India Humanitarian
Programme, Oxfam India,
Kolkata, West Bengal, India



Oxfam India's flood response in Assam in 2017.

Twitter and Early Warning Systems: Limits and Potential for India



Twitter as a disaster response agent.

Online social media (OSM) has become a popular platform for people to share information on diverse topics. Twitter, a micro-blogging service, has been widely used as an information dissemination agent, particularly during crisis situations such as earthquakes, floods, hurricanes or political conflicts (Wang and Zhuang, 2017). Twitter enables its users to share text and/or multimedia content directly from the location where the incident has taken place, thereby allowing common people to serve as news reporters. Due to this, it has become a common trend to see event updates to be available on social media first and then introduced in the mainstream media thereafter. Continuous efforts are being made to use Twitter as an effective communication channel during crises and for this purpose, Twitter started a new service called Twitter alerts, designed to prioritize information from credible organizations during crises when other communication channels are not accessible.

In South Asia, the potential of Twitter to serve as a disaster response agent was first realized

during the Kashmir floods of 2014, when citizen groups organized themselves entirely on Twitter to provide assistance to agencies on the ground. During this extreme event, a Twitter hashtag "# JK Flood Relief" was recognized as a groundbreaking effort that used crowdsourced information for raising awareness as well as getting people and corporations to donate relief materials. Twitter played a vital role to ensure connectivity among people during the 2015 Chennai flood when the entire city was suffering from power cuts lasting from two to five days. It helped local people to get information about how to commute from one place to another based on which roads the water had receded. National Disaster Management Authority (NDMA), an Indian government organization, has been leveraging the use of Twitter to make India a disaster risk resilient country. During the Mangaluru floods of 2018, NDMA used Twitter to gather information about the damage caused in the affected areas and create awareness among the citizens by employing Twitter as a disaster early warning system.

Despite the advantages of Twitter as a disaster management tool, it has also been criticized for spreading rumors and misinformation during crises. Twitter users could respond to rumor information by spreading it, doubting it, or seeking confirmation provided that they are involved in that particular topic of rumor through their posting of tweets. A recent study by Wang and Zhuang (2018) found that most of these misinformed Twitter users tend to spread the rumor information, indicating the poor rumor detection ability of Twitter users. The response behaviour of rumor spreading users is a major topic of discussion since it has been found that during crisis situations, a majority of these users did not respond effectively to prevent the spread of their rumors after they were debunked. However, the debunking process of rumors in itself was significantly fast during disasters, thereby playing a major role in preventing large-scale panics and economic loss. Hence, in India, people can take the advantage of Twitter as a disaster early warning system during extreme events; but at the same time they must be cautious and take proper steps to minimize the spread of misinformation. ■

- **Puneet Agarwal, and Jun Zhuang,**
Department of Industrial and Systems
Engineering University, Buffalo,
New York, USA

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Early Warning for Floods in South Asia

South Asia is highly vulnerable to extreme weather events and natural hazards such as floods, landslides, earthquakes, avalanches, droughts, thunderstorms, extreme temperatures and cyclone. Between 1980 and 2015 a total of 1289 disaster events have been recorded affecting more than 2 billion people in the region. Floods and landslides are the most frequently occurring natural hazards, particularly during the monsoon season and account for nearly half of the events recorded in the countries of South Asia. In recent years, increasingly erratic and unpredictable monsoon rainfall patterns and increased climate variability have led to severe and frequent flood disasters in the region.

The floods have resulted in loss of lives and livelihoods, agricultural productivity, and hydropower production, among others as well as in the displacement of millions of people, threatening achievement of the United Nations Sustainable Development Goals. Between 1980 and 2015 the social and economic costs of floods have been almost 84,000 people dead and US\$ 88 billion in damages. The 2017 floods across South Asia killed more than 1000 people and affected almost 45 million people in the region. Often there is differential impacts of such disasters killing more women, children, elderly and physically-challenged people who are typically more vulnerable to the adverse effects of floods.

