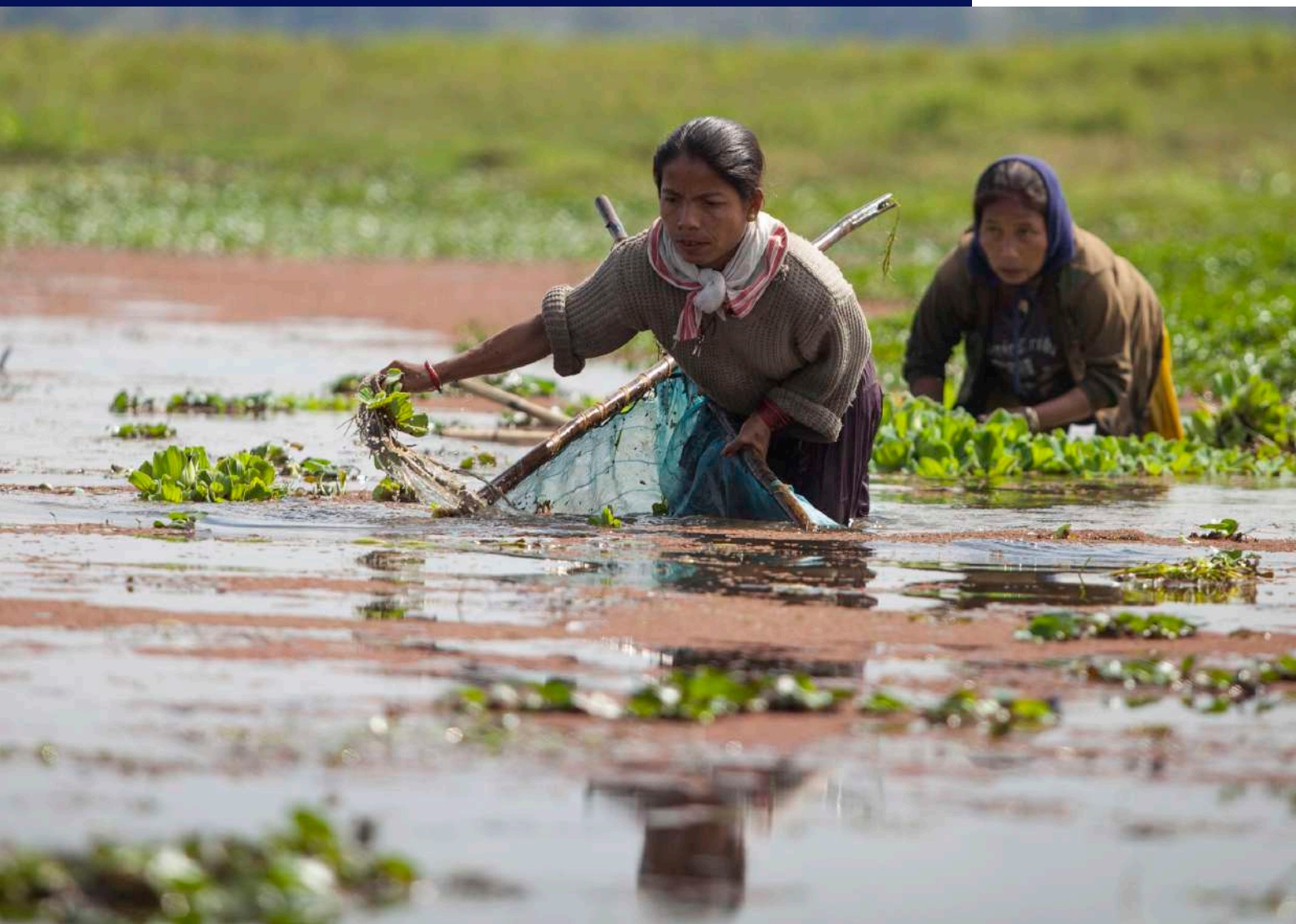
ICIMOD Proceedings 2016/4

ICIMOD

FOR MOUNTAINS AND PEOPLE

Knowledge Forum on Disaster Risk Reduction and Resilient Livelihoods in the Koshi Basin



About ICIMOD

The International Centre for Integrated Mountain Development (ICIMOD) is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush Himalayas (HKH) – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – based in Kathmandu, Nepal. Globalization and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream and downstream issues. ICIMOD supports regional transboundary programmes through partnerships with regional partner institutions, facilitates the exchange of experiences, and serves as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop economically and environmentally-sound mountain ecosystems to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now and in the future.

About Koshi Basin Programme

With support from the Department of Foreign Affairs and Trade (DFAT), Government of Australia, International Centre for Integrated Mountain Development (ICIMOD) initiated the Koshi Basin Programme (KBP) in 2013 to enhance the regionally coordinated management of the Koshi basin for the improved wellbeing of local communities and sustainable use of ecosystem goods and services. Since its inception in 2013, KBP has been working to develop knowledge and tools to better address the water issues in the basin. It aims to contribute to inclusive poverty reduction in the Koshi basin by evaluating the range of possible water-related development pathways through evidence-based decision-making and basin-wide cooperation. These pathways take into account climate change, hazards, and the provision of sustainable freshwater ecosystem services. The KBP uses the river basin management approach to promote sustainable use of transboundary water resources and develop 'win-win' solutions that can be supported by all countries. Particular focus is given to issues of gender and inequality and their linkages to drivers of change and river basin management, as well as to the potential of employing incentive-based mechanisms to improve water use efficiency and productivity.

ICIMOD gratefully acknowledges the support of its core donors:
The governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Switzerland, and the United Kingdom.

ICIMOD Proceedings 2016/4

Knowledge Forum on Disaster Risk Reduction and Resilient Livelihoods in the Koshi Basin

4–5 February 2016

Patna, Bihar, India

International Centre for Integrated Mountain Development, Kathmandu
September 2016

Published by
International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal

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This publication was produced under the Koshi Basin Programme (KBP) of ICIMOD. The KBP is supported by the Australian Government through the Sustainable Development Investment Portfolio for South Asia, as well as by ICIMOD's core funds contributed by the governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Switzerland, and the United Kingdom.

Disclaimer
The knowledge forum in Patna, Bihar, India was jointly organized by ICIMOD's KBP in collaboration with the Bihar State Disaster Management Authority (BSDMA), the National Disaster Management Authority (NDMA) and the National Institute of Disaster Management (NIDM). This document summarizes the proceedings of the knowledge forum including presentations and panel discussions.

This publication is available in electronic form at www.icimod.org/himaldoc

Citation: ICIMOD (2016) *Knowledge Forum on Disaster Risk Reduction and Resilient Livelihoods in the Koshi Basin*. ICIMOD Proceedings 2016/4. Kathmandu: ICIMOD

Contents

Acronyms and Abbreviations

ANSISS	AN Sinha Institute of Social Studies
AKU	Aryabhatta Knowledge University
BAMETI	Bihar Agriculture Management and Extension Training Institute
BAPEPS	Bihar Aapda Punarwas Evam Punarnirman Society
BSDMA	Bihar State Disaster Management Authority
BSS	Bihar Sewa Samiti
CDDMASS	Centre for Development and Disaster Management Support Services
DFAT	Department of Foreign Affairs and Trade
DMD	Disaster Management Department
DRR	Disaster Risk Reduction
FMIS	Flood Management Information System
FMISC	Flood Management Improvement Support Centre
GBPIHED	GB Pant Institute of Himalayan Environment and Development
GDS	Grameen Development Studies, Sitamarhi
GEAG	Gorakhpur Environmental Action Group
GFCC	Ganga Flood Control Commission, Patna
GPSVS	Ghoghardiha Prakhand Swarajya Vikas Sangh
HKH	Hindu Kush Himalayas
HYCOS	Hydrological Cycle Observation System
ICAR	Indian Council of Agricultural Research
ICIMOD	International Centre for Integrated Mountain Development
IDF	Integrated Development Foundation
IEG	Institute of Economic Growth
IGSNRR	Institute of Geographic Sciences and Natural Resources Research
IMHE	Institute of Mountain Hazards and Environment
IIT	Indian Institute of Technology
IMD	Indian Meteorological Department
KBP	Koshi Basin Programme
LIDAR	Light Detection and Ranging
MoEFCC	Ministry of Environment, Forest and Climate Change
MPA	Megh Pyne Abhiyan
NIDM	National Institute of Disaster Management
NIT	National Institute of Technology
NDMA	National Disaster Management Authority
PGVS	Poorvanchal Gramin Vikas Sansathan
SDIP	Sustainable Development Investment Portfolio
SRTM	Shuttle Radar Topography Mission
TWCWM	Third World Centre for Water Management
UNICEF	United Nations Children's Fund
WRD	Water Resources Department

Acknowledgements

We would like to thank all those who contributed in making the knowledge forum a meaningful event. The event was organized by ICIMOD in partnership with the Bihar State Disaster Management Authority (BSDMA), the National Disaster Management Authority (NDMA) and the National Institute of Disaster Management (NIDM) and other key institutions in China, India and Nepal.

We would like to thank Dr David Molden, Dr Eklabya Sharma, Dr Golam Rasul, Dr Arun Bhakta Shrestha, Dr Shahriar M Wahid, Nira Gurung, Kanchan Shrestha and Govinda Shrestha from ICIMOD for their contribution and support. Our team is grateful for the valuable support of the BSDMA, in particular Anil K Sinha, Ajit K Samaiyar, Asif Shahab, Monisha Dubey, and Dr Madhubala. Our special thanks goes to PN Rai and Dinesh Mishra for their support.

We would also like to thank the participant organizations for their contributions and participation (Complete list in Annex 2)

Executive Summary

In an attempt to build a strong, regional knowledge network to better ensure water security and resilient livelihoods, a 'Knowledge Forum on Disaster Risk Reduction and Resilient Livelihoods in the Koshi Basin' was organized by ICIMOD's Koshi Basin Programme in partnership with the Bihar State Disaster Management Authority (BSDMA), National Disaster Management Authority (NDMA), and National Institute of Disaster Management (NIDM) and other key institutions in China, India, and Nepal. The event was held from 4–5 February 2016 at Bihar Agriculture Management and Extension Training Institute (BAMETI) in Patna, India.

The forum was the first of its kind, with the participation of over 250 representatives from China, India, and Nepal. Participants included diplomats, senior government officials, government institutions and UN agencies and ICIMOD's partner organizations, academic, research institutions, community-based organizations and the private sector.

The objectives of the forum were to:

1. Share evidence-based knowledge and tools generated on:
    a. flood and drought-related disaster risk reduction and vulnerabilities in the Koshi basin
    b. socioeconomic and livelihood improvements in the Koshi basin
2. Discuss challenges and potential for converting knowledge into policy and actions in the Koshi basin
3. Discuss how regional cooperation can strengthen the process by using evidence-based knowledge for effective policy support.

The forum had five technical sessions in addition to inaugural and closing sessions. The guest speakers included high-ranking state officials of the Government of Bihar and a senior official from the Australian High Commission in New Delhi. The inaugural address was delivered by Bihar Minister for Disaster Management Department (DMD) Professor Chandrashekhar, and the Minister for Energy and Commercial Tax Bijendra Prasad Yadav gave a special address. Rajiv Ranjan Singh, Minister for Water Resources Department, conveyed a message through a representative who was present at the forum. Ryan Thew, First Secretary (Development) at the Australian High Commission, presented on the Sustainable Development Investment Portfolio (SDIP) approach for South Asia, highlighting the Australian government's long-term investment in and support for disaster risk reduction and the importance of regional cooperation for river basin management.

During the opening sessions, several other speakers highlighted the need to link science, policy, and practice in the basin. They stressed the importance of regional cooperation in the management of the Koshi basin. They also drew attention to the importance of generating and sharing technical knowledge and evidence-based data for better disaster management. They emphasized the need to synthesize and translate research into policy action, and to incorporate indigenous knowledge in disaster management strategies.

The five technical sessions were:

1. Disaster risk reduction in the Koshi basin: Flood and geohazards
2. Resilient livelihoods in the Koshi basin
3. Disaster risk reduction and livelihoods
4. Group work: Floods, livelihoods, early warning system, and droughts
5. Panel discussions on regional learning to strengthen policy making on river basin management

The five technical sessions included nine presentations in addition to interactive group and panel discussions. The presentations highlighted the need to address the issues in the Koshi basin in a coordinated and collaborative manner given the transboundary nature of most of the challenges. There is a need for studies on socioeconomic dynamics and livelihoods in the basin as well as policy analysis. Another important question is how to institutionalize

indigenous knowledge and link it with policies. Participants suggested that the findings of the studies should be simplified so that developmental practitioners, policy makers, and high-level decision makers can easily understand them and translate them into action. More data and in-depth data are needed to shed light on the nuances of different forms of livelihoods in each area of the basin. This will help translate research into policy action.

Knowledge tools such as the flood early warning system are not enough to reduce the impact of floods. There is also need to build confidence among the local communities by working closely with them. Politicians and decision makers have an important role in this. Strong political will is needed to improve disaster management and livelihood strategies for basin-dependent communities. The speakers suggested that working closely with politicians and decision makers was key in transforming knowledge into policy. Policy making is a participatory process and policy makers need to seek participation and engagement of key stakeholders including river communities, citizens' groups, and NGOs. One of the key issues for regional cooperation is benefit sharing between the upstream and downstream countries – not just for economic reasons, but also for building goodwill among countries sharing the basin.

This was the first time a knowledge forum with a regional dimension was being held exclusively for the Koshi River basin. The presence of high-level officials, including state ministers, helped provide political leverage to help address the basin's issues.

The participants said they were able to take valuable information and knowledge as take-away messages, including:

- data sharing throughout the entire basin;
- focus on community aspirations to produce more resilient livelihoods;
- contribution by countries to enhance regional flood outlook;
- regional exchange between participants on knowledge and good practices;
- promotion of evidence-based policy and a multi-disciplinary approach; and
- using science in policy formulation.

During the closing session, the speakers said that the points made in the technical sessions showed a way forward for disaster risk reduction. More forums like this one are needed to bridge the gap between organizations and governments for knowledge sharing and learning.

Background note for the knowledge forum

Rich in biodiversity with high ecological significance, the transboundary Koshi River basin is shared by China, India and Nepal. Over 40 million people across the three countries depend on the basin for water and livelihoods, but the basin is also highly fragile and vulnerable to natural disasters. Its upstream areas, mostly in China and Nepal, have problems of shifting snowlines, glacier retreat, landslides, soil erosion, and land degradation. The downstream areas of the basin in the northern part of India's Bihar and the southern region of Nepal routinely suffer from extreme natural events like devastating floods and drought. As a result, a large number of communities in these areas are among the poorest in the region despite the floodplains being highly fertile and hosting rich agricultural resources.

The vast stretches of fertile floodplains of the Koshi basin are among the most agriculturally abundant regions of Bihar (India) and Nepal. The region frequently suffers from significant flood and drought events, resulting in low agricultural productivity, cropping intensity, and access to markets for the farmers. Lack of regionally coordinated knowledge of the complex nature of disaster management and agricultural livelihood issues and challenges in the transboundary basin has hindered investment in infrastructure, land, and measures for increasing agricultural productivity.

Communities in the Koshi basin have yet to widely adopt adaptation strategies such as alternative farming, plant drought-resistant crops, and floodplain zoning. There is lack of action for several reasons, including limited financial resources, lack of technical knowledge and awareness, unclear property rights, as well as lack of the sharing of information across borders and poor governance.

