

Enhancing ecosystem-based adaptation to disaster risk reduction in the Himalayan river basin: Integrating traditional and local knowledge in disaster management plan in Nepal, India and Bangladesh



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1. Summary

South Asian countries— Nepal, Bangladesh, India— share the same Himalayan ecosystem, and represent one of the world’s most diverse regions in terms of language, culture, religion and geography. The floodplain riverscape of Koshi River Basin (KRB)— from source to sink (e.g., Nepal to Bangladesh via India) is one of the largest river basins of Gangas in the Himalayas encompassing the diverse communities where people have maintained strong links to ecosystem dynamics and developed knowledges, practices, and institutions to accommodate recurrent disturbances and natural ecosystems, yet is also among the most vulnerable area to disasters (e.g., landslides, floods, and sedimentation). This region has high ethnic and cultural diversity, with many have unique local approaches and capabilities—embedded as a part of cultural practices and social systems— for coping with disasters and harnessing the opportunities therein. An overwhelming emphasis of most adaptation strategies to DRR has been on engineering structures such as dams and embankments. There is an urgent need for a new approach that is socially and culturally acceptable, economically viable and low-cost, and based on already existing practices embodied in TLEK. Ecosystem-based adaptation approaches provide flexible, cost-effective and useful alternatives for reducing and/or avoiding the impact of disasters, and can be enhanced by careful attention to TLEK. In this project, we explored the extent of resilience provided by traditional and local ecological knowledge (TLEK) using both empirical and theoretical frameworks and validate the usefulness of TLEK to DRR. Additionally, we assessed national polices of Nepal, India and Bangladesh for their extent of integration with Eco-DRR and TLEK, and provided training to university students.

2. Objectives

The specific objectives of project are to:

1. Identify and document traditional and local ecological knowledge that are relevant to ecosystem-based adaption (EbA) to DRR in Nepal, India and Bangladesh;
2. Assess mechanisms for applying EbA to DRR and compare how environmental and socio-economic correlates of such EbAs vary across various socio-economic and environmental situations;
3. Assess how learning processes and adaption measures, including traditional and local ecological knowledge, have been or could be integrated into national policies and programs related to mainstreaming DRR;
4. Develop a web portal for sharing EbA to DRR, and integrating into local, national and regional disaster mitigation plans;
5. Strengthen capacity of young researchers/professionals.

3. Outputs, Outcomes and Impacts

Outputs	Outcomes	Impacts
1. Documented traditional and local ecological knowledge that are relevant to ecosystem-based adaption (EbA) to DRR in Nepal, India and Bangladesh	1.1 A proof concept is established with case study, research reports, papers 1.2 Several cases were identified and documented as in papers and policy briefs.	The findings of this project offer valuable insights into the status of traditional ecological knowledge (TEK) in disaster risk reduction (DRR) and provide critical insights into how eco-DRR and TEK can be mainstreamed in DRR efforts in Nepal, India, and Bangladesh.
2. Assessed how learning processes and adaption measures, including traditional and local ecological knowledge, have been or could be integrated into national policies and programs related to mainstreaming DRR	2.1 Policy integration review framework developed. 2.2 Integration of Eco-DRR in policies of Nepal, India and Bangladeshis carried out. 2.3 Integration of TLK in policies of Nepal, India and Bangladeshis carried out. 2.4 Policy brief published and widely circulated.	The project has provided an important avenue for mainstreaming TEK and Eco-DRR in these three countries through the publication of peer-reviewed articles, policy briefs, and educational materials. The project has contributed to increased awareness and understanding, and it has provided critical resources (e.g., research products) to take these issues to the next level. We call governments of these three countries to develop robust policies, strategies, and legislations for mainstreaming TEK and eco-DRR.
3. Developed a web portal for sharing EbA to DRR, and integrating into local, national and regional disaster mitigation plans;	3.1 Metadata classification protocol developed and integrated in website 3.2 Project findings and cases integrated in website 3.3 Hundreds of cases on TLK to DRR around the world reviewed and integrated.	
4. Training and workshops conducted.	4.1 Graduate and undergraduate students from various discipline trained. 4.2 A sharing workshop organized to disseminate	