The transboundary scale of such disasters calls for effective cooperation between the countries

sharing the Indus, Ganges and Brahmaputra basins: Bangladesh, Bhutan, China, Nepal, India and Pakistan. The existing bilateral river treaties and data sharing agreements are not sufficient to avert flood catastrophes of such transboundary scale. Thus, investments in early warning systems with sharing of timely data and information, strong institutional mechanism, effective risk communication and education and awareness of the communities can be critical in saving lives and assets and strengthening the resilience of vulnerable communities.

More systematic regional cooperation in hydro meteorological data collection and sharing is necessary, to enable effective and timely forecasting of floods and disaster prevention as well as flood management at the regional level. In 2010, the International Centre for Integrated Mountain Development (ICIMOD), the World Meteorological Organization (WMO) and ICIMOD's partner countries Bangladesh, Bhutan, China, India, Nepal and Pakistan initiated the development of the Hindu Kush Himalayan Hydrological Cycle Observing System (HKH-HYCOS). The project's overall objective is to minimize the loss of human lives and property damage. The project helped build the capacity of the partner countries' national hydromet services and modernized the hydromet networks in the region: a total of 38 hydromet stations (9 in Bangladesh, 9 in Bhutan, 12 in Nepal and 8 in Pakistan) were upgraded to share real-time data. A regional flood information system was

established to facilitate the transboundary exchange of real-time data and know-how. The information system allows the visualization and extrapolation of real-time data from the stations to any geographical location by providing information on the river-water levels and amounts of rainfall.

The data transmitted in real-time along with global datasets are used to develop flood outlook products and to validate model results, such as in satellite-derived products. These products are used by partners to forewarn communities of increasing river-water levels, helping reduce risks. In August 2014 and 2017, for example, the flood outlook was used by Nepal's Department of Hydrology and Meteorology along with other forecasts to issue flood advisories. It did so by means of flood bulletins which were widely disseminated through its website and shared with the National Emergency Operation Centre and targeted recipients to enable timely flood warning.

The hydromet services of Bangladesh, Bhutan, Nepal and Pakistan have since been able to attract sizeable investments for the modernization of their hydromet networks. Activities funded through HKH-HYCOS have improved the capacity of the hydromet services to take up these projects, and contributed to building climate resilience for people at risk. ■

- Mandira Singh Shrestha,

Programme Coordinator: Hi-RISK, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal

Early Warning System (EWS) and Community Resilience to Floods

The Disaster Management Act 2005 has strongly mentioned the need for an early warning system. The Hyogo Framework for Action and subsequently the Sendai framework referred to it as an indispensable tool to save lives during disasters. Notwithstanding the recognized importance of EWS, the approach remained fragmented, adhoc and withdrawn from communities and local needs¹. Over the years EWS has acquired a new meaning. It has shifted from the existing isolated, fragmented and techno-centric science to a better integrated science suitable for posterity to benefit from.

Every warning system has to encompass three stages of operations involving different government organizations i.e; Detection and Warning, Communication and Response. The first involves the science institutions exclusively and reflects upon the capacity of country's satellite and remote sensing agencies, last stage reflects upon the local government capacities to work with people and manage efficient administration. The middle stage is a platform for intensive partnership and sharing amongst disconnected organizations such as the science institutions, district administration, NDMA/SDMAs/DDMAs/universities/schools/NGOs and local groups of people. It is the second and

the last stage which fails EWS in India despite the most sophisticated superstructure of science erected on the DMA 2005 design. This has led to an inconsistent, incomplete and diluted EWS system in India.

The key institution for EWS in India is the Indian Meteorological Department (IMD) which had initially worked on a two stage EWS. Gradually much improvement has taken place and more stages have been introduced in the 'Pre-Cyclone watch' and the 'post-landfall Scenario'. As the stages are added the governance of EWS becomes easier

to manage and coordinate with district administration and the disaster management Crisis Managers. Once detection takes place a bulletin is issued by the IMD for a Cyclone-Alert. This may be from 48 hrs or less but enough to evacuate humans and nonhumans to safer places. Much advancement has also taken place in science on the Aircraft Meteorological Data Relay system, the Cloud Motion Vectors (CMVs) and the Very High Resolution Radiometer (VHRR) payload on board INSAT-2E to provide water vapor channel data in addition to VIS & IR on-board. A separate payload known as Charged Couple Device (CCD) has also been deployed on board this satellite. The concern for the university research is to explore the investment, capacity enhancement and its proportional benefits in pushing the disaster management structure to act in time. This draws further to connect to many ethical, social and legal issues which are embedded in accountability, transparency and efficiency of NDMA related structures of operations at the community levels².