ICIMOD, with the support from the Australian Department of Foreign Affairs and Trade (DFAT), is facilitating the regionally coordinated Koshi Basin Programme (KBP) to generate knowledge on the frequency, magnitude, and exposure to hydrometrological-induced disasters resulting from climate change events like the melting of glaciers and snow, land use change, and rising challenges related to sedimentation,

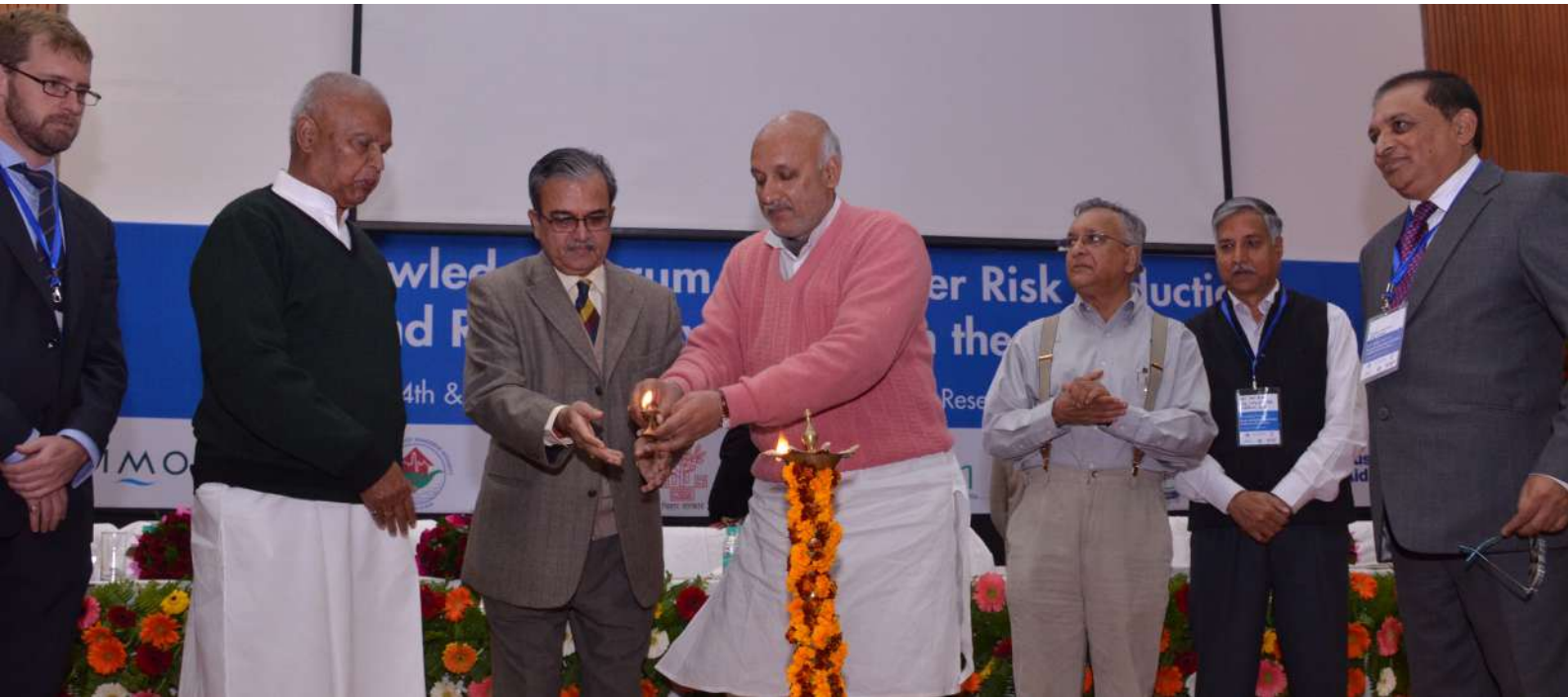
SESSIONS

Inaugural Session

Speakers: (Listed in order of their presentations)

- Dr Eklabya Sharma, Director of Programme Operations, ICIMOD;
- Ryan Thew, First Secretary of Development for the Australian High Commission;
- Professor Asit K. Biswas, Distinguished Visiting Professor at Singapore's Lee Kuan Yew School of Public Policy;
- Professor Santosh Kumar, Executive Director at the New Delhi Institute of Management;
- Arun Kr. Singh, Principal Secretary of India's Water Resources Department;
- Kamal Kishore, Hon'ble Member of NDMA
- Dr Uday Kant Mishra, Hon'ble Member of BSDMA;
- Anil K. Sinha, Hon'ble Vice Chairman of the BSDMA
- Vijendra Prasad Yadav, Hon'ble Minister of Bihar's Energy and Commercial Tax;
- Professor Chandrashekhar, Hon'ble Minister, DMD, Government of Bihar
- Ajit Kumar Samaiyar, Senior Advisor at BSDMA.

The panel for the opening session included scholars, practitioners, and government officials. Following the official lighting of the lamp, Dr Eklabya Sharma formally welcomed the audience to the forum. He noted the Koshi basin's importance with regard to disaster management, and said that ICIMOD and BSDMA have been working together for two years with the goal of disaster risk reduction. He said that the goal should be to link science, policy, and practice in the basin, and to encourage regional cooperation by linking upstream and downstream work in river basin communities. Dr Sharma highlighted the importance of filling the data gap to endorse evidence-based policy making. He explained that the data was valuable in harnessing the immense potential for investment in infrastructure and development in the basin. He said that there are challenges in achieving these goals, including limited financial resources, lack of technical knowledge, low level of awareness about adaptation options, absence of collective action, unclear property rights, and the lack of effective role of governmental agencies.



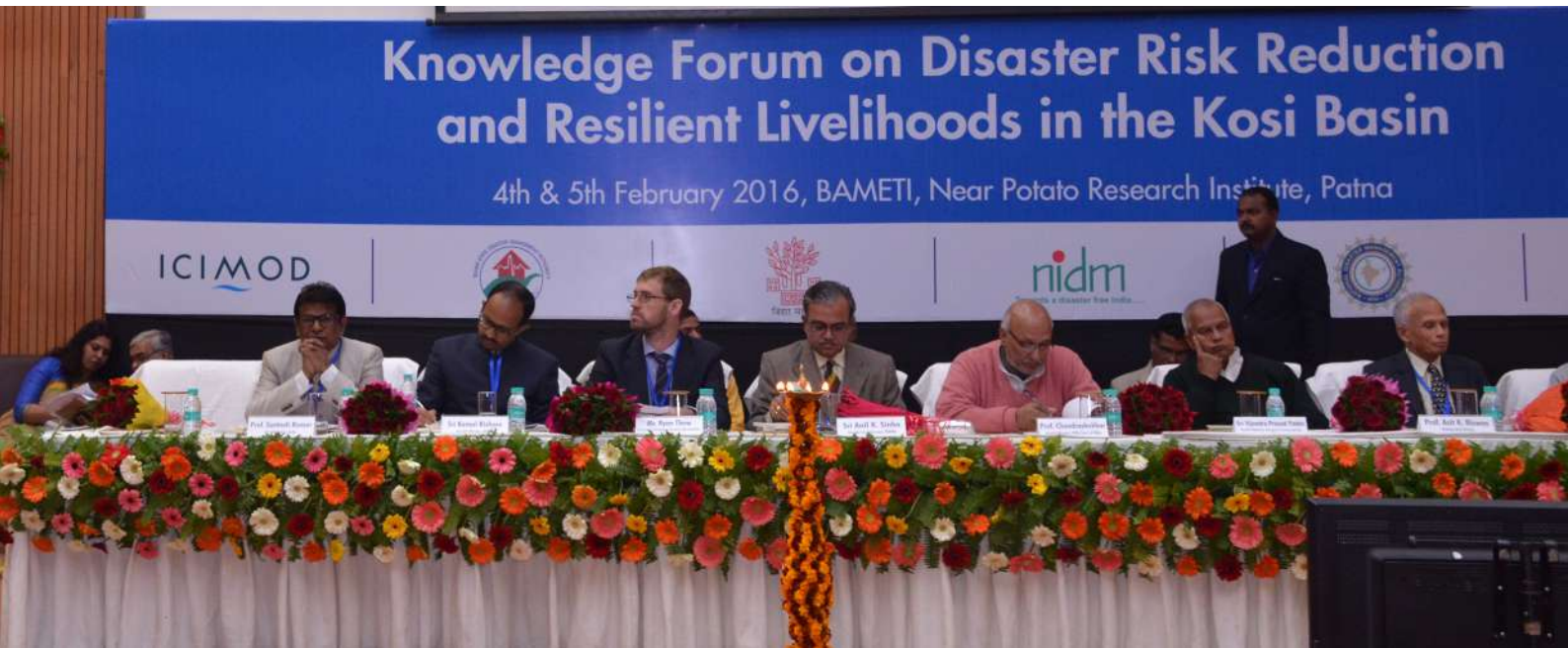
The next speaker Ryan Thew said that the Australian government has a long record of investing in disaster risk reduction, and that the Australian government is happy to support ICIMOD in addressing these issues. He reflected on the earlier message of Dr Sharma about how regional cooperation is fundamental to river basin management, adding that the knowledge required to deal with disasters contributes significantly across national borders.

Professor Asit K Biswas began by recalling his discussion on water issues with India's late Prime Minister Indira Gandhi, in which she had said, "Water is a means to an end. I am interested in ends. Please talk about water as a catalyst for economic development, and an engine for reducing poverty." He explained that water is the root of all issues in the world, and that water is also at the root of poverty in the Ganga, Brahmaputra, and Meghna basins, home to large numbers of poor people. Part of the problem is that countries in the HKH – Nepal, India, and Pakistan – are not actively working together. He explained how regional cooperation is possible and gave an example of how Bhutan is currently producing large amounts of hydropower due to its collaboration with India. He noted that Nepal has the potential to produce four times the amount of Bhutan's hydropower with a strong regional collaboration. He explained that ICIMOD, as an intergovernmental organization, is an ideal catalyst for this cooperation. With enough resources and serious effort, there is every possibility to make this region a highly developed one. What the region needs is to generate enough knowledge, synthesize it, and ultimately translate into policy. Professor Biswas concluded his presentation by quoting Confucius: "The essence of knowledge is applying it."

Following this, Professor Santosh Kumar started by noting the paradox that Bihar is both a water surplus and water scarce state. This suggests that there are managerial issues that need to be overcome. Specifically, efforts need to concentrate on the challenges of storing water, using water as a development resource, and addressing the fact that every year, water washes away roads, infrastructure, and telecommunications. As a result of flooding, people in the Koshi basin are often forced to become landless, or to migrant labourers. Professor Kumar concluded with important questions including: How to restore infrastructure? Can the agricultural sector take a larger role in livelihood management? How can the region develop a financial mechanism for improving livelihoods? How to develop a disaster risk reduction and flood resistant technology?

Next, PN Rai gave a personal account of the Koshi disaster that happened in 2008. He described the destruction of fishing boats and farms, and highlighted the fact that recovery is a painful process, one that has not been fully completed till date. Even after eight years since the disaster, people of the region have still not received community-based flood early warning systems. He hoped that the forum would help disseminate these early warning systems.

Kamal Kishore began by noting that flood risk management is easier said than done since management across boundaries is often challenging. However, he expressed hope that the forum would help combat this challenge by advocating for a basin-wide approach. He reiterated that flood risk management is closely related to economic development, and noted that all floods do not warrant the same response, explaining that different places have different needs according to local context. He stressed that those working in disaster management cannot afford to take a long view of things. Both short term and long term perspectives need to be taken into account simultaneously.



Following this, Dr Uday Kant Mishra noted that Bihar is an exceptional state: Chief Minister Nitish Kumar is planning to set up a Centre for River Studies in Arya Bhat Knowledge University, and has also resolved Seven Nishchays (Seven Decisions), one of which is a goal to have water in every household. He then quoted from the book 'Do Patan Ke Beech Me' by Dinesh Mishra, and referenced late Gulzarilal Nanda, who said people need to learn how to live with floods. Importantly, he noted that the cause behind floods is not water but siltation. He concluded with three important points to consider: 1) flood insurance should be considered an important part of relief; 2) appropriate use of technologies should be integrated into disaster management; and 3) knowledge, in addition to relief, should be shared with communities.

Next, Anil Sinha began by reminding everyone that the definition of disaster is broad, as stated in Disaster Management Act of 2005. It is important to think of disaster in this wider sense. Worldwide, he stated, a lot of data has been generated on climate change, but the Hindu Kush Himalayan region remains data deficient. However, it is important to note the distinction between data and knowledge. The HKH region may be data-deficient, but it is not knowledge-deficient, and this knowledge – including indigenous knowledge – should be capitalized on. In this regard, he said he was pleased with the potential of the knowledge forum, and believed that it should be an annual event, with an emphasis on collecting evidence-based data for the Koshi basin and the larger region. At the same time, the focus should also be on community-based adaptation and community-based disaster management, in an effort to have a two-way exchange of knowledge.

On behalf of Rajiv Ranjan Singh, chief engineer, Indu Bhushan Kumar read a statement saying that the subject of floods, disasters, and water management in the Koshi basin is both challenging and important, as Bihar experiences the fury of the Koshi with stunning consistency. He expressed hope that the workshop would produce many recommendations that would prove useful in the coming years.

Following this, Minister Vijendra Prasad Yadav stated that as Bihar has five river basins, understanding the status, character, and behaviour of the Himalayas and the Koshi basin is important. The basin has no scarcity of water, and planners should figure out how to turn this water into an engine for economic growth. He also noted that floods bring not only immense amounts of water, but also alter the region's geography through deposition of silt. The behaviour of the river – and how it moves and changes – should be the focus of studies in the coming years. This understanding is best achieved through the accumulation of technical knowledge. Minister Yadav asked the Australian government for technical assistance in this regard.

Lastly, Professor Chandrashekhar said that when it comes to the Koshi basin, enhancing research ultimately means enhancing local communities and it is important to remember that ultimately, this work is for the communities themselves. Along these lines, Professor Chandrashekhar emphasized that disaster management should start with primary and elementary education, and steps have already been made in this direction. For instance, a policy was passed to incorporate community-based disaster management response into local primary and elementary education. In the end, he said that the Government of Bihar believes in 'Vasudhaiva Kutumbakam', which translates as 'the world is one family'.

Key Messages

- The goal should be to link science, policy, and practice in the basin
- Regional cooperation is fundamental to river basin management.
- Water can be a catalyst for economic development.
- Knowledge generation alone is not enough: knowledge needs to be synthesized and translated into policy.
- Disaster management should consider both the short term and the long term.
- There is a difference between data and knowledge: the Koshi basin is data deficient despite rich in knowledge wise; local knowledge should be incorporated into disaster management strategies.
- Technical knowledge and evidence-based data are very important for improving disaster management.

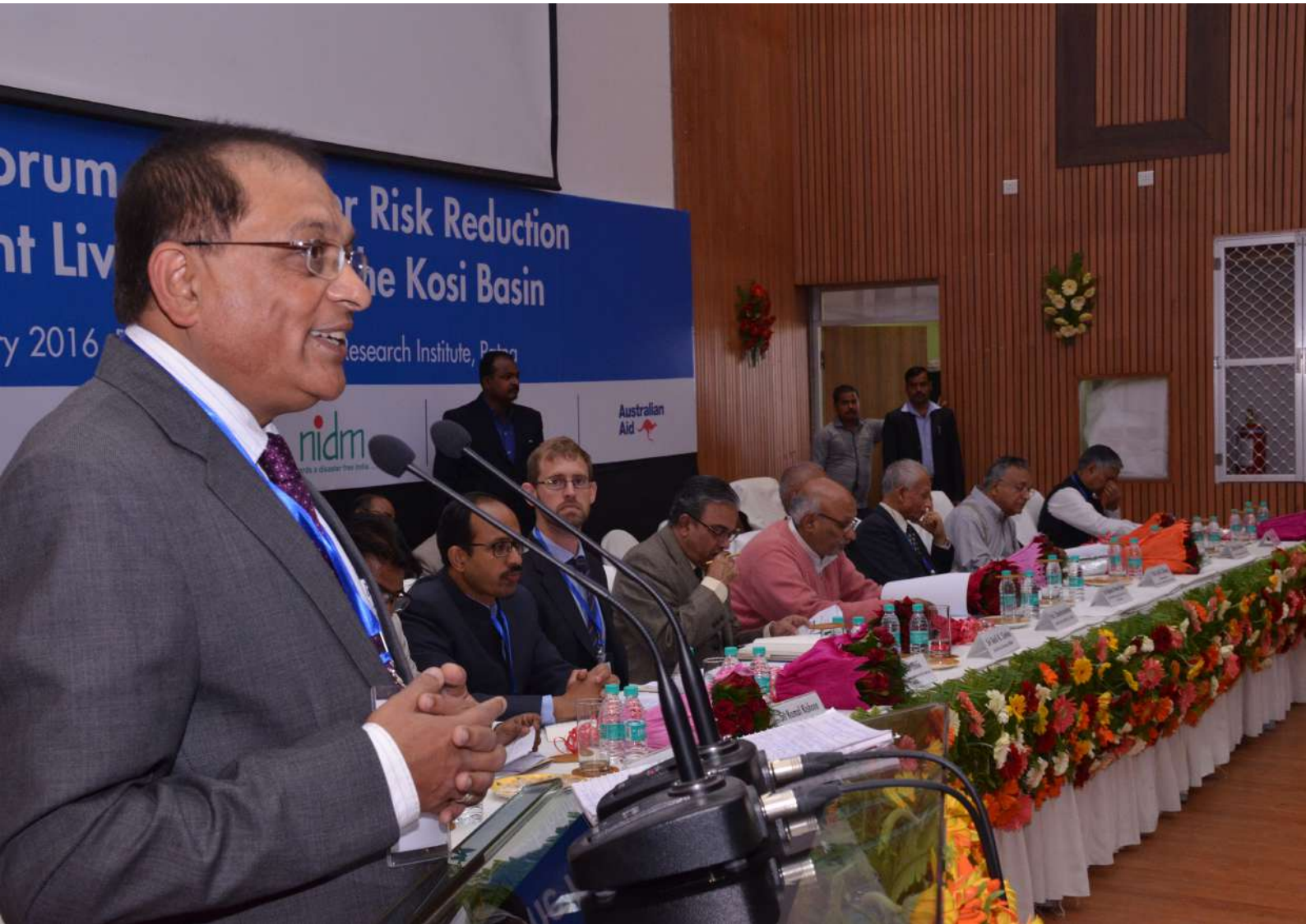
Technical Session 1

Session objectives: The session included presentations on the Koshi basin's management at the transboundary level. The focus was on the importance of knowledge sharing at the regional level to address the challenges in dealing with natural disasters. This session was divided into two technical sessions: floods and geo-hazards.