	<p>project findings to key stakeholders.</p> <p>4.3 Stakeholders representing diverse field involved in project closing meeting.</p> <p>4.4 Mentor-mentee approached used in project team, offering opportunities to learn and grow.</p>	
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4. Key facts/figures

1. A framework to categorize traditional ecological knowledge to disaster risk reduction developed.
2. A framework for to assess integration of eco-DRR and TLK into national policies developed.
3. A sharing workshop on “Enhancing Ecosystem Based Adaption to Disaster Risk Reduction in the Himalayan River basin: Integrating of traditional and local knowledge in disaster management plan in Nepal, India and Bangladesh” organized.
4. A dedicated web portal for sharing EbA to DRR, and integrating into local, national and regional disaster mitigation plans developed.
5. One training session organized targeting DRR professional and students.
6. One presentation on conference have been done.
7. Two journal articles in high quality journal have been published.
8. Three journal articles in high quality journal have been submitted.
9. One journal article for publication of APN’s journal, “APN Science Bulletin” prepared.
10. Ten policy briefs published.
11. Sixteen researchers from four different countries (Nepal, India and Bangladesh) have been trained as project staff (e.g., intern, research assistant, field data collection etc.).

5. Publications

Peer-reviewed articles

Published

1. Paudel, P. K., Lamichhane, A., Acharya, K. P., & Bastola, R. (2023). Ecosystem restoration reduces community vulnerability to water-induced disasters: Need to rethink Chure conservation in Nepal. *International journal of disaster risk reduction*, 90, 103647. <https://doi.org/10.1016/j.ijdrr.2023.103647>
2. Paudel, P. K., Dhakal, S., & Sharma, S. (2024). Pathways of ecosystem-based disaster

risk reduction: A global review of empirical evidence. *Science of The Total Environment*, 172721. <https://doi.org/10.1016/j.scitotenv.2024.172721>

Submitted

3. Paudel, P. K., Parajuli, S., Sinha, R., Bohara, M., Abedin, A., Adhikari, B. R., Gautam, S., Pal, I., Huntington, H.. Integrating traditional and local knowledge into disaster risk reduction policies: Insights from Nepal, India and Bangladesh. Submitted to *Environmental Science and Policy* (Under Review)
4. Paudel, P. K., Parajuli, S., Bohara, M., Kibria, M. G., Abedin, A., Gautam, S., Pal, I., Sinha, R. Mainstreaming Ecosystem-Based Approaches into Disaster Risk Reduction Policies: A Comparative Study of Nepal, India, and Bangladesh. Submitted to *Policy Design and Practice* (Under Review).

Ready to submit

5. Paudel, P. K., Timilsina, R. R. C., Sinha, R., Parajuli, S., Abedin, A., Adhikari, B. R., Pal, I., Gautam, S., Kibria, M. G., Huntington, H. Village Mobility and Local Resource Utilization are adaptation strategies in Nepal's Koshi Floodplain. Ready to Submit, *APN Science Bulletin*
6. Timilsina, R. R. C., Poudel, J., Paudel, P. K. Living with disasters: Economic factors drive people live to in disaster-prone areas in Nepal. Manuscript ready to submit "International Journal of Disaster Risk Reduction.

Policy Briefs (not peer reviewed)

1. Paudel, P. K., Bohara, M., Timilsina, R. R. C., Bastola, R. (2023). *Disaster-proofing our communities: The urgent need for local governments to prioritize development based on risk assessment*. Policy Brief No. 01. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.14384.23047>
2. Paudel, P. K., Bohara, M., Timilsina, R. R. C., Bastola, R. (2023). *Strengthening traditional institutions for community-based disaster risk reduction*. Policy Brief No. 02. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.27806.00328>