Forecasting for floods, flash floods, fire, stampede, earthquakes and any other geospatial disaster involves different compartments which are interconnected yet separate in operations, equipment and rescue designs. When the



EWS at Odisha meteorological station.

1 The argument is confirmed in the UNISDR report on EWS structure of disaster management in India <https://www.unisdr.org/2005/mdgs-drr/national-reports/India-report.pdf>, where institutions of sciences such as IMD Doppler Radar wind profiler.

2 See 'Disaster Law: The Emerging Thresholds'(Routledge 2017) by Amita Singh.

scientific flood forecasting was initiated by the Central Water Commission (then known as Central Water & Power Commission) in November, 1958, a Flood Forecasting Centre was set up at its Headquarters in Delhi. The network has since expanded to cover all the major flood prone inter-State river basins in the country.

The international partners from Nepal, (ICIMOD) discussed the regional flood information system in the Hindu Kush Himalayan region (HKH-HYCOS) which is adapted to the World Meteorological Organization's (WMO) model of World hydrological Cycle Observing System (WHYCOS). The HKH region

also concerned the Ganges-Brahmaputra-Meghna and the Indus river basins. However, the experts agreed that there is no reliability of data as research documentation in linkage to communities and their responses has yet to be undertaken in India. This also weakens resilience efforts such as insurance schemes, Index Based data and effective compensation to victims.

The workshop highlighted the need for research, data and emphasis on the ethics towards duty and responsibility to mankind and all living creatures. The coming of drones make identification easier but it the administrator on the other side who may or may not decide to

record more vulnerable communities such as women, elderly, children, disabled and socially ostracized.

In conclusion, the EWS invites attention of NDMA's structure of disaster governance and university and academic institutions for generating a data bank of comparative socio-legal and economic vulnerabilities of communities as well as the administrative and science based systems. ■

- Dr. Amita Singh, Professor of Law & Governance, Chairperson, Special Centre for Disaster Research, Jawaharlal Nehru University (JNU), New Delhi, India

REGIONAL COOPERATION ON EARLY WARNING

Planning Early Flood Warning Across India, Nepal and Bangladesh Rivers: A View

Number of events across the 4 countries: 2000-2017

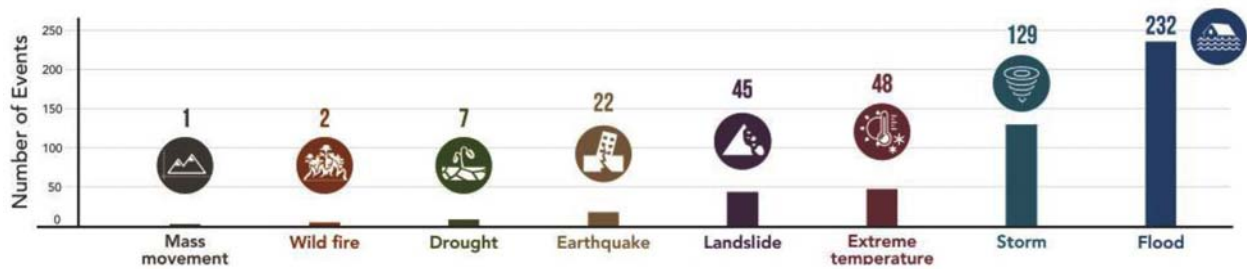


Table-1.: No of event from 2000-2017.

Context

It is an established fact that floods occurred more than any other the other disaster from 2000 to 2017. The data from CRED (Centre for Research on the Epidemiology of Disasters) on the basis of four countries India, Nepal, Bangladesh and Myanmar authenticates this statement.

Furthermore, among three countries of South Asia, viz. India, Bangladesh and Nepal all the disasters happen

either due to the floods or storms in the aforementioned period. In Bangladesh around 29% was affected by the floods, where as in India 55% affected by the floods whereas in Nepal 49% were affected by the floods¹. It is quite evident that flooding has had a major impact on communities across South Asia.