Chair	Dr Eklabya Sharma, ICIMOD
Co-chaired by:	SK Sahu, Central Water Commission, Patna
Presenter:	Dr SM Wahid, ICIMOD

Dr Wahid presented an overview of ICIMOD's Koshi Basin Initiative. He explained that the Koshi River basin faces many challenges ranging from floods – including flash floods – landslides, and Glacial Lake Outburst Floods (GLOFs). As many of these challenges are transboundary in nature, sharing of information and knowledge is crucial. To meet this challenge, he explained that the KBP is generating evidence-based knowledge at the local and river basin level, which is key for development planning. The programme has developed the Koshi Basin Information System (KBIS), where data and information on the Koshi basin can be agglomerated and shared.

[1] GLOF is an outburst of flood that occurs when the dam containing a glacial lake fails. Glacier thinning and retreat in the Himalayas have resulted in formation of new glacial lakes and enlargement of existing ones due to the accumulation of melt water behind loosely consolidated end moraine dams. Such lakes are inherently unstable and subject to catastrophic damage and are potential sources of danger to people and property in the valleys below them.



Technical Session 1a: **Floods**

Session objective: To discuss the importance of regional flood outlook and forecasting, and share experiences from the Bagmati basin.

Chair	Dr Eklabya Sharma, ICIMOD
Co-chaired by:	SK Sahu, Central Water Commission, Patna
Presenter:	Dr Arun Bhakta Shrestha, ICIMOD, and Nagan Prasad, FMIS

In his presentation, Dr Arun B Shrestha talked about the importance of the regional flood outlook and learning at ICIMOD. The countries of Hindu Kush Himalayan region is highly prone to disaster, and has an average of 60 disaster events per year. On average, more than 24,000 people have been killed annually and 160 million affected by natural disasters. Floods are one of the recurring hazards in the Himalayan region, and their frequency and magnitude intensity is increasing due to climate change. Under an ICIMOD programme known as HKH HYCOS (Hydrological Cycle Observation System), monitoring stations have been established for real time flood information system to make information travel faster than flood waves. About 37 hydro meteorological stations have been upgraded in Bangladesh, Bhutan, Nepal, and Pakistan under HKH HYCOS. As part of the flood forecasting system, these stations can reduce flood vulnerability in the Koshi River basin. Since 2014, ICIMOD has been developing a web-based regional floodinformation system, which KBP is piloting as a regional flood outlook. A pilot model has been set up for Ganges and Brahmaputra basin using the Mike11 model. The real time information from HKH-HYCOS station is very useful during disaster events. During the August 2014 Sun Koshi landslide disaster in Nepal, the landslide created a dam, which formed an artificial lake holding about 7 million m3 (cubic metres) of water. A real time water level update from a data collection centre at Pachuwarghat, Sunkoshi, 37 kilometers downstream of Sunkoshi was provided in the HYCOS website (http://www.icimod.org/?q=14356) during the event.

Nagan Prasad, joint director of Flood Management Improvement Support Centre (FMISC) within Bihar's Water Resources Department, presented on the flood forecasting initiative from the Bagmati Basin that is being implemented by FMISC. Bihar is India's most flood-prone state, with 76% of the population in the north living under the recurring threat of devastating floods. The Central Water Commission has established flood-forecasting stations in North Bihar in 21 locations on the northern tributaries of the Ganges, and 7 on the main river. The warning time varies from 9 hours to 24 hours based on gauge-to-gauge correlation. The information about the floods is disseminated through a website as well as on a person-to-person basis. He mentioned that FMISC is also working in the Bagmati Adhwara basin to increase the lead-time of flood forecasts using rainfall forecast as one of the key inputs. The flood forecast model required using IMD rainfall forecast data (up to 3 days), rainfall data, water level, and cross section information. The results of the flood forecasting model have to be processed in a GIS-based environment into maps of flood inundation extent, depth, arrival time, and duration, with other relevant themes in the background for the targeted 1,800 sq. km. area (intensive modeling area based on LIDAR survey). Flood inundation information in the rest of the basin is based on SRTM data of the Bagmati-Adhwara basin. These inundation maps are subsequently being processed into web-enabled formats.

Technical Session 1b: **Geohazards**

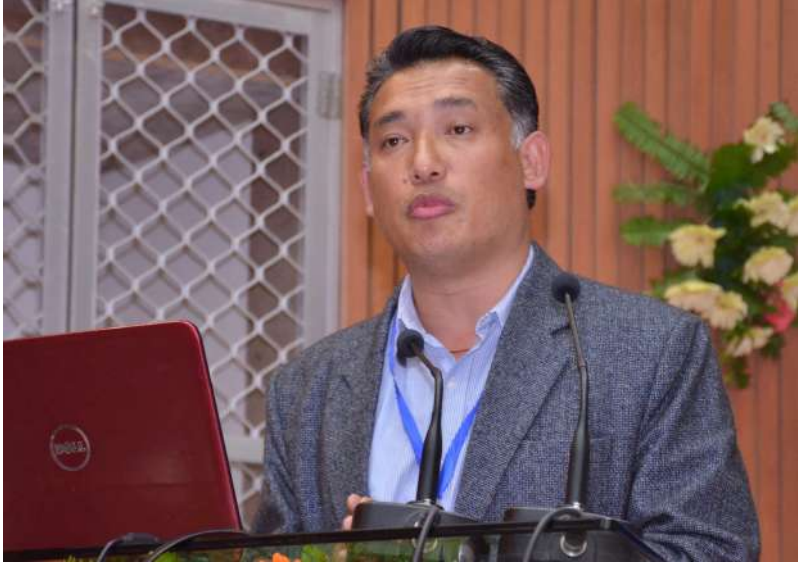
Session objectives: Discuss sedimentation and geomorphological challenges. Presentation on landslide inventory in Koshi basin and relevance for downstream. Sharing information on land cover change and degradation, debris flow and erosion.

Chair	Bibhas Kumar, Central Water Commission, Government of Bihar
Co-chaired by:	Dr Pradhan Parth S arthi, Central University of South Bihar
Presenter:	Prof Rajiv Sinha, IIT Kanpur; Deo Raj Gurung, ICIMOD; Prof. Zhang Yili, and Prof Chen Ningsheng, Chinese Academy of Sciences, China

Professor Rajiv Sinha of IIT Kanpur presented on the sedimentation and geomorphological challenges in the Koshi basin. The Koshi basin is an extremely dynamic system of rapid planform changes, and has a high sediment yield. The high rainfall events in the mountains erode the soil particles and transfer them into the Indo-Gangetic Plains. He explained that through the KBP, a detailed analysis of hydrology and sedimentation is being carried out in the Indian and Nepali parts of the basin. The preliminary data suggests that there is degradation of sediment in Chatara stations and aggradation of sediment at Birpur; the latter mainly due to the presence of the barrage directly south of Birpur. Sediment budgeting between Chatara and Birpur indicates aggradation. Furthermore, he noted, potential for erosion in the Koshi basin is also being estimated by using the stream power approach. He suggested bringing a soft engineering flood management approach, such as flood risk mapping, wetland and river bank restoration, land use management, and flood moderation andreactivation of paleo channels– to reduce the flood risk.

Next, Deo Raj Gurung of ICIMOD presented on the landslide inventory being created in the Koshi basin, and its relevance for downstream communities. He noted that the natural erosion rate in the Himalayas is so high that the sediment transport from headwaters tributaries creates various channel environments, and modifies patterns of channel morphology. Although the Koshi basin comprises only 5% of the Ganges River basin, it contributes to nearly 25% of the total sediment load. Each year, nearly 120 million tonnes of sediment is transported from the Koshi River basin into the Ganges River. Approximately 40% of the Koshi basin has more than 4,000 metres of elevation, and 30% of the basin is above 30° slope. In the mountains, landslide is the dominant hazard due to highly unstable slopes. ICIMOD has created a landslide distribution map of the Koshi basin from a landslide database of 1954-63 (topographic maps), 1990 (Landsat/Google image), and 2010 (satellite image/Google image). Landslide events have increased over time, although a slight decline was noticed from 1990 to 2010. Majority of landslides are between 1,000–3,000 metres in elevation. Similarly, landslides are normally confined to areas with 15°–60° slope. The increase of landslides is consistent across the slope. Landslides are most common in forested areas, followed by agricultural areas. He further emphasized that in order to understand the impact of sedimentation in downstream areas, understanding of upstream processes in the source area is imperative.

Following this, Professor Zhang Yili of CAS made a presentation on the land cover changes and hazards alleviation in the Koshi basin. One of the major activities that Professor Yili and his research team have carried out is assessing the land use and land cover (LULC) changes in the Koshi basin during the last two decades (1990–2000–2010). The land cover pattern of the Koshi basin includes 9 major land classes, which is dominated by grassland, forest,

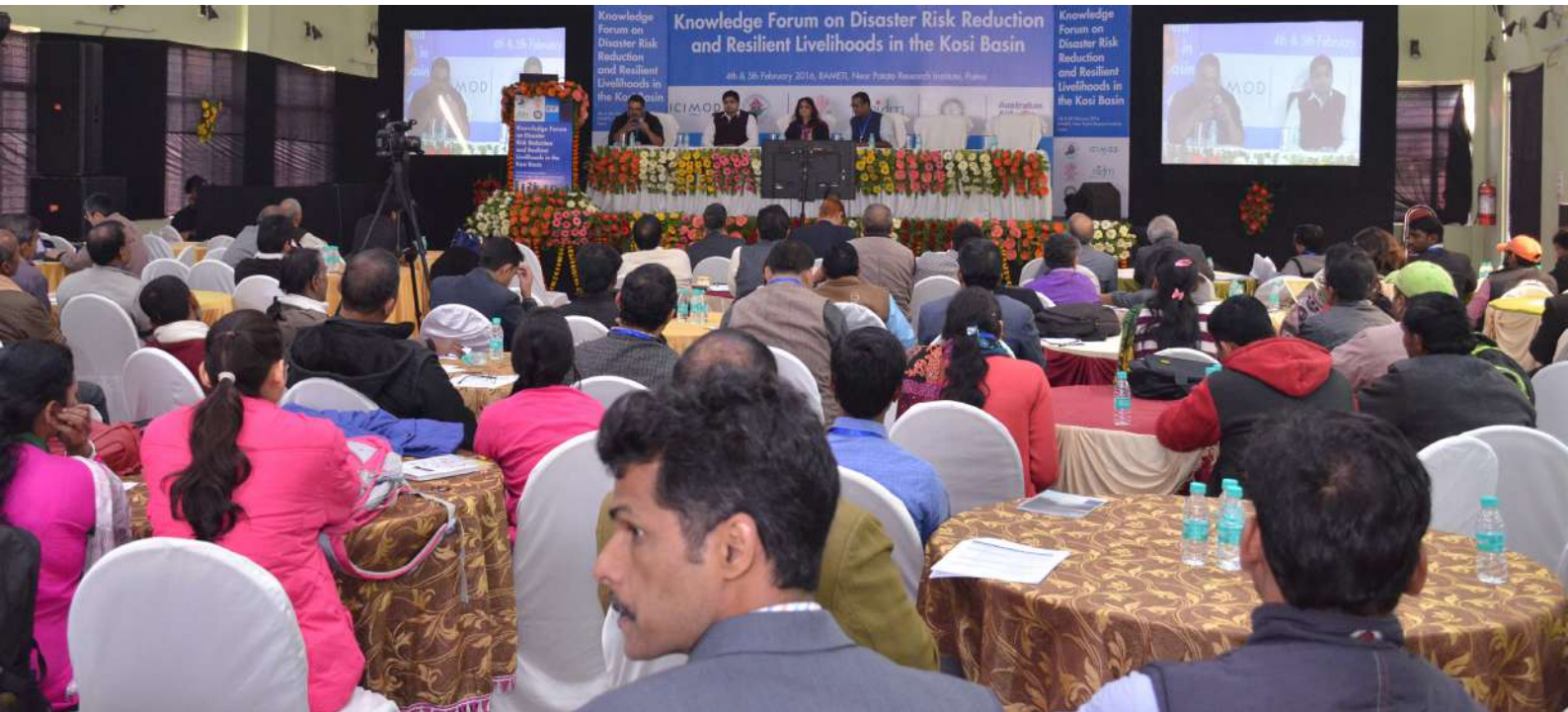


and bare land. Grassland occupies 35%, followed by forest, which is 23%. Comparing the 1992 map with the 2010 map, populated areas have more than doubled (from 2.69 km^2 to 4.16 km^2), and grassland areas have increased by 13%. Approximately 20% (169 km^2) of swampy areas have changed into other land cover types between 1992 and 2010. Similarly, 0.21% (26km^2) of the forested areas have changed to other land cover types. Scrubland has reduced by 4%.

Lastly, Professor Cheng Ningsheng of CAS presented on the water-related hazards in the Koshi River basin. The dominant hazards in the Koshi basin are GLOFs, floods, debris flows and drought. Landslides in Nepal were usually triggered by rainfall and road construction. The 2015 earthquake and aftershocks in Nepal also triggered landslides. A team of nine scientists led by Professor Chen spent a month investigating geological hazards in Nyalam County. A series of recommendations were proposed for post-disaster reconstruction in earthquake-affected areas.

Key Messages

- Regional hydro meteorological stations can reduce flood vulnerability.
- ICIMOD's Koshi Basin Programme recently launched a flood outlook, which aims to help basin communities respond to flooding.
- Increase in landslides consistent across the slopes and common in forest areas
- Knowledge of upstream processes in the source area is key to understanding the impact of sedimentation in downstream areas.
- Over the past 20 years, forested areas in the basin have decreased, while grasslands and populated areas have increased.
- Landslides are usually triggered by rainfall and road construction. The post-2015 landslides in Nepal show they have been triggered by earthquakes and their aftershocks.