3. Paudel, P. K., Bohara, M., Timilsina, R. R. C. (2023). *Local crop varieties strengthen community resilience to disasters: a policy brief for Nepal, India and Bangladesh*. Policy Brief No.03. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.1007/978-3-319-93671->
4. Paudel, P. K., Bohara, M. (2023). *Reinvigorating neglected land: a policy brief for harnessing economic opportunities in river floodplains*. Policy Brief No. 04. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.34468.69763>
5. Bohara, M., Paudel, P. K. (2023). *Traditional knowledge of planting vegetation on verges and slopes for slope stabilization needs to be promoted in the local development program*. Policy Brief No.05. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.32790.97603>
6. Abedin, M. A. and Kibria, M. G. (2023). *Indigenous knowledge and weather forecasting: A weapon to predict extreme weather events*. Policy Brief No. 06. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal.
7. Abedin, M. A., Kibria, M.G. (2023). *Indigenous knowledge and weather forecasting: A weapon to predict extreme weather events*. Policy Brief No.07. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal.
8. Paudel, P. K., Bohara, M. (2023). *Disasters in the Mountains of Nepal: The Impact of Poorly Planned Development Irrespective of Landforms*. Policy Brief No.08. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.10978.91849>
9. Timilsina, R. R. C., Paudel, P. K. (2023). *The Role of Cultural Beliefs, Myths, and Faith Needs to Be Acknowledged in Strengthening Community Response to Disaster Risk Reduction*. Policy Brief No.09. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.24400.69128>

6. Media reports, videos and other digital content

1. Featured project overview in a video uploaded at https://youtu.be/_y82ojQpRB8?si=TqtVwleoRBESQg2k
2. Featured in a Facebook page titled, <https://www.facebook.com/tlkdr>, “Local and Traditional Knowledge for Disaster Risk Reduction”

7. Pull quotes

I am surprised to see the breadth of knowledge our community possesses to cope with disasters. Such knowledge is at risk of gradual loss. We need a concerted plan and adequate resources to integrate it into disaster risk reduction, from policies to actions, and from federal to local levels.

- *Prakash K Paudel, Ph.D.
Team leader, Kathmandu Institute of Applied Sciences,
Kathmandu Nepal*

"Participating from a distance, I have been so impressed at the depth and breadth of the project, tackling a complicated subject across three countries, and achieving fresh and valuable insights that will make a real difference to people living in this shared watershed."

- *Henry P. Huntington, Ph.D.
Eagle River, AK 99577 USA*

"It was a great pleasure to work as a team member of this project. We are really interested to work on this more regarding the recording and validation of the TLK in DRR in a specific location. However, we strongly believe that the findings will be interesting to all the stakeholders associated with the DRR policies. Definitely, we will continue work together as new start of research on DRR."

- *Mohammad Golam Kibria, PhD*
- *Md. Anwarul Abedin, PhD
Bangladesh Agricultural University, Bangladesh*

The project aimed to explore traditional wisdom that can be integrated into disaster management plans across Nepal, India, and Bangladesh. Similarities in disaster adaptation techniques among these South Asian countries in the Himalayan ecosystem indicate a shared importance, emphasizing its inclusion in disaster management plans. My experience working with experts from different countries, from policy to practice, is rewarding. I see a profound synergy between scientific rigor and indigenous wisdom.

- *Sital Parajuli, Institute of Himalayan Risk
Reduction, Kathmandu Nepal*

"My journey along the Koshi River unveiled not only the challenges of floods and Kattan but also the resilience of communities deeply connected with their environment. I realized that integrating traditional practices into modern strategies is a key for fostering resilience and sustainability in the face of environmental challenges."

- *Raja Ram Chanda Timilsina, Kathmandu Institute
of Applied Sciences, Kathmandu Nepal*

“It was truly a remarkable experience as a research team member, especially with the thrilling field experience it offered. I had the privilege of witnessing the resilience of communities deeply affected by the devastating flood disaster along Koshi river. This hands-on experience provided invaluable insights into the challenges faced by local populations and underscored the urgency of our work in disaster response and adaptation efforts.”

■ *Meena Bohara, PhD Kathmandu Institute of Applied Sciences, Kathmandu Nepal*

8. Acknowledgments

We would like to express our sincere gratitude to the Asia-Pacific Network for Global Change Research (APN) for funding the project. We would like to thank highly dedicated team at the APN Secretariat, who provided countless advice and suggestions on various aspects of project management and administration, including project reporting deadlines. We would also like to express our sincere thanks to Dr. Madan Lall Shrestha, APN representative and Academician at the Nepal Academy of Science and Technology, Nepal. Additionally, we extend our gratitude to our past project collaborators, Dr. Kanchan Mishra from IIT Kanpur and Asma Ahmed from Bangladesh Agriculture University, Bangladesh, who contributed significantly during the first year of project implementation. Special thanks to Prof. Dr. Rajiv Shaw from Keio University, Japan, for valuable suggestions during the project's inception. Our heartfelt thanks go to the researchers, government officials at the federal to local level, and non-governmental organizations who directly and indirectly participated in this project, providing valuable time, experiences, expertise, and datasets. We greatly benefited from experts from various organizations during project result-sharing meetings, providing valuable insights to the team. Finally, we owe a debt of gratitude to the local communities who shared their experiences and provided exceptional hospitality during our extended stays in the field. They are truly experts, and we thank them for their wonderful wisdom and eagerness to share.