One of the important aspects of flooding in South Asia is the trans-boundary nature of floods that

mostly generates from the Himalayan mountain range. It is widely known that recurring catastrophes/ floods in trans-border river basins of the Ganga and the Brahmaputra cause extensive damages to the lives, livelihoods and properties of the communities at-risk and increase their vulnerability to external shocks. Total reported damages were US\$ 352,000, just 0.1% of the losses estimated by Munich Re to be US\$ 3.5 billion. Of this,

some US\$ 350 million in occurred in Bangladesh, US\$ 2.5 billion in India and US\$ 600 million in Nepal².

While understanding the nature of the problem, the Sendai Framework for Disaster Risk Reduction 2015-2030 has outlined the regional and global coordination mechanisms for effective flood recovery and mitigation. Early Warning Systems (EWS) was recognized as a key component for DRR at various levels. Further the Asian Ministerial Conference on DRR (AMCDRR) held in New Delhi in November 2016 has emphasized the need for promoting cooperation, collaboration and coordination among the nations for an effective Trans Border Flood Early Warning System.

Early Warning System

Though flood mitigation process is a complex web of systems that requires coordination, planning and management at several levels from centre to the state, an effective application of early warning measures on most of the trans boundary rivers can reduce the impact of loss and damage communities are suffering over the years.

The Early warning systems, along with other information services based on weather, water and climate data play a key role in disaster preparedness and improving the productivity and performance of climate sensitive sectors such as agriculture. Along with investments in resilient infrastructure, risk financing strategies and capacity building measures, they are a key part of a toolkit for strengthening disaster and climate resilience.

Need of Regional Approach

The bilateral river treaties and data sharing agreements currently in

Along with investments in resilient infrastructure, risk financing strategies and capacity building measures, they are a key part of a toolkit for strengthening disaster and climate resilience.

place are not sufficient to avert and adapt to flood catastrophes on a trans-border scale. Most of the national government though maintain the government to government level interaction and tends to exchange information regarding floods and other natural disasters on an ad-hoc basis. However, the institutional interaction between the countries are straightjacketed in nature and countries bounded by the bilateral treaties, hindered the information sharing process with third countries. It is clear that because of the regional nature of floods regional interdependencies between countries in terms of weather and climate is bound to happen.

The current water sharing agreement is limited to the Ganges River. An agreement on the Tista/Teesta River, a tributary to the Brahmaputra, has been discussed for many years but has not been signed. The cause and effect of weather pattern mostly being generated by monsoonal rains also requires comprehensive regional planning and effective coordination among South Asian countries. While significant progress has been achieved in strengthening regional early warning systems for tsunamis and tropical cyclones, especially since the 2004 Indian Ocean Tsunami, critical gaps exist for other hazards, despite the technology being largely available. Specifically, countries in Asia/South Asia. In the

present situation the regional institutional agreements between the South Asian countries are inadequately addressed. The SAARC forum which is the largest policy making body at South Asian level is not functioning optimum due to different geo-political and diplomatic exigencies of the region.

Involvement of Community and Water Diplomacy

An involvement from the community across the border is required for effective implementation of early warning measures. This can be done through either formulating regional institutions with a mandate for community involvement or by promotion of track II water diplomacy by having river basin dialogue on annual basis ensuring the participation of most of the relevant stakeholders

Governance Framework

Regular government to government interaction in terms of developing disaster management strategy should be priority action. The first level of interaction should happen within the country among the different organizations working in the space of flood mitigation.

Updating of existing disaster management strategies and action plans is required to empower the flood victim trans-border community for better operation through CEWS. Persuasion is required to develop bilateral and multilateral agreements that support hydro-meteorological data sharing between countries and basin scale flood forecasting in all trans-border rivers. ■

- **Rajeev Jha**, DRR Specialist, and **Swati Chhibber**, Partnership Development Manager, Practical Action, New Delhi, India

1 Decoding the monsoon flood in Bangladesh, India, Myanmar, Nepal, report by CRED

2 ibid

Role of EWS on Floods: A View from Bihar

Knock. Knock. "Who's there?" "Disaster"

I prefer not to open the door, if disaster knocks it. Even though I know that it will knock it down and enter, at least I'll be prepared.