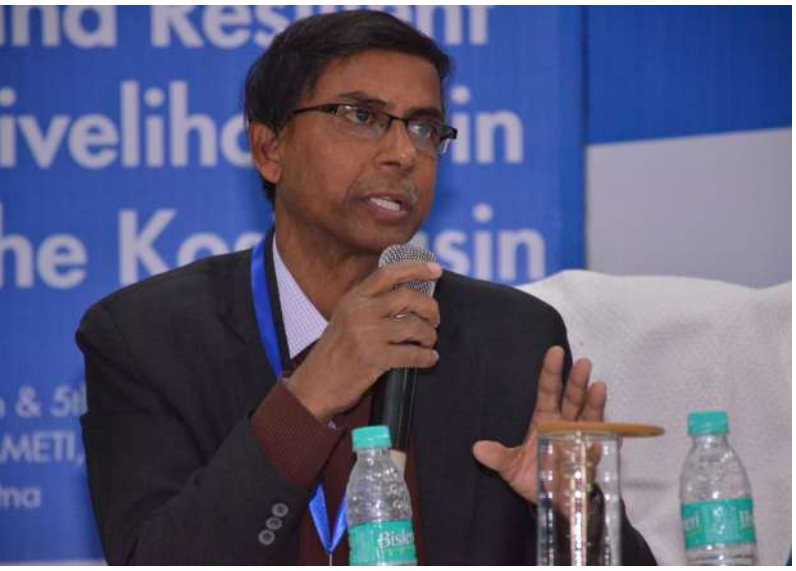


Technical Session 2: **Resilient livelihoods in the Koshi basin**

Chair	Prof Sunil Ray, ANSISS
Co-chaired by:	B Chakraborty, National Institute of Hydrology, India
Presenter:	Prof Nilabja Ghosh, IEG; Dr Biplab Dhak, ANSISS; Dr Amarnath Tripathi, IEG

Session objectives: Focus on the issues of spatial interlinkages in crop yield determination and food crops in Koshi basin in Bihar

The session featured representatives from ANSISS and IEG, partners of ICIMOD's Koshi Basin Programme. Since 2013 ANSISS has focused on the study of socioeconomic dynamics and livelihoods as well as policy analysis in the Koshi River Basin. During 2015, ANSISS successfully completed a household survey of 1,600 households from 32 villages representing 11 districts of the Koshi basin. During the session, ANSISS made two presentations based on the household survey. IEG's work with ICIMOD has focused on the problems of water and food security in the Indian part of the Koshi basin since 2013. Based on their preliminary observations, IEG made two presentations during the session.



First, Professor Nilabja Ghosh from IEG presented on food crops and crop yield in the Bihar part of the Koshi basin, with special attention to the spatial variations and socio-economic and weather-related variables of crop yield. She began by explaining her methods. To capture the study's spatial dimension, the basin districts were divided into upstream, midstream, and downstream areas. She employed an econometric model, and considered three types of variables: economic variables (price of the crop, price of alternative crops, cultivated area, etc.), infrastructure-related variables (such as electricity, road network, and irrigation), and weather variables (rainfall and temperature). Professor Ghosh also used a Moran's spatial index and spatial auto-correlation to capture the spatial dimension in regression equations. The regression results suggest a significant impact of upstream rainfall on crop yield. It was observed that rainfall in midstream districts is by and large unfavorable to crop yield, but upstream rainfall helps in most cases to sustain crop yield. The significant dependency of yield on the basin's geography is mainly due to the basin's slope. Crop yield was found to be responsive to economic variables in many cases, while infrastructure was found to be more sensitive in determining maize yield.

During the question and answer session after the presentation, the audience suggested that these are important results, which should be presented in simple language as far as possible so that development practitioners, policy makers, and high level decision makers can take up the results.

Second, Dr Biplab Dhak from ANSISS presented on livelihoods and food security in the Koshi basin. Key findings of his study included:

- More than 65% of the sampled households depend on agriculture as a principal livelihood option, and 76 percent of households keep livestock;
- About 90 percent of households in the study area were found to be marginal landholders (with landholding of less than 1 hectare);
- There is a strong linkage between agriculture and livestock;
- Approximately 10 percent of landless households depend solely on livestock;
- Areas that suffer from recurrent floods and droughts are highly vulnerable;

- Lack of irrigation facilities, declining agricultural productivity, and a lack of infrastructural facilities also play a significant role in increasing vulnerability in the basin.

His findings also suggested that there was a correlation between low monthly per capita consumption expenditure and high incidence of food insecurity. Food insecurity was found to be more acute within the embankment area, and relatively less so within the protected area. Lastly, the study found that migration is emerging as a prevalent coping strategy. The findings show 38 percent of households in the study area have at least one out-migrant. Approximately 90% migrants send remittances, and 35.6 percent of households in the study area receive remittances with the amount of INR 41,783 per year on average.

During the question and answer round, a participant said that a deeper analysis of data would provide insight into the nuances of different forms of livelihoods in each of the areas in the basin (within the embankment, outside the embankment, protected by the embankment, and without the embankment). This would allow the research to inform policy. Another participant said that soil was brought to raise the embankment, which resulted increased the waterlogged area within the embankment—an area previously free from waterlogging. Further data analysis was recommended to better understand what happened in this instance.

Third, Dr Amarnath Tripathi from IEG presented on the improving trend of maize cultivation in the Koshi basin, and how it is impacting farm incomes and household food security. The presentation was based on a primary survey conducted recently by IEG in Saharsha and Khagariya districts of the basin. To see the impact of maize farming on farm income and household food security, the study's methodology included a simple comparison of means using a *t-test*, a comparison of estimated covariates of adjusted means, and the two-stage Hackman correction method.

Although data analysis was still underway, some preliminary findings were drawn from the presentations:

- Small and marginal farmers were found to be more amenable to maize farming, while medium and large farmers still devote the largest share of their land to rice and wheat;
- Subsidized food distributed under the public distribution system seems to be a significant covariate of maize cultivation;
- Notable relationship between household food security and maize cultivation. However, the relationship between farm household income and maize cultivation was not found to be very significant.

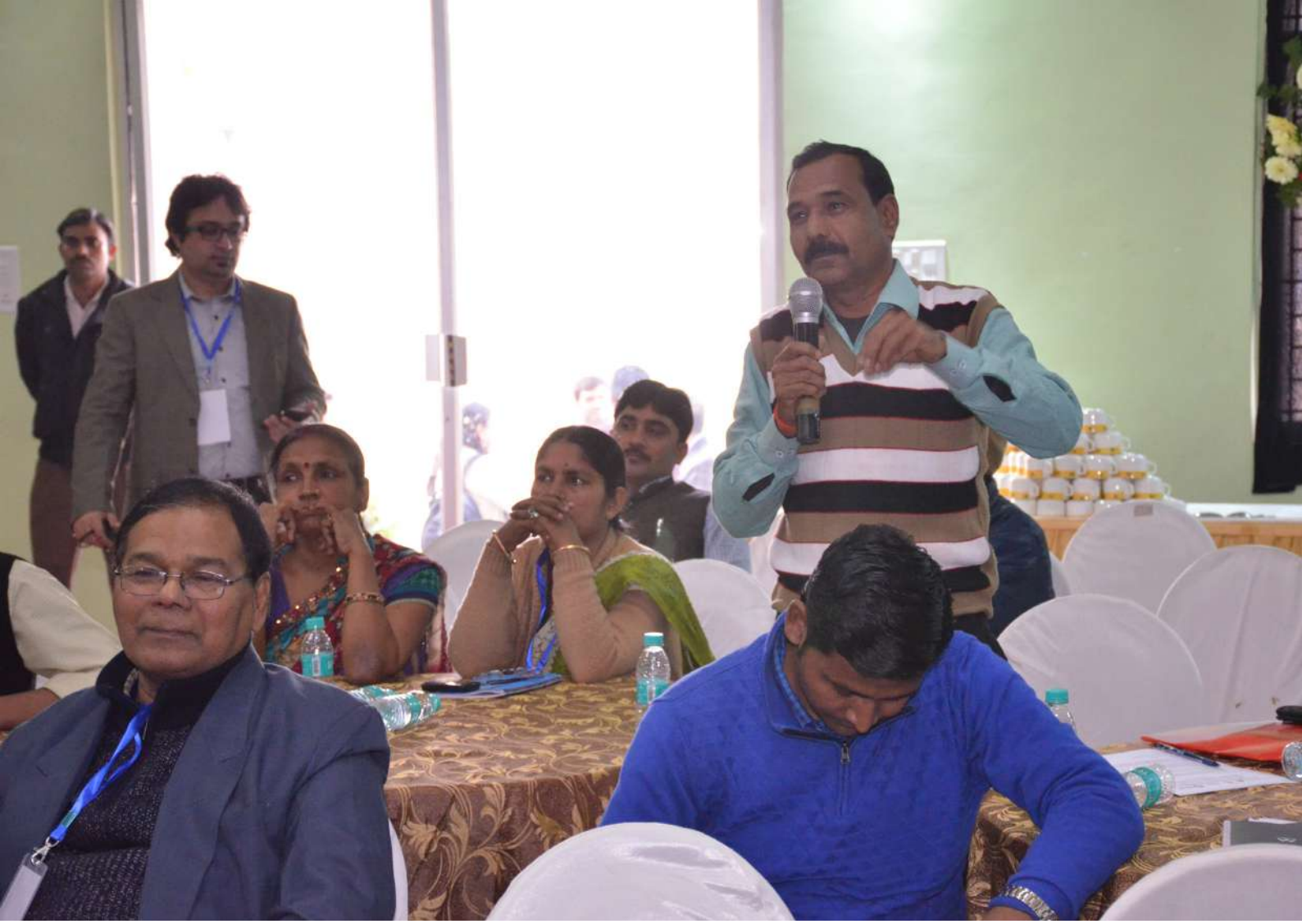
Dr Tripathi emphasized that as the analysis is still in its early stage, findings may change with further investigation. The presentation raised the concerns of the audience, including policy makers and farmers.

The audience asked several questions:

- What are the negative implications of increasing maize cultivation? Why is maize cultivation increasing in the Koshi basin? Why are farmers not earning a viable income from maize cultivation?

Key Messages

- Geographic location within the basin can determine whether rainfall will have a negative or positive impact on crops.
- Due to the basin's slope, while rainfall is usually beneficial to crop yield in upstream communities, rainfall can be detrimental to crop yield further downstream
- A majority of people living in the Koshi basin depends on agricultural for their livelihood.
- Migration is emerging as a prevalent coping strategy in the basin.
- Small and marginal farmers seem to be more amenable to maize farming, while medium and large farmers still devote the largest share of their land to rice and wheat.
- There is a notable relationship between household food security and maize cultivation.



In the following session, Dr Arun Bhakta Shrestha offered concluding remarks. He noted that the distinguished guests during the opening session highlighted the need for cooperation for livelihood improvement and management in the transboundary Koshi River basin, and that this cooperation was the most beautiful aspect of the two-day forum. He summarized the most important points of the day as follows:

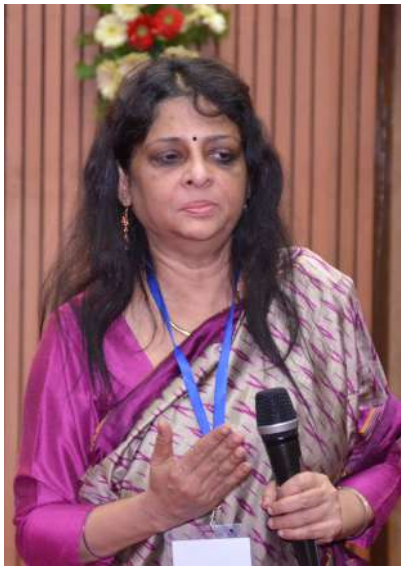
- Data and information is fundamental for the accuracy of flood forecasting in the Koshi basin. Currently, efforts are focused on making a three-day flood outlook rather than a flood forecast. In the future, collaborative efforts and data/information sharing will help make flood forecasting more accurate.
- Food insecurity and livelihood vulnerability exist across all parts of the basin, including areas within the embankment, outside the embankment, protected by the embankment, and without the embankment. Further analysis of data is needed to give concrete policy recommendations.
- The presentation about geo-hazards and sedimentation model was inspiring, but also missed some socioeconomic dimensions. In the future, such a study should incorporate this dimension.
- The Koshi basin is rich in local and indigenous knowledge. Development and engineering interventions in the Koshi basin should integrate this knowledge into their future plans.

Technical Session 3: **Disaster risk reduction and livelihoods**

Session objectives: Discuss flood risk reduction from the ground level perspective, with a focus on agriculture, flood and rehabilitation issues in the Koshi River basin

Chair	Prof Nilabja Ghosh, IEG
Co-chaired by:	Dr Anjal Prakash, ICIMOD
Presenter:	Eklavya Prasad, MeghPyneAbhiyan (Cloud Water Campaign), Bihar; Dr Aviral Pandey, ANSISS, Bihar

The session featured representatives from Megh Pyne Abhiyan and ANSISS, partners of ICIMOD's KBP. First, Eklavya Prasad captured insights from the field. He noted that indigenous knowledge should be preserved and utilized in development. The modern, imported definition of 'sustainability' has unfortunately failed to accommodate centuries-old indigenous knowledge, and as a result, the basin is facing problems. In addition, he said, due to market-oriented farming practices, the basin has lost crop diversity. Farmers preserve their own seed stock and purchase seed in the market. Similarly, in the name of development, engineering is increasingly imposed on the basin. Previously, local communities had their own ways of managing floods. The establishment of the embankment and sophisticated infrastructure has ignored this indigenous knowledge, and this has exacerbated rather than addressed the problem. He emphasized the need to fuse indigenous knowledge and science for future sustainable development. Scientific knowledge is important for development, but it should be translated into locally understandable forms and customized to the specific needs of the community. For example, rather than copying the floating-house model from Thailand, practitioners should scale up bamboo-machhan in the Koshi flood affected areas because this is a product of local engineering and indigenous knowledge; it is cost effective and generates employment in the locality.



Next, Dr Aviral Pandey from ANSISS presented on agriculture, flood, and rehabilitation issues in the Koshi basin. Dr Pandey noted that all four areas of the Koshi basin (within the embankment, outside the embankment, protected by the embankment, and without the embankment) have flood problems, but each area experiences different impacts. In the absence of government interventions, people in the Koshi basin have adopted their own mechanisms to cope with flood problems. Building machhan and pukka houses; practicing food storage, fuel storage, and crop rotation; and migration are some of the most common coping strategies. Dr Pandey also noted that distress-led migration is prevalent in all four areas, and emphasized that crop insurance and the development of small enterprise for income generation could be viable options for coping with the impact of floods in the basin.

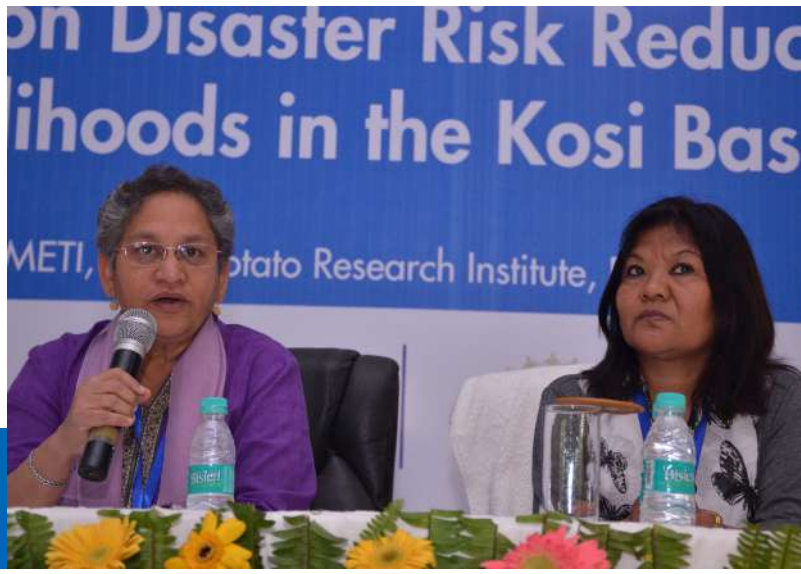
During the discussion, the audience appreciated the fact that Dr Pandey's study had examined four flood typologies and their differing impacts in the Koshi basin. Participants also noted that floods can sometimes be beneficial to crops, and that Dr Pandey's study could be more nuanced if he analysed the ways in which the local people are coping with each category of flood. The audience agreed that this type of research should provide policy recommendations, which could tangibly improve the life and livelihoods of the Koshi people. Anil Sinha suggested that flood early warning systems can be one option to reduce the impact of floods, however, people's confidence in these systems has to be improved. This can only happen by working closely with the community.

Key Messages

- Indigenous knowledge should be preserved and utilized in development and fused with scientific knowledge.
- Scientific knowledge should be translated into terms that are understood by local people.
- Out-migration is prevalent throughout the Koshi basin; efforts must focus on promoting livelihoods in post-flood contexts.

Technical Session 4: **Group work**

Session objectives: In this session, participants were divided into four groups and assigned four themes – food, livelihoods, early warning system and community-based disaster management. The objective of group discussion was to address issues related to disasters in the Koshi basin and propose possible solutions.