9.

Appendices

Appendix 1: Project findings sharing on " Enhancing Ecosystem-Based Adaptation to Disaster Risk Reduction in the Himalayan River Basin: Integrating Traditional and Local Knowledge into Disaster Management Plans in Nepal, India, and Bangladesh", December 04, 2023.

On December 4, 2023, a sharing workshop on "*Traditional and Local Knowledge in Ecosystem-based Adaptation to Disaster Risk Reduction in the Himalayan River Basin*" was held at Yalamaya Dhokaima Café in Patan Dhoka, Lalitpur. The sharing workshop began with a check-in period from 9:45 to 10:00, followed by a warm welcome delivered by Dr. Mahendra Thapa from the Kathmandu Institute of Applied Sciences (KIAS) at 10:00. Dr. Basanta Raj Adhikari, the Director of the Center for Disaster Studies at Pulchowk Campus, Institute of Engineering, Tribhuvan University, Nepal, then introduced the research project.



Dr. Prakash K Paudel, Team Leader, sharing project findings



Dr. Mahendra Thapa delivering a welcome speech



Participants in the workshop

Dr. Prakash Kumar Paudel, the Principal Investigator (PI) from KIAS, presented the project's results and milestones. This included discussions on living in floodplain areas, local and traditional knowledge for ecosystem-based adaptation, risk perception from a multi-dimensional approach, and the integration of Eco-DRR and Traditional & Local Knowledge (TLK) in three South Asian countries, highlighting existing gaps and opportunities. The presentation is followed by a round table discussion from on bridging research and policy gaps and determining the way forward for new research. Mr. Rabin Bastola from Amrit Science College, Tribhuvan University, moderated the session and engaged participants in exploring avenues for mainstreaming TLK and Eco-DRR in Nepal.

The workshop was attended by representative from Central Department of Anthropology, Tribhuvan University, World Conservation Union Nepal (IUCN Nepal), Small Earth Nepal, Ministry of Forest and Environment, Government of Nepal, DPNet, Nepal Academy of Science and Technology, Government of Nepal, Resource Himalaya Foundation, Central Department of Environmental Science, Tribhuvan University, and Conservation Nepal etc. The workshop provided a platform for fruitful discussions and knowledge exchange among researchers, policymakers, and practitioners, contributing to enhanced understanding and action towards ecosystem-based adaptation and disaster risk reduction in the Himalayan region.