An Early Warning System (EWS) can be defined as a chain of information communication systems and which comprises of sensors, event detection, and decision subsystems. They work together to forecast and signal disturbances that adversely affect the stability of the physical world, providing time for the response system to prepare for the adverse event and to minimize its impact.

What is the relevance of EWSs?

EWSs prevent loss of life and reduce the economic and materialistic impact of disasters. To be effective,

early warning systems need to actively involve communities at risk, facilitate public education and awareness for risk, effectively disseminate alerts, and warnings and ensure a constant state of preparedness. A complete and effective early warning system supports four main functions: **Risk analysis, Monitoring and Warning; Dissemination and Communication; and a Response Capability.**

Special issues attached to its Relevance

It is widely known and accepted that disasters affect women and men

differently. The **United Nations Handbook for Estimating the Socioeconomic and Environmental Effects of Disaster** (2003) emphasizes that one consequence of disaster "is the decapitalization of women and the reduction of their share of productive activities in the formal and informal sectors."

WHO research says that women and children are particularly affected by disasters, accounting for more than seventy-five percent of displaced persons. In addition to the general effects of natural disaster and lack of health care, women are vulnerable to reproductive and sexual health problems, and increased rates of sexual and domestic violence. Moreover, gender roles dictate that women become the primary caretakers for those affected by disasters - including children, the injured and sick, and the elderly - substantially increasing their emotional and material work load. Women's vulnerability is further increased by the loss of men and/or livelihoods, especially when a male head of the household has died and women must provide for their families.

(Similar to its general relevance, EWS definitely helps women and allows absolute awareness for preparedness)

Vulnerability? Talk of Floods? Major Show for EWS: CBFWS

Specialised Zone: Hindu Kush Himalaya (HKH)

The border between India and Nepal in Sitamarhi District of Bihar is generally characterized as a flat, flood prone, and partially waterlogged area. Light to heavy



rainfall in the Churia Hills of Nepal can cause flash floods that affect this zone. Flash floods have an impact on the Ratu river in the Sursand block of Sitamarhi every year. These rapid and intense flash floods cause huge losses of life and livelihood. Local people are aware of traditional early warning and preparedness methods that pertain to recurrent flood risks. However, they are unable to receive appropriate and timely information to minimize casualties and loss.

To address the challenges of flash floods, the International Centre for Integrated Mountain Development (ICIMOD), in partnership with Yuganter, is supporting the implementation of Bihar's roadmap on Disaster Risk Reduction, led by the Disaster Management Department of the Government of Bihar through a pilot project on Community-Based Flood Early Warning System (CBFEWS).

What is CBFEWS, Exactly? And what are its Features?

A Community-Based Flood Early Warning System (CBFEWS) is an integrated system of tools and plans to flood emergencies prepared and managed by communities. The objectives are to manage flood or flash flood risk by providing early warning to downstream communities and to enhance cooperation between upstream and downstream communities in the sharing of flood information. CBFEWS is implemented in communities under flood risk to enhance the capacity of local people to withstand the adverse effects of floods or flash floods. A properly designed and implemented system can save lives and property by providing time for downstream communities to prepare and respond to the threat of floods.

Features of CBFEWS

- Implemented in tributaries and flashy rivers.

- Upstream-downstream linkages
- Provides almost real-time information.
- Low-cost technology.

How does it work?

To be more accurate, this system is installed on the river tributaries, which has a high flooding risk, making the downstream communities extremely vulnerable. The upstream community generates the flood information using a simple low cost instrument and disseminates the real time early warning to the downstream communities providing sufficient lead time for preparedness. The system consists of a transmitter unit (which is placed on the river at a point where level reaches during the flood) and a receiver unit placed at the house of the nearest village. The house owner is known as the caretaker. He monitors the unit and disseminates the information received from the instrument to the downstream community, local government, line department and other stakeholders through mobile access.