Chair Dr Rucha Ghate, ICIMOD
Co-chaired by: Dr Chanda Gurung Goodrich, ICIMOD

Group 1: **Floods**

Group Moderators: Dr Arun Bhakta Shrestha, ICIMOD and Dr Madhubala, BSDMA

The group discussed flood-related problems in the Koshi basin and current tools and technologies to cope with these problems. Short term and long term problems included:

- Immediate rescue and relief after the floods
- Lack of housing and food for humans, lack of shelter and fodder for livestock
- Difficulties in accessing drinking water, sanitation, and emergency health services
- Insufficient law and order
- Loss of property and agriculture
- Gender-based issues, including maintenance of personal hygiene, sexual harassment and violence, and trafficking
- Protection of children
- Disposal of bodies, both human and livestock
- Waste disposal
- Snake biting

The group also listed current strategies for rescue and relief:

- Before the flood, communities rely on flood forecasting systems, which commonly include loudspeakers and trumpets, a fire signal, or mobile communication (although sometimes there is communication gap, and people do not receive the information on time)
- During and immediately after the flood, communities rely on rescue ropes, country boats and banana stems, temporary bamboo bridges, traditional medicine, and food items such as choora (flattened rice), murhi (popcorn rice), sattu (flour mixed with ground pulses and cereals), and roasted gram.

The group brainstormed potential solutions to disaster-related problems:

- It should be clearly emphasized that people should evacuate immediately after they receive information about an impending flood.

- A temporary rainwater system should be promoted to ensure access to safe drinking water; faaydemand shauchalay (a local term for 'beneficial toilet') can provide safe and hygienic sanitation for adolescent girls and women. It is a special toilet pan that separates solid waste from urine.
- Recovery and rehabilitation efforts should be coordinated across the different sectors.
- Disaster risk reduction should happen across all levels: community, national, and international. There should also be a strong focus on child safety in the schools.

Group 2: **Livelihood**

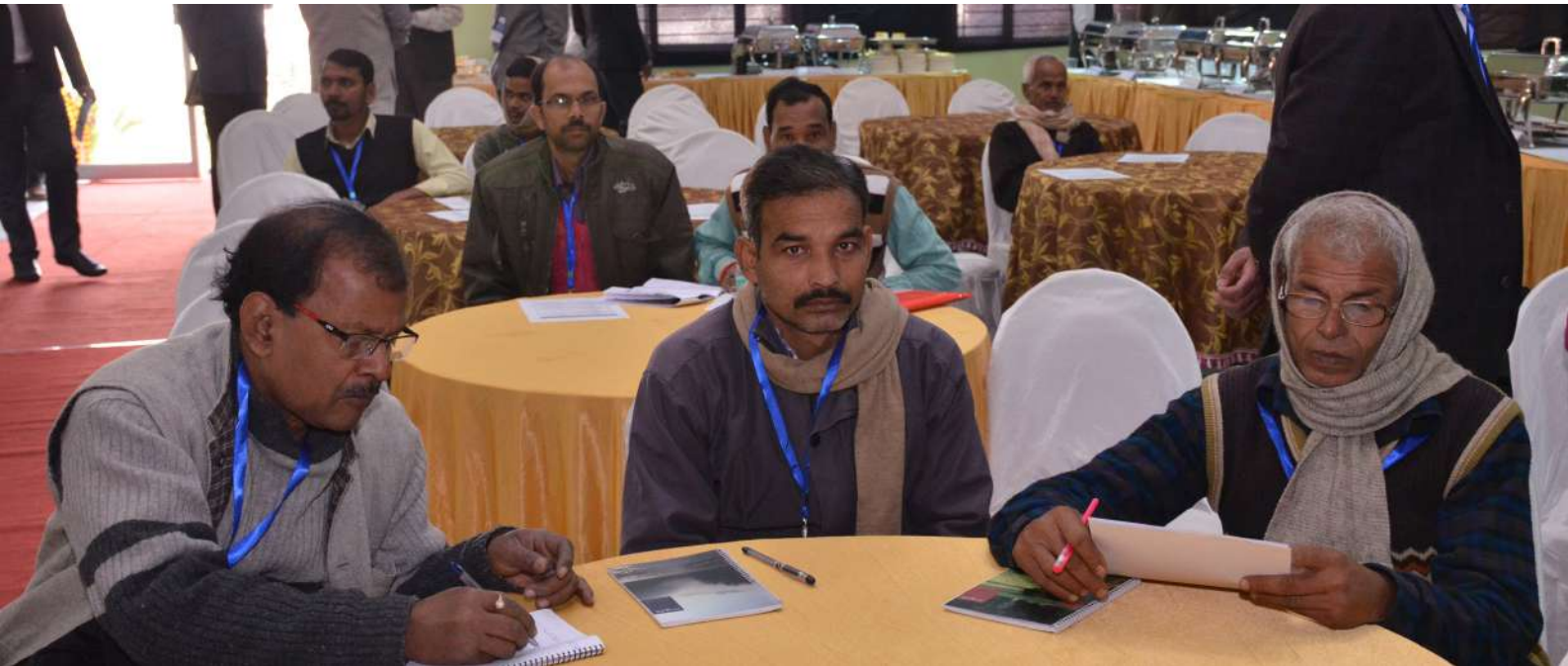
Moderators: Professor Neetu Chaudhary, ANSISS and Dr Anand Vijeta, BSDMA

The group discussed livelihood-related problems in the Koshi basin, and current tools and technologies to cope with these problems. Short term and long term problems included:

- Chronic cycles of debt
- Out-migration of men for work, which leaves women on their own
- Child labour and child trafficking to fulfill economic needs
- Lack of awareness about how to properly use fertilizer, which creates a lower crop yield
- Low crop yield due to floods
- Lack of land ownership and shared land farming (batedari)
- Increasing population pressure and pressure on agricultural land
- Livestock endemics

The group brainstormed potential solutions to livelihood-related problems:

- Promotion of water-based farming activities such as makhana (fox nut) and singhasa farming
- Employable skills training for vulnerable migrant communities
- Development of cottage industries such as bamboo and tissue cultures
- Implementation of crop insurance
- Promotion of animal vaccinations to protect against diseases
- Marketing of animal fodder by-products
- De-siltation and dewatering in order to revive the river's old course for freshwater farming
- Training and end product marketing for women self-help groups



Group 3: **Early warning systems**

Moderators: Dr SM Wahid, ICIMOD and
Dr Shankar Dayal, BSDMA

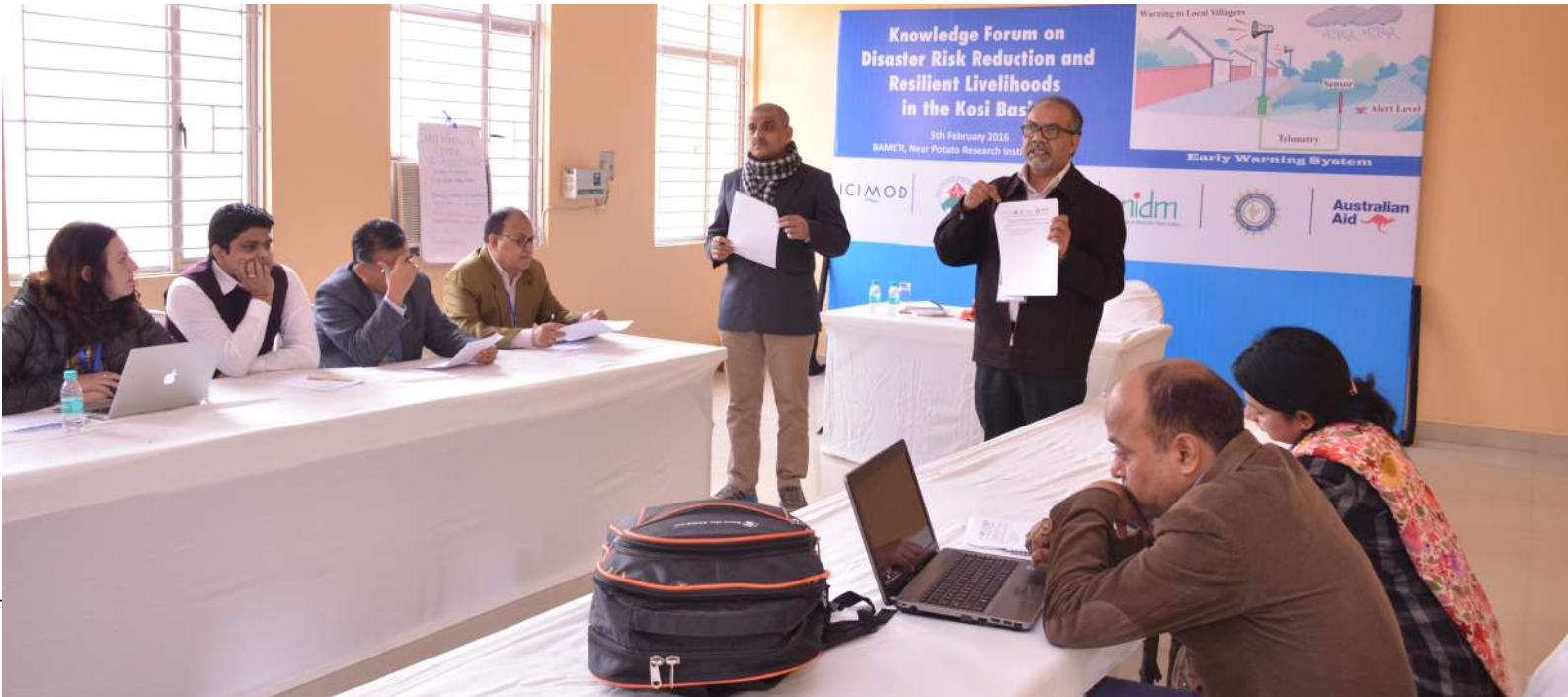
The group started off by discussing why early flood forecasting is important. They noted that early preparation saves lives and livelihoods, and is the backbone for adequate flood and disaster management. The group then discussed the specific challenges related to early warning systems, which included:

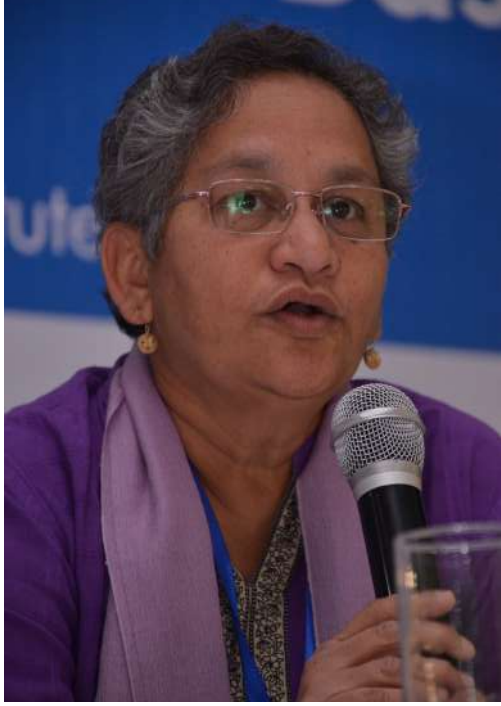
- Lack of data on mountain conditions, water levels, rainfall, and river cross sections. While data is commonly available to Nepal, it is not made available to the India side of the Koshi basin.
- Lack of an inundation map, which can be created more easily if there is access to data.
- There is need for a more proper dissemination of knowledge.
- Construction of roads, settlements, and canals often obstructs the flow of water during a flood.
- Maintaining warning systems is difficult. It is important to remember that the systems need to be actively maintained even during the remaining nine months of the year when there is no monsoon.

The group brainstormed potential solutions for improving the flood forecasting system so as to make them functional at the time of need:

- Dissemination of flood forecasts in local languages
- Ground levels should be mapped to create more accurate inundation maps and thus pave the path for policies geared towards addressing water blockages by creating more equal leveling
- Toll free numbers that can be reached 72 hours before a flood instead of the current 24 hours
- The potential flood coverage area should be specified at the time of embankment breach
- Active promotion of warning system maintenance throughout the year. For this, electricity is necessary, and an alternative source of energy such as solar power would be required.

The group noted that active involvement of local communities is necessary for these systems to succeed. Communities are the main stakeholders in disaster management. They should be involved at all levels of the management process. They can collect data and transfer it to higher-level administrators, who can then decide a course of action. Information should flow from bottom to top for effective implementation of decisions. In such a system, the community can play a pivotal role. Lastly, the group emphasized that the community should be strengthened in such a way that it is able to help itself. It should be equipped with aid instruments that can support local needs, and be taught how to use up-to-date technologies.





Group 4: **Community-based disaster management**

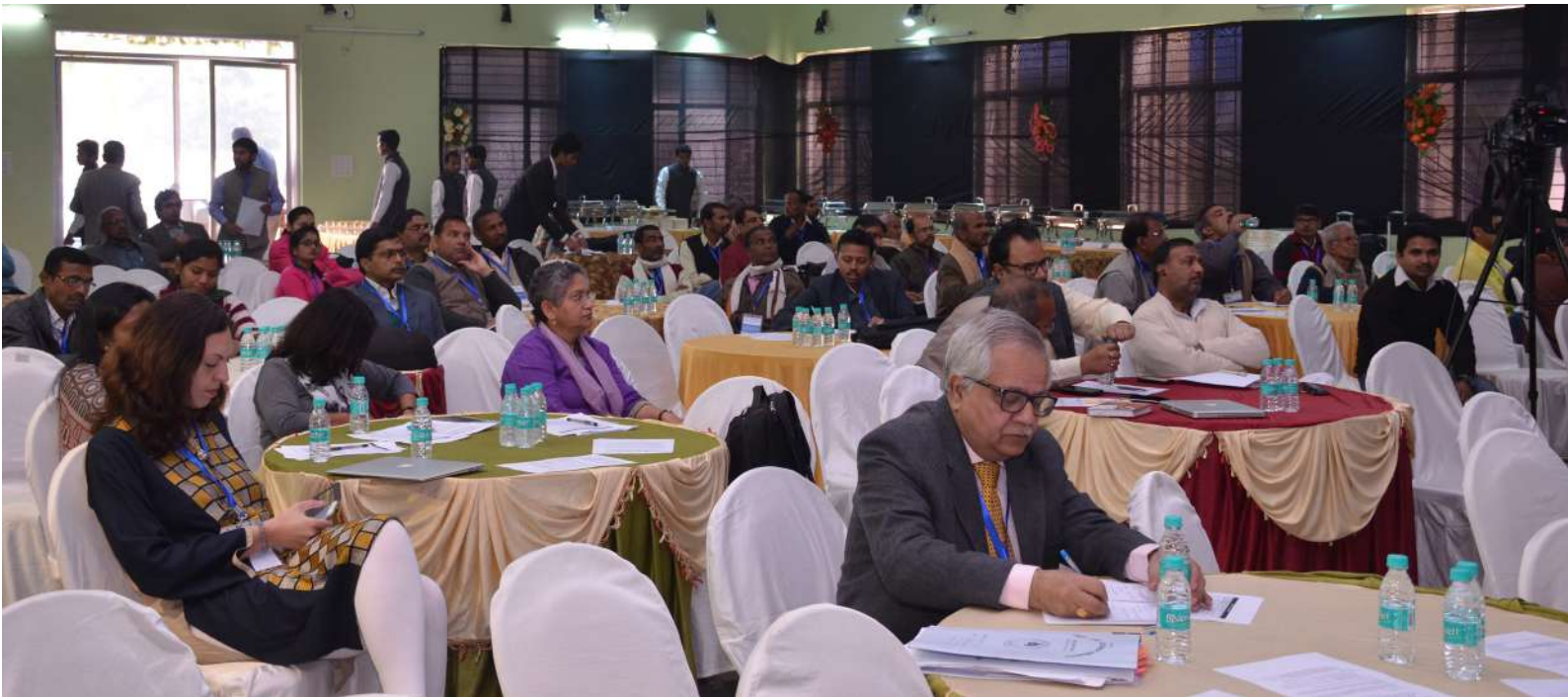
Moderators: Dr Vishal Vasvani BSDMA and Dr Rucha Ghate, ICIMOD.