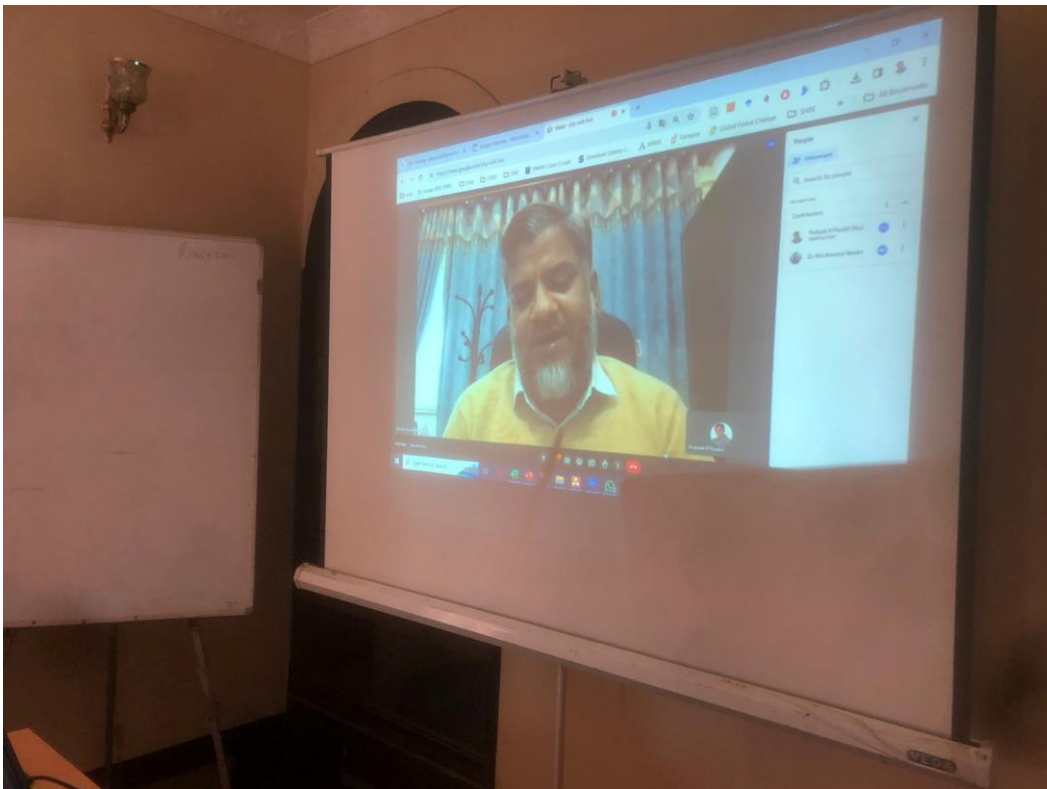
The workshop concluded with thanks and final remarks. The event was supported by the Asia-Pacific Network for Global Change Research (APN-GCR) from Japan and involved collaboration from various institutions, including Kathmandu Institute of Applied Sciences (KIAS), IIT Kanpur, Huntington Consulting, Bangladesh Agricultural University, Asian Institute of Technology (AIT), Pulchowk Campus, Institute of Engineering (IOE), and the Institute of Himalayan Risk Reduction, Kathmandu, Nepal.

Appendix 2: A three-day extensive training on " Traditional & Local Knowledge and Ecosystem-based Disaster Risk Reduction", January 03-05, 2024.

An intensive three-day training program, spanning from January 3rd to 5th, 2024, was organized for graduate and undergraduate students, as well as DRR professionals, aiming to provide them with the requisite knowledge and skills to effectively integrate Traditional and Local Knowledge (TLK) with Ecosystem-based Disaster Risk Reduction (Eco-DRR) principles into DRR plans. The training was provided by Dr. Basant Raj Adhikari, Prof. Dr. Md. Anwarul Abedin, Dr. Mohammad Golam Kibria, Dr. Prakash K Paudel, Mr. Rabin Bastola, and Mr. Suraj Gautam. Participants were exposed to both practical and theoretical aspects, encompassing disaster types and risk reduction approaches, TLK components and significance, early warning systems, and the pivotal role of ecosystems in DRR. Throughout the program, attendees actively engaged in dynamic discussions, collaborative group activities, and insightful case studies, enriching their understanding and exploring practical applications in real-world contexts. The training took place at KIAS Hall.



Training participants giving a pose



Prof. Dr. Md. Anwarul Abedin providing training via online.



Mr. Suraj Gautam providing training on Early Warning System

Appendix 3: Project closure workshop on " Enhancing Ecosystem-Based Adaptation to Disaster Risk Reduction in the Himalayan River Basin: Integrating Traditional and Local Knowledge into Disaster Management Plans in Nepal, India, and Bangladesh", January 14-15, 2024.

Kathmandu Institute of Applied Sciences organized a two-day project concluding meeting on Jan 14-15, 2024 Hotel Country Villa, Nagarkot. The project "*Enhancing Ecosystem-Based Adaptation to Disaster Risk Reduction in the Himalayan River Basin: Integrating Traditional and Local Knowledge into Disaster Management Plans in Nepal, India, and Bangladesh*", is led by Dr. Prakash K. Paudel (PI) and is funded by the Asia-Pacific Network for Global Change Research. The meeting was attended by collaborators from Indian Institute of Technology Kanpur (Prof. Rajiv Sinha, Ms. Shobhit Sing), Bangladesh Agriculture University, Mymensingh (Prof. Md. Anwarul Abedin, Dr. Mohammad Golam Kibria), Institute of Himalayan Risk Reduction (Er. Suraj Gautam) and Institute of Engineering, Pulchowk Campus (Dr. Basanta Raj Adhikari). Dr. Henry Huntington attended online. The meeting is also participated by representatives from several organizations.