Key Elements of CBFEWS

1. Risk Knowledge and Scoping – *Systematically collect data and undertake scoping risk assessments.*
2. Community Based Monitoring and Early Warning – *Upstream communities to install early warning instrument and monitor floods.*
3. Dissemination and Communication – *Upstream communities to communicate flood information and provide early warning to downstream communities.*
4. Response Capability and Resilience – *Enhance community response capabilities and build resilience.*

Talk of its Impacts and Success Stories!

A special mention of social impact on community is needed here. This

system had helped the community people in responding to the alarming situation in a much easier way, than before.

People of all ages, irrespective of any differences, have been provided with basic necessities, as per requirement.

Exempli Gratia (for the Sake of example)

- Rani Jha is an Anganwadi worker of AWC-138. She has been working in Srikhandi Bittha panchayat in Sursand block of Sitamarhi district and finds the EWS very useful. She discussed that before the establishment of the system, members of the community had no source of estimation for flash floods and so they had to face acute problems in the evacuation and preparation of the same. This situation had also led to large scale destruction of everything that came to its way. Sometimes it was so catastrophic that it led to a severe number of casualties. She also stated that in her remembrance, in that year (when this interview was taken) they got timely information and people took shelter at safer places. Hence, there was no loss, either in terms of lives or of property.
- Bhagsheela Devi is an ASHA worker of Srikhandi Bittha East. She narrated that she received the news about the flood four hours prior to it, because of the EWS. As a result, she was able to take all the pregnant women to a nearby school, so as to ensure their safety during the floods and made sure that the medical assistance was easily accessible to them. ■

– Sanjay Pandey,

Executive Director, and

Salony Vyas,

Intern, Yuganter, Bihar, India

Community Perception Changes for Disaster Risk Reduction Management after Srinagar Floods–2014

The frequency and severity of weather- and climate-related hazards has increased due to human activities, exposing more people and a greater value of assets to disasters. These extreme weather events have impacted both natural and human systems. (STERN, 2006; IPCC, 2007c). Sendai Framework of Action, has rightly endorsed Disaster risk-reduction management (DRM) through community resilience measures, as a key to reduce the disaster related affects. Mainstreaming disaster risk-reduction management within the policies and programmes of different sectors ensures that the effects of disasters are minimized and people are made resilient for

improved coping capacities to attain resettlement at the earliest.

The state of Jammu & Kashmir experienced the worst floods in the past 60 years, during first week of September 2014, due to unprecedented and intense rains. "The synchronization of movement of westerly winds in the extreme north, with the passage of monsoon disturbances in the lower latitudes caused heavy to very heavy rainfall along the foothills of the Himalayas, and adjoining areas of Jammu & Kashmir" (KAMALJIT RAY et.al, 2015). A total of 1.16 million people out of 1.27 million people of Srinagar Urban Agglomeration were affected by the September 2014 floods. (NRSC-ISRO, 2014, p54).

A survey was conducted, to examine the changes in the perceptions, towards Disaster Risk Reduction Management in terms of adopting protective measures, preparedness and disaster risk reduction awareness after Srinagar 2014 floods. A total of 125 households affected by the Srinagar floods, were randomly selected for the survey from 4 severely affected areas of Srinagar city in May-June 2016. The results from the survey depicts comparisons of the perception before the September 2014 floods and after the floods in May-June 2016. (Refer Table No. 1).

The results depict that the State machinery has been created for ensuring a conducive atmosphere of



Inundation of Srinagar City - Areal View, 10th September 2014.

Source: National Remote Sensing, Department of Ecology, Environment and Remote Sensing, Government of Jammu & Kashmir.

Table No. 1
Surveyed Respondents in Srinagar City
Perception of Preparedness of Disaster Risk Reduction Management (Percentage)