The group began the discussion by delineating specific aspects of disaster management that communities can:

- apply adaptation measures
- warn villagers and help in the evacuation process
- identify risks, vulnerabilities, and capacities of villagers and encourage better preparation
- save embankments and other protective structures
- identify local resources and ways to use them
- aid in organizing the planning processes, and investing more in community orientations

The group emphasized that the communities should decide who should be involved in the planning and management process, and that the government can facilitate the process by:

- ensuring accountability
- promoting capacity building
- creating and strengthening safe infrastructure
- offering administrative support to facilitators and NGO partners
- mainstreaming DRR measures at all leveling



Technical Session 5: **Panel discussion**

Session objective: A panel discussion and interactive session on how regional learning can strengthen the process of using evidence-based knowledge for effective policy making in the river basin management

Chair	Dr Eklabya Sharma, ICIMOD
Co-chaired by:	Dr AK Sen, IMD
Presenter:	Anil K Sinha, BSDMA; Prof Asit K. Biswas, TWCWM; Prof Sunil Ray ANSISS; and Dr Golam Rasul, ICIMOD

Dr Sharma opened the session by saying that he hoped the discussions would be concrete with logical conclusions. He said the panelists would address three specific issues:

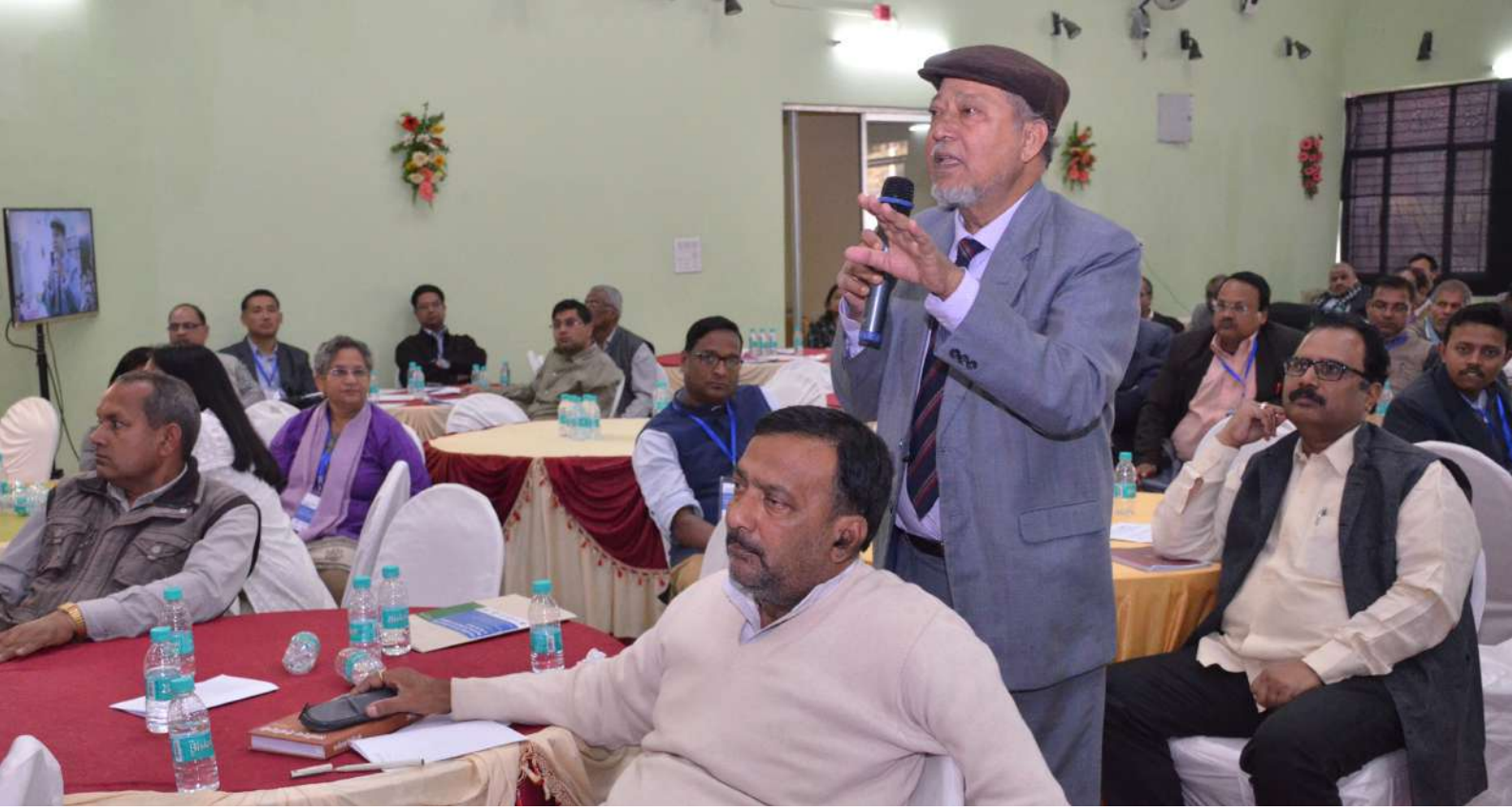
- Importance of regional learning;
- Evidence based knowledge;
- Applying evidence-based knowledge on policy making.

Surrounding these issues, the participants also raised some key questions

- How can we draw politicians' attention to important water issues?
- How can the knowledge be translated into policy?
- How does the trade-off between indigenous knowledge and market demand work? How to institutionalize local knowledge?
- How do the upstream countries benefit by helping the downstream countries?

Dr Golam Rasul started by saying that the Koshi River basin management needs to have a regional dimension. No single country can handle management of water resources on its own, especially in the face of potential water crisis in the future. He said that Koshi River is not boundary-specific and is more of a regional asset. Sharing knowledge with each other had the potential to managing water better given that the basin has water surplus but not managed effectively especially keeping the monsoon and dry seasons in mind. Over 80 percent of water is collected during the three monsoon months from June to August. The regional partnership especially between Bihar and Nepal can help to manage water to avoid flood disaster and secure enough water especially during the dry season when the farms are usually dry due to poor irrigation systems. He stressed that knowledge needs to be followed by an action through policy-making. However, the culture of participation is still a challenge in the region. He explained that it is not just the responsibility of the policy makers to make policies but needs wider participation of citizens groups, NGOs, communities.

Professor Asit K. Biswas, who spoke next, explained that there was a need of synthesis for what works and doesn't work and to identify how to create an enabling environment to overcome challenges. But he emphasized that there should be country-specific plan and action. He explained that what works in Bihar may not succeed in Nepal. However,



he explained that in usual discourses, there was not enough attention towards science and technology, in which investment is needed, and that would make a huge difference in knowledge management. He also said that scientists should learn how to deal with politicians if the scientists want to see their knowledge turned into action and policies. He shared that their knowledge needs to be evidence-based and scientists should be aware of a politician's agenda and they need to present evidence in the way that can catch the attention of politicians and decision makers.

Speaking next, Anil K. Sinha said that the knowledge forum had helped to generate constructive discussions and interaction with good information and knowledge to take back to their respective countries. He also stressed that each country had much to learn from each other. As an example, he noted how Bangladesh has been successful in community-based disaster management. He also mentioned how Nepal, in the face of the devastating earthquake, had managed the disaster. He explained that there is a need for Bihar's disaster management to be specific with a clear goal while making multi-hazard preparedness plans. He added that China also offered very good lessons that other countries could learn from, especially its government's impressive work in de-sedimentation. A key part of basin management is also using the indigenous knowledge of the Koshi basin population but there is lack of scientific documentation of their knowledge even by social scientists.

The next speaker Professor Sunil Ray said there is a need to integrate the three key aspects in basin management: ecological, sociological and economical. All these three aspects should have people-centric approaches. Ecology provides livelihood, though on a social level, the livelihood opportunities are often distributed and power relations come into play. He stressed that no matter how strong the regional cooperation, the regional water management will not be successful without a basin-centric approach. Collaboration is much needed in all aspects including technology, ecological and economical aspects.

Key messages

Dr Sharma ended the first part of the session and opened the floor to the participants for questions and answers. The panelists gave the following responses:

How to deal with politicians?

Prof Biswas explained that while meeting a politician, one should try to share knowledge that builds into the politician's agenda with a long-term perspective. Anil K. Sinha responded that a positive attitude is needed while dealing with policy and decision makers, as there were good examples of past collaborations. He relayed the message of the state minister, who extended his gratitude to the organizers for hosting such a significant event. His participation clearly displayed his political will and the priority he attached to the water management issue.

How to transform knowledge into policy?

On the issue of transforming knowledge into policy, Anil K. Sinha said that there are challenges, especially the way policies are made with a top-down approach. This raises the question as to who decides how water should be managed. He asked whether the approach should be the other way around, from bottom to top and right based. A combination of both is needed, i.e., an active participatory approach, also stressed by Dr Golam earlier. This approach seems viable, especially in Bihar, where the locally elected bodies have a strong presence with over 250,000 elected people from 8,634 Panchayats.

How to institutionalise indigenous knowledge?

Professor Ray stressed the need to find out how indigenous knowledge can be made applicable rationally and how it can be beneficial for the government and communities. A conflict exists between the demands of the market and the use of indigenous technology. He explained that the first step would be to study further how indigenous knowledge can be applicable to local market demands and how it can be linked to sustainable development. There is need for strategy and policy that can help people in the basin sustain their livelihood activities.

What are the benefits of the linkage between upstream and downstream countries?

Dr Golam said that both the upstream and downstream countries could gain in many aspects including economic, political, technological, disaster risk reduction as well as promoting goodwill among them. He said that the benefit sharing works in many ways. For instance, Nepal, as an upstream country, could benefit from technical and financial support to harness its hydropower potential but it cannot achieve that alone without technical and financial support from other countries, i.e., India, China and beyond. Even an economically strong and technologically advanced country needs collaboration not only for economic benefits but also for promoting goodwill with neighbours.

Dr Eklabya Sharma ended the panel session with the remark that active participation of the panelists and the audience made the discussions constructive. He expressed hope that the suggestions and feedback provided at the forum would prove useful for policy makers and science-based organizations and experts.

Key messages

- Knowledge sharing with political leaders is key for collaborative efforts.
- Participatory approach needed for both policy making and knowledge transfer
- Indigenous knowledge should be institutionalized and linked with sustainable development goals.
- There is need to have strategy and policy in place to sustain livelihood activities in the Koshi basin.
- Linkage between upstream and downstream countries is vital not only for water management but also for economic benefits and promoting goodwill among neighbours.

Closing Session

Speakers:

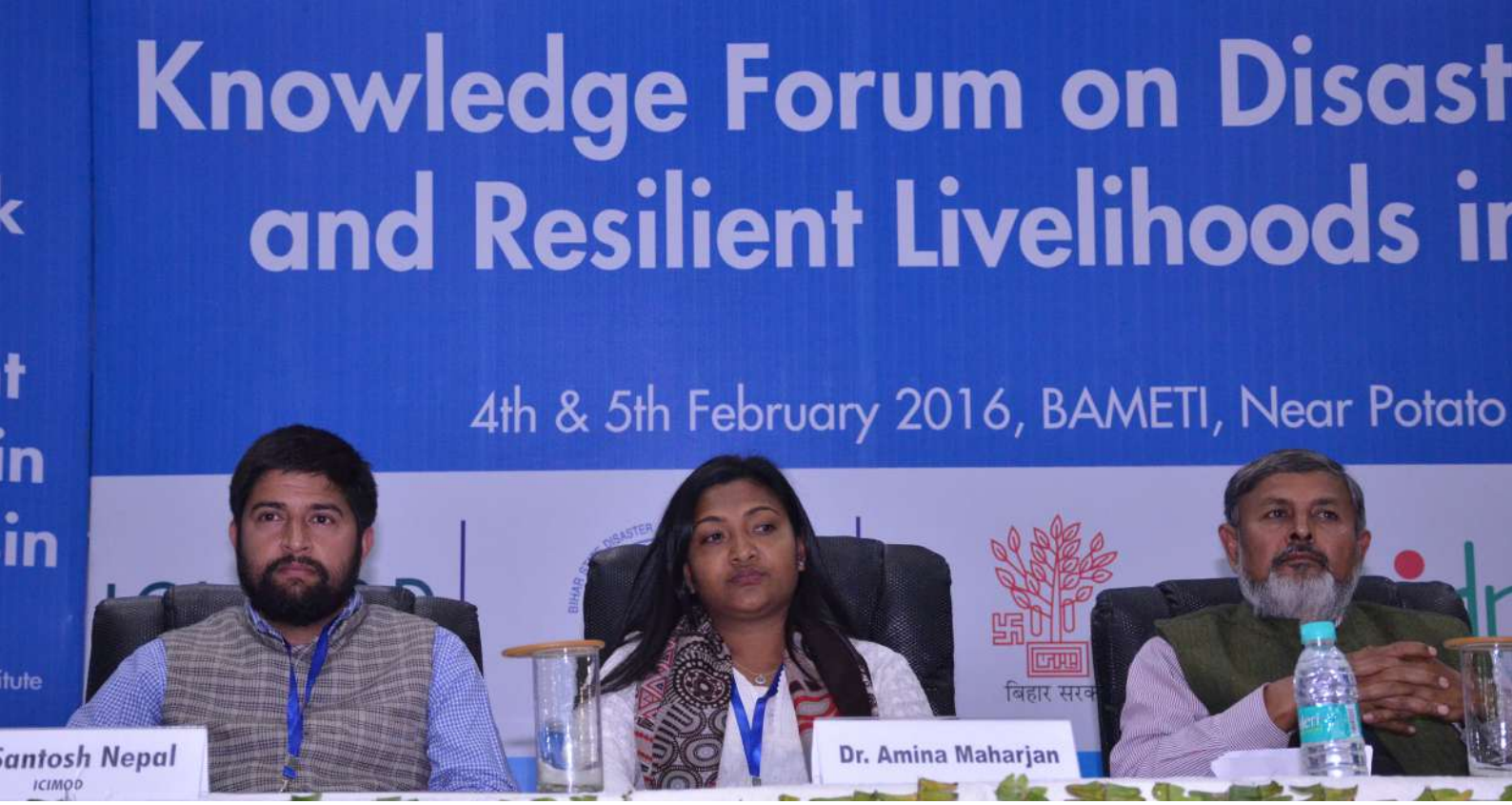
- Dr Arun B Shrestha, ICIMOD
- Dr Eklabya Sharma, ICIMOD
- Dr Amina Maharjan, ICIMOD
- Vyas Ji , Disaster Management Department
- Anil K Sinha, BSDMA
- Dr Santosh Nepal, ICIMOD

During the last session of the knowledge forum, Dr Arun B Shrestha provided his reflections on the forum. He started by thanking the high-level dignitaries who had attended the two-day forum. He remarked that water should not be seen simply as water but as a means of cooperation, development, and prosperity in the region. Cooperation around water should happen at both the local and national level in order for it to be most effective. He added that there are different kinds of knowledge, and that local knowledge – which must be documented and revived – needs to merge with scientific knowledge to bring about effective water management in the basin. Further, he said that the forum's technical sessions represented a tremendous step towards disaster risk reduction, and that the ideas that came out of the sessions must be taken forward. Gathering more data is important but difficult. It is also necessary to make the best use of existing data because communities cannot wait until the data gets collected. He said that group discussions topics, i.e., floods, geo-hazards, disaster risk reduction, and livelihoods are closely related to one another. The panel discussions highlighted the need to look at issues in terms of different scales, for instance, the different capacities (technical, financial, etc.) of countries for disaster response; and the need to contextualize global experiences for the region. More research is needed on sedimentation and waterlogged conditions of the basin. In the end, he reiterated that knowledge is necessary, and it is best when local knowledge is combined with scientific knowledge.

Dr Eklabya Sharma began by noting that such a forum was taking place for the first time in the history of the Koshi basin, and that the presence of three state ministers demonstrated their commitment to and enthusiasm for addressing the issues. The forum generated several takeaway messages: there should be data sharing throughout the entire basin; there should be a focus on community aspirations, which will help produce more resilient livelihoods; more emphasis should be laid on a regional flood outlook, which can be strengthened if neighbouring countries contribute; there should be an exchange of knowledge and good practices; there should be promotion of evidence-based policy and a multi-disciplinary approach. Above all, he said, it is important that science informs policy, and that policies integrate the three pillars of sustainable development: social/cultural development, economic development, and environmental development.

Following this, Dr Amina Maharjan from ICIMOD, a specialist in migration and livelihoods, gave concluding remarks that focused on the forum's gender component. She said that the important role of women is often overlooked. Women are valuable sources of traditional knowledge, and should be integrated into the entire process of water management.