Participants in the closing workshop giving a group photo.

The day commenced with a warm welcome from Dr. Mahendra Thapa of KIAS, setting the tone for the discussions ahead. Dr. Madan Lal Shrestha, representing APN, provided insightful remarks on the significance of integrating TLK into DRR efforts. Dr. Basanta Raj Adhikari from Tribhuvan University introduced the research project, highlighting its objectives and scope.



Dr. Basanta Raj Adhikari from Tribhuvan University highlighting project’s objectives and scope



Dr. Madan Lall Shrestha providing an overview of APN supported project and opportunities for new researchers



Dr. Henry P Hunting participated online

Throughout the morning sessions, esteemed speakers such as Dr. Prakash Kumar Paudel, Prof. Dr. Rajiv Sinha from Indian Institute of Technology Kanpur, and Prof. Dr. Md. Anwarul Abedin from Bangladesh Agricultural University shared their experiences and insights on TLK research in the region. Raja Ram Timilsina and Dr. Prakash Kumar Paudel presented the project's milestones and findings, emphasizing the importance of local knowledge in informing effective disaster management strategies.



Dr. Prakash K Paudel sharing project milestones and findings



Prof. Dr. Rajiv Sinha, IIT Kanpur (left) and Prof. Md. Md. Anwarul Abedin (right) sharing project findings from India and Bangladesh respectively.

The day concluded with valuable insights from Dr. Henry P Huntington on the global significance of the Nepal project and the need for prioritizing local knowledge in designing sustainable development programs.



Participants discussing on project findings and way forward.

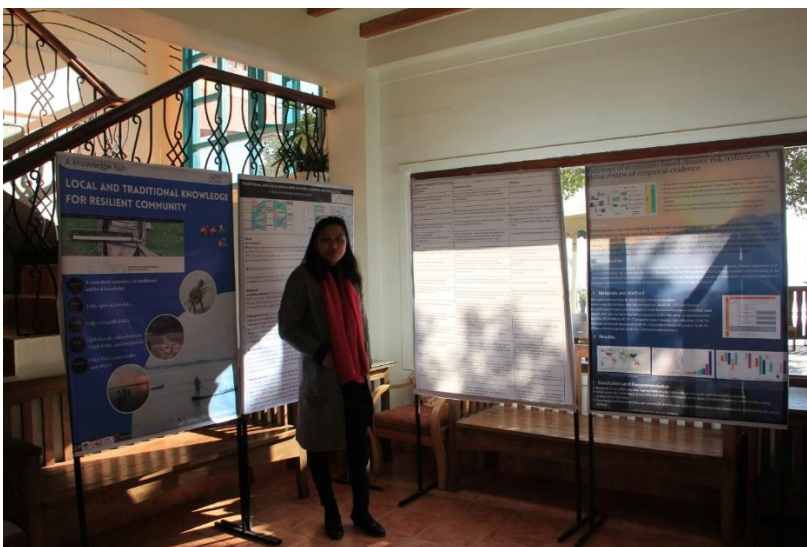
The second session included a round table discussion with a panel of experts: Dr. Santosh Nepal, Dr. Rashila Deshar, Prof. Dr. Indrajit Pal and Ms. Neshma Tuladhar. Participants engaged in a lively roundtable discussion, addressing key issues such as early career involvement in TLK research, barriers to integrating TLK into academic programs, and the prioritization of women and disadvantaged groups in disaster planning.



A panel of experts providing their review.

Dr. Madan Lal Shrestha delivered concluding remarks, emphasizing the importance of collaborative efforts in advancing TLK-based DRR initiatives. The event continued on January 15, focusing on formulating a dissemination plan to ensure the widespread sharing of project outcomes and concluding with a concise summary of key takeaways. Overall, the conference provided a platform for fruitful discussions and knowledge exchange, paving the way for enhanced ecosystem-based adaptation to disaster risk reduction in the Himalayan River basin.

The meeting also included a session “A walk to Project Gallery”, where project findings were displayed as a poster and physical model to allow lively discussion



Dr. Rashila Deshar giving a photo on “A walk to Project Gallery”.