Indicator	Before	During
	September 2014	May-June 2016
	Percentage	Percentage
Installed Early Warning System	No (100)	No (60)
Appropriate Awareness created about flood eventually by Government	Yes (5)	Yes (40)
Awareness about flood eventually by Civil Society/ NGOS	Yes (10)	Yes (80)
Awareness through mock drills by Government	No (100)	Yes (25)
Knowledge of Rules and Regulations in place like not to construct around river channels/ flood channels	Yes (10)	Yes (75)
Implementation status of such rules	No (100)	No (60)
Knowledge of de-silting and dredging activities of government for river channels/ flood spill channels	No (100)	No (30)
Implementation of de-silting and dredging activities of government for river channels/ flood spill channels	No (100)	No (30)
Implementation of rules and regulations for the removal of unauthorized and illegal constructions around river channels/ flood channels	No (100)	No (40)
Any knowledge of any safety audits in place by government to avoid flooding in the flood prone areas	No (100)	No (90)
Observed or have knowledge of steps taken by government to strengthen flood protection walls/ strengthen bunds Yes / No If yes how would you rate its implementation	No (100) No idea (100)	No (60) Good (70)
Knowledge that government has identified safe areas of evacuations in case of emergency at the time of disasters	No idea (100)	No Idea (90)
How would you rate the overall preparedness of Government to face any such eventuality in future	Poor (95)	Poor (50)

Source: Field Survey by Research Team March - May 2016.

implementing rules and regulations especially, zero tolerance towards illegal encroachments in the river channels. The community has been sufficiently informed about rules and regulations of not encroaching river channels and flood channels. Even civil society organizations and individuals have better perception of disaster-risk reduction methods. They have observed significant improvement in the strategies being adopted towards disaster risk reduction, protective and preparedness measures. Steps like de-silting, dredging, maintenance of bund walls, clearance of river channels have been taken effectively by government agencies. However,

awareness generation measures like safety audits, implementation of building codes and development of emergency resettlement centres are not being looked into. Although early warning system equipment have been installed but people are not aware as to how such warning will be communicated and what measures are required during the warning period. More mock drills and adequate capacity building of community, individuals and other stakeholders need to be undertaken. ■

- **Bupinder Zutshi**

Professor, Centre for the Study of
Regional Development
Jawaharlal Nehru University,
New Delhi, India

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EWS for Floods: A View from Himalayas

Himalayan region is prone to natural hazards like floods, glacial lake outburst, droughts, landslides, avalanches and earthquakes. The unstable geological conditions and steep terrain, combined with climate change and frequent extreme weather conditions, pose myriad challenges for the communities. The frequent occurrence of flash floods, one of the major natural disasters in the region, threatens lives, livelihoods and infrastructure, both in the mountains and downstream. Vulnerable groups like the poor, women, children, the elderly and people with disabilities often suffer the worst impacts.

The establishment of a regional flood information system allowed for a timely exchange of flood data and information for reducing flood vulnerability. A wide range of information is produced to support multi-scale disaster risk reduction (DRR) systems using satellite rainfall estimation, satellite altimetry based flood early warning systems, flood inundation modelling, and model derived hydrological information. Whereas, Community Based Flood Early Warning System (CBFEWS) enabled by wireless technology is one of the promising interventions for minimizing flood risk at the community level.

Flood Forecasting Capacity in the Hindu Kush Himalayan (HKH) Region
Understanding the present capabilities of hydro meteorological services in the participating countries and disaster management authorities and utilizing the expertise available is necessary for the development of an Regional Flood Information System (RFIS).



Village level trained task force member.

Adequacy of hydro meteorological observation networks and quality control of observations of Hydrometric information is fundamental to the planning, operation and management of water resources and flood defense. Hydro meteorological observation networks include stage and discharge measurements as well as meteorological observations such as rainfall, temperature, humidity, pressure and wind speed.

Development of a Regional Flood Information System

The occurrence or threat of natural disasters creates opportunities to facilitate cooperation among countries by fostering linkages. Given the geopolitical sensitivity in the HKH region, there are few regional initiatives for cooperation and management of hazards and water resources. But the increasing problems of floods that are common to all countries have brought them together to work collectively in looking at ways to minimize the adverse impacts. One such example

is the HKH Hydrological Cycle Observing System (HYCOS), a regional initiative to establish an RFIS in the Ganga-Brahmaputra-Meghna and Indus Basins. ICIMOD initiated this project in partnership with WMO and the regional member countries Bangladesh, Bhutan, China, India, Nepal and Pakistan (Molden et al., 2014).

Real-time Monitoring Network

Early flood warning for better preparedness is largely dependent on the timely availability and quality of hydro meteorological data. Collection of hydro meteorological data in real time requires a range of sophisticated sensors together with professional competence in management and operation. The first priority was to update and automate existing hydro-meteorological stations to make them capable of observing parameters and transmitting the data at regular and specific intervals. A wide range of options are available for automatic in situ water-level observations, including stilling

wells, pressure sensors, bubbler sensors and radar sensors.