Next, Vyas Ji, Principal Secretary of the Disaster Management Department, gave his closing remarks. He noted that people in the Nepalese and the Indian parts of the Koshi basin are connected both culturally and environmentally, as disasters threaten both upstream and downstream communities. In the upstream areas, landslides are prevalent, whereas in the downstream, floods are prevalent. During the Sun Koshi landslides of 2014, India received no information from Nepal, and this created problems downstream. The 2015 earthquake also affected Bihar, and it is another example of how lives in the basin are interlinked. Hence, it is important to share data and traditional knowledge. Sharing knowledge will help improve disaster management strategies, including strategies for managing the Koshi barrages. He noted that Bihar's Disaster Management Department is preparing a Bihar Disaster Risk Reduction Roadmap, and that the discussions from the workshop will be useful for fine-tuning the document.



Anil K Sinha concluded by saying that despite some data gap in the Koshi basin region, there is no shortage of information. What is lacking is systematic documentation and dissemination of available information, and this problem should be rectified. A basin-wide and people-centric approach should be used rather than a boundary-based one. As of now, there is often a gap between the agencies that gather weather data and the communities that use them, and this is something that should change. In order to facilitate information gathering, he added, this forum should become an annual event.

Lastly, Dr Santosh Nepal thanked the organizers, chief guest, participants, invitees and community people for making the event a success. He also thanked the speakers who made valuable presentations, and invitees who came from outside. He thanked Anil K Sinha, Vice chairman of BDSMA and Dr David Molden, Director General of ICIMOD, and Dr Eklabya Sharma, Director of Programme Operations of ICIMOD, for their guidance and support. Similarly, he thanked Kanchan Shrestha and Govinda Shrestha from ICIMOD and Ajit K Samaiyar and Asif Shahab of BSDMA, all of who had worked tirelessly during the preparation of the workshop. Special thanks were given to community representatives who actively shared their experiences and learning related to disaster in the Koshi basin. He also thanked media representatives for covering the event and the teams from ICIMOD and BDSMA for rapporteuring and media outreach support.

Key Messages

- Water should be seen a means of cooperation, development, and prosperity in the Koshi basin
- Geo-hazards, disaster risk reduction, and livelihoods are closely linked to one another
- More research is needed on sedimentation and water-logged conditions of the basin
- Good practices should be exchanged to promote knowledge throughout the basin
- Policies should integrate the three pillars of sustainable development: social/cultural development, economic development, and environmental development
- Women are valuable sources of traditional knowledge, and should be involved in the entire process of water management
- There is no lack of knowledge within the basin. Rather, there is lack of systematic documentation and dissemination of information.

Annexes

Annex 1: **List of participant**

1. A.K. Ghosh, A.N. College, Patna
2. Abhanshu C. Jain, Agriculture Department, Government of Bihar
3. Abhishek Kumar, Caritas India
4. Aditya Narayan Roy, Agriculture Department, Government of Bihar
5. Ajay Kumar, Agriculture Department, Government of Bihar
6. Ajit K Samaiyar, Bihar State Disaster Management Authority
7. AK Sen, Indian Meteorological Department, Patna
8. AKP Singh, Rajendra Agricultural University, Bihar
9. Alok Kumar, Water Resources Department, Bihar
10. Amarnath Tripathi, Institute of Economic Growth
11. Amina Maharjan, ICIMOD
12. Amit Kumar. Central University of Bihar
13. Amit Raj, Caritas India
14. Amita Singh, Flood Management Information System
15. Amitabh Prabhakar, Central Water Commission, Patna
16. Amrita Kumari, Sawla Development Foundation
17. Anamika Anand, Sawla Development Foundation
18. Anand Bijeta, Bihar State Disaster Management Authority
19. Anil Jain, Ganga Flood Control Commission, Patna,
20. Anil K. Sinha, Bihar State Disaster Management Authority
21. Anil Kr. Jha, Bihar State Disaster Management Authority
22. Anil Kr., Flood Management Information System
23. Anil Kumar Jha, Agriculture Department, Government of Bihar
24. Anil Kumar, Agriculture Department, Government of Bihar
25. Anil Sinha (OSD), Bihar State Disaster Management Authority
26. Anirudh Prasad, Special Secretary, Disaster Management Department
27. Anita Nandan, Sawla Development Foundation
28. Anjal Prakash, ICIMOD
29. Anjali Kumari, Sawla Development Foundation
30. Anjani Kumar Singh, Water Resources Department, Bihar
31. Anuj Tiwari, Bihar State Disaster Management Authority
32. Anuksha, Sawla Development Foundation
33. Arbind Kumar Jha, Gorakhpur Environmental Action Group
34. Arti Sinha, Flood Management Information System
35. Arun Bhakta Shrestha, ICIMOD
36. Arun Kr. Singh, Principle Secretary, Water Resources Department, Bihar
37. Arun Kumar Jha, Nav Jagriti
38. Arun Kumar Sinha, Ganga Flood Control Commission, Patna,
39. Arun Kumar, Agriculture Department, Government of Bihar
40. Arun Kumar, Bihar Agriculture University, Sabour, Bhagalpur
41. Arun Kumar, Water Resources Department, Bihar
42. Arvind Kr. Yadav, Bihar Sewa Samiti, Madhubani
43. Arvind Pandey, AN Sinha Institute of Social Sciences
44. Arvind Sharma, Agriculture Department, Government of Bihar

45. Arvinder Singh, Agriculture Department, Government of Bihar
46. Ashish Ranjan, Koshish, Patna
47. Ashish Rastogi, Flood Management Information System
48. Ashok Kumar, Ghoghardiha Prakhand Swarajya Vikas Sangh
49. Ashok Prasad, Agriculture Department, Government of Bihar
50. Ashok Ranjan, Water Resources Department, Bihar
51. Ashutosh Kumar Sinha, Central University of Bihar
52. Ashutosh Upadhyaya, ICAR-Research Complex for Eastern Region, Patna
53. Asit K. Biswas, National University of Singapore
54. Aviral Panday, AN Sinha Institute of Social Studies
55. B. Chakraborty, National Institute of Hydrology
56. B. Chakraborty, National Institute of Hydrology, Patna
57. B.K. Mishra, Bihar State Disaster Management Authority
58. Babul Prasad, Integrated Development Foundation
59. Baleshwar Prasad, Sawla Development Foundation, Madhubani
60. Balram Kumar Gupta, Flood Management Information System
61. Banktesh Narayan Singh, Agriculture Department, Government of Bihar
62. Banku Bihari Sarkar, Nanak Sandesani and Ghanshyam Mishra, UNICEF India
63. Baristar Pandey, Flood Management Information System
64. Bharat Jyoti, Environment. & Forest Department, Bihar
65. Bharat P. Yadav, Bihar State Disaster Management Authority
66. Bharat Prasad Singh, Agriculture Department, Government of Bihar
67. Bharti, Sawla Development Foundation
68. Bibhas Kumar, Central Water Commission, Patna
69. Bijendra Chaudhary, Agriculture Department, Government of Bihar
70. Bimala Devi, Sawla Development Foundation
71. Binod Prasad, Agriculture Department, Government of Bihar
72. Bipin Kr. Ray, Disaster Management Department
73. Bipin Mishra, Water Resources Department, Bihar
74. Bipin Prasad, Risk Management Solution Institute
75. Biplab Dhak, AN Sinha Institute of Social Studies
76. Brajesh Kumar, Agriculture Department, Government of Bihar
77. Chanda Gurung Goodrich, ICIMOD
78. Chandan Kumar, Flood Management Information System
79. Chandrabhanu Narayan Singh, Agriculture Department, Government of Bihar
80. Chandrasekhar, Hon'ble Minister, Disaster Management Department
81. Chen Ningsheng, Institute of Mountain Hazards and Environment, CAS
82. D.D. Prasad, Water Resources Department, Bihar
83. D.K. Gupta, Health Department, Government of Bihar
84. D.M. Diwakar, AN Sinha Institute of Social Studies
85. Dasrath Chaupal, Samajik Chetra Kendra
86. Deepak Kumar, Caritas India
87. Deepak Prasad, Bihar Aapda Punarwas Evam Punarnirman Society
88. Deepali Mitra, Sawla Development Foundation
89. Denom Kumar, Caritas India
90. Deo Raj Gurung, ICIMOD
91. Dev Arja, Bihar State Disaster Management Authority
92. Dhananjay Pati Tripathi, Agriculture Department, Government of Bihar
93. Dharmendra Kumar, Flood Management Information System
94. Dhirendra Kumar, Bihar Veterinary College, Patna
95. Dinesh Kumar Thakur, Centre for All Round Development (CARD), Samastipur, Bihar

96. Dinesh Kumar, Agriculture Department, Government of Bihar
97. Dinesh Mishra, individual expert
98. Dipalimitaa, Sawla Development Foundation
99. Pramod Kumar, Agriculture Department, Government of Bihar
100. Ajay Kumar, Agriculture Department, Government of Bihar
101. Archana, Bihar Veterinary College
102. Rajesh Kumar, Agriculture Department, Government of Bihar
103. Sushma Suman, Bihar Veterinary College
104. Eklabya Sharma, ICIMOD
105. Eklavya Prasad, HI-AWARE local partners - Megh Pyne Abhiyan
106. G. Thakur, Ganga Flood Control Commission, Patna,
107. G.P. Lal, Water Resources Department, Bihar
108. G.P.Sinha Institute of Disaster Management
109. Gagan Disaster Management Department, Bihar
110. Gajanan Mishra, Water Resources Department, Bihar
111. Ganesh Ram, Agriculture Department, Government of Bihar
112. Ghanshyam Jha, Ganga Flood Control Commission, Patna,
113. Ghanshyam Mishra, UNICEF India
114. Giovanna Gioli, ICIMOD
115. Girish Peter, Caritas India
116. Golam Rasul, ICIMOD
117. Gorakh Thakur, Ganga Flood Control Commission, Patna,
118. Govinda Shrestha, ICIMOD
119. Hah Nawaz Khan, Flood Management Information System
120. Hareram Kumar, Bihar Veterinary College
121. Hari Narain, Water Resources Department, Bihar
122. Indrajeet Saxeena, Kosi Command Area Dev. Authority
123. Jagdev Ram, Agriculture Department, Government of Bihar
124. Jai Prakash Narayan, Agriculture Department, Government of Bihar
125. Jay Kumari, SDF
126. Jeetesh Kumar, Bihar Veterinary College
127. Jeevan Kumar, Nav Jagriti
128. Jitendra Kr. Singh, Poorvanchal Gramin Vikas Sansathan
129. Jitendra Kumar, NavJagriti
130. Jitendra Singh, Poorvanchal Gramin Vikas Sansathan
131. Juli Kumari, Sawla Development Foundation
132. Jyoti Kumari, Caritas India
133. K. Anjana, Nav Jagriti,
134. K.D. Pandit, Flood Management Information System
135. K. P. Singh Rajendra Agriculture University, Samastipur,
136. K.P. Mahato, Nodal Office
137. Kamal Kamat, Samajik Chetra Kendra
138. Kamal Kishore, National Disaster Management Authority
139. Kaushal Kishore Sharma, Agriculture Department, Government of Bihar
140. Khusboo Kumari, Sawla Development Foundation
141. Kiran Kishor Prasad, Agriculture Department, Government of Bihar
142. Krishna Kant Jha, Agriculture Department, Government of Bihar
143. Kristen Zipperer, ICIMOD
144. Kumar Anshumaly, Bihar Livelihood Promotion Society (Jeevika)
145. Kumari Usha, Aryabhatta Knowledge University, Patna
146. Kunal, Flood Management Information System

147. Lal Pari Devi, Caritas India
148. M. Ahmad, Flood Management Information System
149. M.N. Sinha, Head, Geology Department, Patna University
150. M.V. Ghani, Lea Associate
151. Madan Gopal Kauleshnam, Risk Management Solution Institute
152. Madhu Bala, Bihar State Disaster Management Authority
153. Mahakant Ray, Bihar Sewa Samiti, Madhubani
154. Mahendra Yadav, Kosi Abhiyan
155. Mahesh Kumar, Caritas
156. Malti Verma, Sawla Development Foundation
157. Mamta Kumari, Caritas
158. Manati Verma, Sawla Development Foundation
159. Manikant, Bihar State Disaster Management Authority
160. Manish Kumar, Flood Management Information System
161. Manjrika Devi, Sawla Development Foundation
162. Manju Devi, NavJagriti
163. Manoj Kumar, Bihar State Disaster Management Authority
164. Manoj Raman, Water Resources Department, Bihar
165. Maulishri, Flood Management Information System
166. Md. S.M. Karim, Aryabhatt Knowledge University, Patna
167. Md. Zakaullah, Flood Management Information System
168. Monica Rani, Sawla Development Foundation
169. Monika Rani, Sawla Development Foundation
170. Monisha Dubey, Bihar State Disaster Management Authority
171. Mrityunjay Kumar, Agriculture Department, Government of Bihar
172. Mukesh Kumar, Institute of Economic Growth
173. Mukesh Ranjan Verma, Flood Management Information System
174. Mukul Kumar, Samantha
175. Mukul Kumar, Save the Children
176. Nagan Prasad, Flood Management Information System
177. Nagendra Sahani, Agriculture Department, Government of Bihar
178. Nanak Sandesani, UNICEF India
179. Narendra Kumar Lohani, Agriculture Department, Government of Bihar
180. Narendra Kumar Sinha, Agriculture Department, Government of Bihar
181. Naresh Paswan, Bihar State Disaster Management Authority
182. National Institute of Technology, Patna
183. Neelam Kumari, Flood Management Information System
184. Neetu Chaudhary, AN Sinha Institute of Social Sciences
185. Nelson Dona, Sawla Development Foundation
186. Nikhil Kumar, Flood Management Information System
187. Nilabja Ghosh, Institute of Economic Growth, Delhi
188. Nilhari Neupane, ICIMOD
189. Nira Gurung, ICIMOD
190. Nitesh Kumar Ray, Agriculture Department, Government of Bihar
191. Nitish Kumar, Bihar Veterinary College
192. Nitu Souju, Bihar Veterinary College
193. Nivedita Roy, Agriculture Department, Government of Bihar
194. Nunulal, Bihar Veterinary College
195. Om Prakash Srivastava, Agriculture Department, Government of Bihar
196. P.N. Rai, Home Guard & Fire Services, Govt. of Bihar
197. P.P. Sarthi, Central University of Bihar

198. Pankaj Mani, National Institute of Hydrology, Patna
199. Pawan Kumar, Agriculture Department, Government of Bihar
200. Perwez Akhtar, Flood Management Information System
201. Pooja Bharti, Caritas India
202. Prabhat Kumar, Agriculture Department, Government of Bihar
203. Pradeep Kumar Singh, Agriculture Department, Government of Bihar
204. Prakash Das, Kosi Project, Government of Bihar
205. Pranav Kumar, Bihar Veterinary College
206. Prashant Kumar Singh, Flood Management Information System
207. Pravin Kumar Sinha, Bihar Veterinary College
208. Pravind Praveen, Oxfam India
209. Prem Kumar Verma, Sawla Foundation
210. Prinkya Roy, Bihar Veterinary College
211. Priyanka, Caritas India
212. Priyanku Kumi, Poorvanchal Gramin Vikas Sansathan
213. Puju Kumari, Caritas India
214. Rabindra Kumar Verma, Agriculture Department, Government of Bihar
215. Rajan Sinha, Institute of Disaster Management
216. Rajbimal K Kant, Bihar Sewa Samiti
217. Rajbind Kr. Kamat, Bihar Sewa Samiti, Madhubani
218. Rajendra Kumar Verma, Agriculture Department, Government of Bihar
219. Rajesh Gupta, Water Resources Department, Bihar
220. Rajesh Kumar, Water Resources Department, Bihar
221. Rajesh Nareen, Bihar State Disaster Management Authority
222. Rajiv Kumar, Caritas India
223. Rajiv Ranjan Singh, Hon'ble Minister, Water Resources Department, Bihar
224. Rajiv Sinha, Indian Institute of Technology, Kanpur
225. Rakesh Chaubey, Flood Management Information System
226. Rakesh Ranjan, Agriculture Department, Government of Bihar
227. Raksha Kumari, CARD
228. Raksha Kumari, Nav Jagriti
229. Ram Prakash Sahani, Agriculture Department, Government of Bihar
230. Ramakar Jha, National Institute of Technology, Patna
231. Rambali Chaudhary, Agriculture Department, Government of Bihar
232. Ramchandra Yadav, Koshi Police, Supaul
233. Ramchandra, Kosi Abhiyan
234. Ramesh Jha, Bihar State Disaster Management Authority
235. Ramesh Kumar Ghoghardiha Prakhand Swarajya Vikas Sangh
236. Ramesh Kumar, Ghoghardiha Prakhand Swarajya Vikas Sangh
237. Ramji Singh, Agriculture Department, Government of Bihar
238. Ramkewal Yadav, MDSDF
239. Rampukar Ranjan, Water Resources Department, Bihar
240. Ramsha Kumar, Central University of South Bihar, Patna
241. Randhir Kr. Sinha, Water Resources Department, Bihar
242. Ranjay K. Panday, CARD
243. Ranjeev, Kosi Abhiyan
244. Ravi Prakash, Flood Management Information System
245. Ravi Prakash, Flood Management Information System
246. Ravi Ranjan Kumar, Bihar Veterinary College
247. Ravindra K. Das, Caritas
248. Ravindra Kumar Sinha, Water Resources Department, Bihar