Project Leader, Dr. Prakash K Paudel, gave a vote of thanks and concluded with the sharing of a penholder crafted by the local indigenous women's community on the outskirts of the Kathmandu Valley. The penholder is made from maize husks, a local product that reflects the utilization of local resources and knowledge.



Appendix 4: Journal Articles

Published

1. Paudel, P. K., Lamichhane, A., Acharya, K. P., & Bastola, R. (2023). Ecosystem restoration reduces community vulnerability to water-induced disasters: Need to rethink Chure conservation in Nepal. *International journal of disaster risk reduction*, 90, 103647. <https://doi.org/10.1016/j.ijdrr.2023.103647>, IF 5

Abstract

Disaster risk reduction strategies are often accompanied by conventional adaptation approaches, involving high costs and limited flexibility. Conversely, ecosystem-based adaptation (EbA) has been advocated as a sustainable approach because it is cost-effective, efficient and provides co-benefits (e.g., ecosystem services). However, there is limited awareness and understanding among both disaster risk reduction professionals and ecologists about the linkages of ecosystem restoration to disaster risk reduction. Here, we assessed people's perceptions towards the availability of ecosystem services in the highly degraded and fragile landscape to floods and soil erosion in Central Nepal. We then assessed vulnerabilities at household level in both pre- and post-restoration periods, using indicators such as distance to the river, land cover composition (ratio of forest to non-forest), occupation, availability of ecosystem services, and effectiveness of the restoration projects in the vicinity. Our results show that vulnerability as a function of adaptive capacity and sensitivity decreased even though there were no significant improvements in some of the provisions of ecosystem services we assessed. Since our results showed restoration projects were not integrated following the principles of EbA criteria, careful integration during project design and implementation would strengthen community resilience in future. Our work provides new insight into the restoration response to disasters and provides a basis for future research and policy development.

2. Paudel, P. K., Dhakal, S., & Sharma, S. (2024). Pathways of ecosystem-based disaster risk reduction: A global review of empirical evidence. *Science of The Total Environment*, 172721. <https://doi.org/10.1016/j.scitotenv.2024.172721>, IF =9.8

Abstract

Ecosystems provide valuable services in reducing the risks of disasters through various pathways, which are increasingly recognized as sustainable strategies for disaster management. However, there remains limited information on the underlying ecological processes of risk reduction. This paper addresses this gap by synthesizing ecological mechanisms and evaluating the 'level of evidence' and 'scale of use' through a review of 64 peer-reviewed research articles published between 2015 to 2022. These research articles covered nine types of disasters, predominantly floods (42.19 %), followed by urban heat waves (18.75 %), storm runoff (10.94 %), coastal erosion (9.38 %), tsunamis (4.69 %), and avalanches and landslides (6.25 %).

each). The level of evidence supporting ecological processes for disaster risk reduction is moderate, as is the 'scale of use'. Results show that there are a few studies describing the mechanism of ecosystem-mediated risk reduction and are mostly limited to the causal relationship. Empirical evidence demonstrates that forest and freshwater ecosystems buffer the risk of urban heat through processes such as transpiration, solar radiation interception, and evaporative cooling, while flood risks are mitigated by enhancing evapotranspiration, reducing water runoff time, and facilitating infiltration rates. Coastal erosion is reduced by dissipating wave energy and through beach nourishment, which facilitates ecological succession. The review underscores that hazard attenuation depends on factors such as forest type (e.g., species composition, age structure, and area), and landscape characteristics (e.g., matrix, composition and configuration). Moreover, the geographic scope of published research is largely confined to developed countries and the global north. Multidisciplinary research involving ecologists and disaster experts is imperative to address existing knowledge gaps and enhance the integration of ecosystem-based adaptation into disaster risk reduction strategies.