Data Storage

For the HYCOS initiative, data storage is provided in three different places. At the site level, site-specific data are stored in a cyclic memory that can hold data for 2-10 years. Real-time data is transmitted simultaneously to the national servers and a regional server; the two servers are synchronized periodically to ensure that the same set of data is available on both. In addition, an automated plausibility analysis of incoming data is performed as a first-order quality check.

Nepal

Nepal is highly vulnerable to the impacts of climate change. The country's average temperature is increasing at the rate of about 0.04°C, and the trend is much higher in the High Himalaya region (4,000-8,000m). This contributes to glacial retreat and expansion of lakes, raising the risk of Glacial Lake Outburst Flood (GLOF). At the same time, deforestation and land degradation of Churai region (700-1,500m) have increased flash floods and inundations especially causing severe damage to the downstream Terai region (below 750m).

Addressing the situation, the National Adaptation Programme of Action (NAPA) has prioritized in its combined profile 4 as GLOF Monitoring and Disaster Risk Reduction.

The Community Based Flood Early Warning System has been installed and operated within the capacity and capability of the communities of the affected area to ensure the sustainability of the project.

Local community has developed flood maps, identification of evacuation routes, designation of evacuation sites and shelters, and implementation of the Community Based Flood Early Warning System (CBFEWS) in small tributaries for flash flood.

Communication between upstream and downstream communities was promoted to enhance collaboration. Increases in river water level upstream are a good indicator of flooding events downstream. DHM employed the local monitoring staff from the upstream community, and equipped them with basic river monitoring system (solar powered for communities with no grid connectivity), but most of the activities were carried out by upstream communities themselves.

Creative use of existing resources and collaboration with various Government Agencies, NGOs and private-sector companies were key to deliver the CFGORRP. Also, there is a risk of mountain trekkers being caught up in the GLOF along the trail. To solve these problems, DHM installed an automated monitoring station at the glacial lake with the collaboration with the Ministry of Home Affairs (MoHA) and telecommunication companies (Nepal Telecom and NCELL) to disseminate warning using SMS.

Institutional Arrangements

The executing agency is the Department of Hydrology and Meteorology (DHM) under the Ministry of Population and Environment (MoPE), which is technically supported by UNDP. The Department of Soil Conservation and Watershed Management (DSCWM), the Department of Water Induced Disaster and Prevention (DWIDP), and the Department of National Park and Wildlife Conservation (DNPWC) are collaborating partners, and responsible for providing inputs to planning, technical oversight. ■

- **Dr. Bhanu Mall**, Secretary,
Purvanchal Garmin Vikas Sangathan
(PGVS), Lucknow, Uttar Pradesh,
India

Editorial Advisors:

Denis Nkala

Regional Coordinator, South-South Cooperation and Country Support (Asia-Pacific), United Nations Development Programme, New York

Ian Davis

Visiting Professor in Disaster Risk Management in Copenhagen, Lund, Kyoto and Oxford Brookes Universities

Dr. John Twigg

Senior Research Fellow in the Risk and Resilience programme, Overseas Development Institute (ODI), London

Madhavi Malalgoda Ariyabandu

Sub-Regional Coordinator, Central Asia & South Caucasus, United Nations Office for Disaster Risk Reduction (UNISDR), Kazakhstan

Mihir R. Bhatt

All India Disaster Mitigation Institute, India

Dr. Satchit Balsari, MD, MPH

The University Hospital of Columbia and Cornell, New York, USA

T. Nanda Kumar

Former Chairman, Institute of Rural Management Anand (IRMA), Anand, Gujarat, India



ALL INDIA DISASTER MITIGATION INSTITUTE

411 Sakar Five, Behind Old Natraj Cinema, Near Mithakhali Railway Crossing, Ashram Road, Ahmedabad-380 009 India. Tele/Fax: +91-79-2658 2962
E-mail: bestteam@aidmi.org, Website: <http://www.aidmi.org>, www.southasiadisasters.net