249. Ravindra Kumar, Grameen Development Studies, Sitamarhi
250. Ravindra Shankar, Water Resources Department, Bihar
251. Ray Singh Meena, National Institute of Technology, Patna
252. Reena Kumari, Sawla Development Foundation
253. Renu, Samajik Chetra Kendra
254. Richa Khushboo, BSDMA.
255. Rucha Ghate, ICIMOD
256. Rupam Gupta, Caritas
257. Ryan Thew, Department of Foreign Affairs and Trade, Government of Australia
258. S.D. Tiwary, FMISC
259. S.K. Sinha, Sr. Advisor, Flood Management Information System
260. S.K. Verma, Flood Management Information System
261. S.N. Malik, Agriculture Department, Government of Bihar
262. S.N. Tiwari, Flood Management Information System
263. Samantray, Bihar Veterinary College, Patna
264. Sambhu Chaudhary , Gorakhpur Environmental Action Group
265. Sanat Kumar Jaipuriyar, Agriculture Department, Government of Bihar
266. Sandeep Kumar, Disaster Management Department
267. Saniu, SCK
268. Sanjay Chandra, Agriculture Department, Government of Bihar
269. SANJAY KUMAR, Flood Management Information System
270. Sanjay Kumar, RC
271. Sanjay Priyadarshi, Agriculture Department, Government of Bihar
272. Sanjeev Kumar, Bihar Veterinary College
273. Santosh Kr., Flood Management Information System
274. Santosh Kumar Uttam, Agriculture Department, Government of Bihar
275. Santosh Kumar, Caritas
276. Santosh Kumar, National Institute of Disaster Management
277. Santosh Nepal, ICIMOD
278. Santoshi Singh, Sawla Development Foundation
279. Sarvajeet Kumar, Agriculture Department, Government of Bihar
280. Satendra Kumar, Water Resources Department, Bihar
281. Satya Priya, The World Bank
282. Saukar Chaudhuri, CARD
283. Shahriar M Wahid, ICIMOD
284. Shaibal Gupta, Asian Development Research Institute
285. Shailendra Kumar, Agriculture Department, Government of Bihar
286. Shailesh Kumar, Agriculture Department, Government of Bihar
287. Shalini Shekhar, Sawla Development Foundation
288. Shambhu Chaudhary, Gorakhpur Environmental Action Group
289. Shankar Dayal, Bihar State Disaster Management Authority
290. Shanti Devi, Sawla Development Foundation
291. Shanti Ranjan, Water Resources Department, Bihar
292. Shashi Bhushan, Sawla Development Foundation
293. Shatrughan Singh, Bihar State Disaster Management Authority
294. Shatrughna Pd. Yadav, Indian Institute of Technology
295. Shiram Kumar, SDF
296. Shishir Kumar Thakur, Bihar Veterinary College
297. Shivam Kumar, Sawla Development Foundation
298. Shravan Singh, GP Sinha Centre for Disaster Management and rural Development, Patna
299. Shyam Kumar Kant, Bihar Sewa Samiti

300. Sivani Kumari, Mahila Kalyan Samiti, Patna
301. Sourabh Swami, Bihar Veterinary College, Patna
302. Sudeep K Mukherjee, Flood Management Information System
303. Sudhakar Jha, Institute of Disaster Management
304. Sudhir Kumar Bajpai, Agriculture Department, Government of Bihar
305. Sudhir Kumar Mishra, Agriculture Department, Government of Bihar
306. Sudhir Kumar, Bihar Veterinary College
307. Suman Kumar, Flood Management Information System
308. Sumbol Afroz, Bihar State Disaster Management Authority
309. Sunil Ray, AN Sinha Institute of Social Studies
310. Sunita Kumari, Flood Management Information System
311. Sunjay Pandey, Bihar Aapda Punarwas Evam Punarnirman Society
312. Sunny Kumar, Central University of Bihar
313. Sunny Kumar, Central University of South Bihar, Patna
314. Sunya Raj, Bihar State Disaster Management Authority
315. Surendra Nath, Agriculture Department, Government of Bihar
316. Suresh Prasad Gupta, Agriculture Department, Government of Bihar
317. Sushil Kumar, Agriculture Department, Government of Bihar
318. Syed Neyaz Khummar, Flood Management Information System
319. T. Prasad, National Institute of Technology, Patna
320. Udaup Krishna, ADM, Sharsha
321. Uday Singh, Agriculture Department, Government of Bihar
322. Umesh Kumar Chaudhary, Agriculture Department, Government of Bihar
323. Upendra Pandit, Sawla Development Foundation, Madhuvari
324. Upendra Prasad Singh, Agriculture Department, Government of Bihar
325. Usha Devi, Nav Jagriti
326. V S Pandey, Risk Management Solution Institute
327. Vandana Singh, Indian Red Cross, Bihar
328. Vibhav Shankar Pandey, MKS Patna
329. Vijay Kumar Babloo, Nav Jagriti
330. Vikash Kumar Yadav, Grameen Development Studies, Sitamarhi
331. Vikash Kumar, Caritas India
332. Vinay Kumar, Water Action
333. Vinod Rajak, Agriculture Department, Government of Bihar
334. Virendra Panday, UNICEF India
335. Virkamal Pandit, Nav Jagriti
336. Vishal Kumar, Flood Management Information System
337. Vishal Vasvani, Bihar State Disaster Management Authority
338. Vishwanath Chaudhary, Agriculture Department, Government of Bihar
339. Vivekanand, National Institute of Technology, Patna
340. Vivekanand, Nav Jagriti
341. Vyas Ji, Disaster Management Department
342. Wu Xue, Institute of Geographic Sciences and Natural Resources Research
343. Zhang Yili, Institute of Geographic Sciences and Natural Resources Research

Annex 2: **List of participant organisations**

1. A.N. College, Patna, Central University of Bihar, Patna, Aryabhatt Knowledge University (AKU), Patna, NIT, Patna
2. Agriculture Department, Bihar
3. Anugrah Narayan Sinha Institute of Social Studies (ANSISS), Patna
4. Bihar Agricultural Management Extension Training Institute (BAMETI)
5. Bihar Agriculture University, Sabour, Bhagalpur, Bihar
6. Bihar Livelihood Promotion Society, (Jeevika),Govt. of Bihar, Patna
7. Bihar State Disaster Management Authority (BSDMA)
8. Central University of South Bihar, Patna
9. Central Water Commission (CWC), Govt of India, Patna
10. Chinese Academy of Sciences (CAS), Beijing, China
11. Department of Foreign Affairs and Trade (DFAT), Government of Australia
12. Disaster Management Department (DMD), Bihar
13. District Magistrates (DM) of Kosi Command Area Districts (Saharsa, Supaul, Araria, Madhepura, Purnea, Madhubani)
14. Flood Management Information System (FMISC, WRD) Bihar
15. Ganga Flood Control Commission (GFCC), Govt of India, Patna
16. ICAR Research Complex for Eastern Region (ICAR-RCER), Patna
17. Indian Institute of Technology (IIT) Kanpur
18. Indian Metrological Department (IMD), Govt of India, Patna
19. Institute of Economic Growth (IEG), Delhi
20. Institute of Geographical Sciences and Natural Resources Research (IGSNRR), CAS, Beijing, China
21. Institute of Mountain Hazards and Environment (IMHE), Chinese Academy of Sciences, Chengdu, China
22. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
23. Kosi Area Command Development Authority, Saharsa, Govt. of Bihar
24. MeghPyneAbhiyan, Bihar
25. National Disaster Management Authority (NDMA)
26. National Institute of Disaster Management (NIDM)
27. National Institute of Hydrology (NIH), Govt of India, Patna
28. Rajendra Agriculture University, Pusa, Bihar
29. UNICEF India
30. Veterinary College Patna
31. Water Resources Department (WRD), Bihar

Annex 3: **Agenda and programme details**

Time	Session Names	
DAY ONE: 4 February 2016		
10:00 – 10:30	Registration	BSDMA and ICIMOD (Mr. Govinda Shrestha)
Inaugural plenary		
10:30 – 10:40	Welcome address	Dr Eklabya Sharma, Director Programme Operations, ICIMOD
10:40 – 10:45	Sustainable Development Investment Portfolio (SDIP) approach for South Asia	Mr. Ryan Thew, First Secretary, Development Australian High Commission, New Delhi
10:45 – 10:55	Key Note: Regional learning to support river basin management	Prof. Asit K. Biswas, Distinguished Visiting Professor Lee Kuan Yew School of Public Policy
10:55 – 11:05	Presentation of bouquet to Hon'ble Ministers& Dignitaries	
11:05 – 11:15	Lighting of the Lamp by dignitaries	
11:15 – 11:25	Presentation of souvenirs from ICIMOD and BSDMA	
11:25 – 11:35	Address	Prof. Santosh Kumar, ED, NIDM, New Delhi
11:35 – 11:45	Address	Sri. Arun Kr. Singh, Principal Secretary, WRD
11:45 – 11:55	Address	Sri Kamal Kishore, Hon'ble Member, NDMA
11:55 – 12:05	Address	Dr U.K. Misra, Hon'ble Member, BSDMA
12:05 – 12:15	Address	Sri. Anil K. Sinha, Hon'ble Vice Chairman, BSDMA
12:15– 12:30	Special message	By representative of Sri. Rajiv Ranjan Singh, Hon'ble Minister, Water Resources Department, Government of Bihar
12:30 – 12:40	Special address	Sri. Bijendra Prasad Yadav, Hon'ble Minister, Energy & Commercial Tax, Govt. of Bihar
12:40– 12:50	Inaugural address	Prof. Chandrashekhar, Hon'ble Minister, DMD, Govt. of Bihar
12:50 – 12:55	Vote of Thanks of Inaugural session	Sri. A.K. Samaiyar, Sr. Advisor, BSDMA
12:55 – 13:00	Group Photo	
13:00 – 14:00	Lunch Break	

Session 1: Disaster risk reduction in the Kosi basin (10mins presentation and 5mins discussion)

Chair: Dr Eklabya Sharma, ICIMOD

Co-chair: Sri. S.K. Sahu, Chief Engineer, Central Water Commission, Patna

14:00 – 14:15	Kosi Basin Initiative: closing the knowledge and competency gap	Dr SM Wahid, ICIMOD
Session 1a: Flood (Chair & Co-chair of session 1 will continue)		
14:15 – 14:30	Importance of regional flood outlook and learning	Dr Arun B Shrestha and Dr Mandira Shrestha, ICIMOD
14: 30 – 14:45	Importance of flood forecasting: experience from the Bagmati basin	Sri. Nagan Prasad, Flood Management Information System (FMIS, Bihar)
14:45 – 15:10	Discussion and session closing remarks	Chair and Co-Chair
15:10 – 15:25	Tea Break	
Session 1b: Geo-hazards (10 mins presentation)		
Chair: Sri. Bibha***s*** Kumar, Ex-chairman, Central Water Commission, Govt. of Bihar		
Co-chair: Dr Pradhan ParthSarthi, Prof, Central University of South Bihar		
15:25 – 15:40	Sedimentation and geo-morphological challenges in the Kosi basin	Prof. Rajiv Sinha, IIT Kanpur
15:40 – 15:55	Landslide inventory in the Kosi basin and the relevance for downstream	Mr. Deo Raj Gurung, ICIMOD
15:55 – 16:10	Land cover change, degradation Debris flow and erosion	Prof. Zhang Yili and Prof. Chen Ningsheng, Chinese Academy of Sciences, China
16:10 – 16:20	Discussion and session closing remarks	Chair and Co-chair
Session 2: Resilient livelihoods in the Kosi Basin (10 mins presentation and 5 mins discussion)		
Chair: Prof. Sunil Ray, Director ANSISS		
Co-chair: Sri B. Chakravorty, Director, National Institute of Hydrology, India		
16:20 – 16:35	Spatial inter-linkages in crop yield determination: Food crops in Bihar Kosi River Basin	Prof. Nilabja Ghosh, Institute of Economic Growth (IEG), Delhi
16:35 – 16:50	Livelihood and food security in the Kosi River Basin	Dr Biplab Dhak, ANSISS
16:50 – 17:05	Does maize cultivation improve farm household income and food security?	Dr.Amarnath Tripathi, Institute of Economic Growth (IEG), Delhi
17:05 –17:15	Discussion and session closing remarks	Chair and Co-chair
17:15 – 17:30	Discussion and Summary	Dr Arun Bhakta Shrestha, ICIMOD
19:00 onwards	Reception dinner	Hotel Maurya, South of Gandhi Maidan

DAY TWO: 5 February 2016

Session 3: Disaster risk reduction and livelihoods (10 mins presentation and 5 min discussion)
Chair: Prof. Nilabja Ghosh, Institute of Economic Growth, New Delhi
Co-chair: Dr Anjal Prakash, ICIMOD

10:00 – 10:15	Flood risk reduction: perspective and issues from the ground	Sri. Eklavya Prasad, MeghPyneAbhiyan, Bihar
10:15 – 10:30	Agriculture, flood and rehabilitation issues in the Kosi River Basin	Dr Aviral Pandey (ANSISS), Patna
10:30 – 10:40	Discussion and Summary	Chair and Co-Chair

Session 4: Group work
Chair: Dr Rucha Ghate, ICIMOD
Co-chair: Dr Chanda Gurung Goodrich, ICIMOD

10:40 – 10:45	Preparation for the group work settings	
10: 45 – 10:50	Introduction of group work This group work intends to understand the issues surrounding disaster in the Kosi basin and possible solutions	Dr Santosh Nepal
10:50 – 12:20 (including tea break)	Group 1: Flood Group 2: Livelihood Group 3: Early warning system Group 4: Community based disaster management	Group moderators. Group work guidance to be provided.
12:20 – 13:00	Group presentation	Group leads
13:00 – 14:00	Lunch Break	

Session 5: Regional learning to strengthen effective policy making in river basin management
Chair: Dr Eklabya Sharma, ICIMOD
Co-chair: Dr A.K. Sen, Director, IMD

14:00 – 15:15	Panel discussion on how regional learning can strengthen the process of using evidence-based knowledge for effective policy making in river basin management	Sri. Anil K Sinha, Hon'ble Vice Chairman, BSDMA Prof. Asit K. Biswas, TWCWR Prof. Sunil Ray, ANSISS Dr Golam Rasul, ICIMOD
15:15 – 15:30	Reflection from the floor	Sri. Eklavya Prasad, MeghPyneAbhiyan, Bihar
15:30 – 15:45	Discussion and Summary	Chair and Co-Chair
15:45 – 16:00	Tea Break	

Session 6: Closing session
Chair: Sri Vyasji, IAS, Principal secretary, DMD, Govt. of Bihar
Co-chair: Dr Anjal Prakash, ICIMOD

16:00 – 16:15	Reflections of the forum	Dr Arun B Shrestha, ICIMOD Dr Amina Maharjan, ICIMOD
16:15 – 16:45	Concluding Remarks	Dr Eklabya Sharma, ICIMOD Vyas Ji, Disaster Management Department, Govt. of Bihar
		Sri. Anil K Sinha, Hon'ble Vice Chairman, BSDMA
16:45 – 16:55	Vote of Thanks	Dr Santosh Nepal, ICIMOD

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