Keywords: Ecological process; Risk reduction mechanism; Eco-DRR; Nature based solution; Disaster risk reduction

Submitted

3. Paudel, P. K., Parajuli, S., Sinha, R., Bohara, M., Abedin, A., Adhikari, B. R., Gautam, S., Pal, I., Huntington, H.. Integrating traditional and local knowledge into disaster risk reduction policies: Insights from Nepal, India and Bangladesh. Submitted to *Environmental Science and Policy* (Under Review) (IF=6.0)

Abstract

Traditional and local knowledge (TLK) can be instrumental in mitigating the risks of disasters. There are calls to prioritize such knowledge to promote community resilience against disasters. This study examines the integration of TLK into disaster risk reduction (DRR) policies in Nepal, India and Bangladesh using a qualitative content analysis. We evaluated the level of integration in three aspects: policy priority, policy governance, and policy integration. Policy priority included five criteria and showed that India has better integrated TLK into national policies, followed by Nepal, and Bangladesh. None of the countries met our criteria for policy governance. Nepal and India emphasize community-based disaster management, combining traditional knowledge with modern technologies. However, policies are silent about the pathways of such integration, the governance mechanisms have no provision for community participation, nor are any integration tools proposed to promote such practices. Overall, the DRR policies have acknowledged the need to engage with TLK, but much more work is needed to prioritize TLK integration, which requires integration tools (e.g., legal, economic and institutional) and resources.

Keywords: disasters; disaster risk reduction; traditional and local knowledge; policy integration

4. Paudel, P. K., Parajuli, S., Bohara, M., Kibria, M. G., Abedin, A., Gautam, S., Pal, I., Sinha, R. Mainstreaming Ecosystem-Based Approaches into Disaster Risk Reduction Policies: A Comparative Study of Nepal, India, and Bangladesh. Submitted to *Policy Design and Practice* (Under Review) (IF =7.0)

Abstract

Humanity faces a rising number of challenging disasters due to their increasing unpredictability and scale. While large-scale engineering solutions have been the mainstream approach, there is a growing acknowledgment that ecosystem-based disaster risk reduction (Eco-DRR) is a suitable approach in the long term due to its cost-effectiveness, social equity, and environmental sustainability. Governments worldwide are integrating Eco-DRR into policies and legislation. Here, we review the extent of integration of Eco-DRR into DRR policies and legislation in Nepal, India, and Bangladesh using content analysis based on five criteria: acknowledgment, inclusion, weighting, resources, and reflexivity. While Eco-DRR principles are acknowledged and included in the national policies of these three countries, they are not prioritized as compared to competing alternatives due to limited integration tools. Resource allocation is directed towards prevention and relief mitigation, with limited emphasis on research and capacity building, which are crucial for strengthening eco-DRR. Notably, policy aspirations still need to be realized in legislative action. Strengthening eco-DRR requires enhanced integration, capacity-building, and robust institutions to boost resilience.

Keywords: Eco-DRR, disaster resilience, hazard mitigation, sustainable development.

Ready to submit

5. Paudel, P. K., Timilsina, R. R. C., Sinha, R., Parajuli, S., Abedin, A., Adhikari, B. R., Pal, I., Gautam, S., Kibria, M. G., Huntington, H. Village Mobility and Local Resource Utilization are adaptation strategies in Nepal's Koshi Floodplain. Ready to Submit, APN Science Bulletin

Abstract

Rivers have historically been vital to human civilization, fostering growth and societal evolution. While there has been a shift in population elsewhere, rivers remain hubs of activity, with the advent of new technologies and infrastructure development to attenuate the risk of hazards. However, many river floodplains are still occupied by traditional communities that routinely face natural hazards like floods, sediment deposition, and channel shifts, challenging local communities. This article examines the adaptation strategies employed by the traditional

communities in Gariya Tappu and Gobargada along the Koshi floodplain of Nepal. Data were collected using mixed methods, involving household surveys, field observations, and ethnographic surveys to assess key adaptation strategies and their interactions. Results show that village mobility is a key adaptation strategy supported by the complete use of locally available resources, local knowledge, skills to utilize such resources, and traditional institutions to streamline efforts in a systematic way. This research underscores the intricate relationship between rivers and society and urges a holistic approach to strengthening disaster resilience that integrates local knowledge and wisdom with scientific expertise.

Keywords: Local and Traditional Knowledge, Disaster Risk Reduction, Coping Strategy, Disaster Risk Management, Community Wisdom

6. Timilsina, R. R. C., Poudel, J., Paudel, P. K. Living with disasters: Economic factors drive people live to in disaster-prone areas in Nepal. Manuscript ready to submit *“International Journal of Disaster Risk Reduction.”*

Abstract

This study investigates the factors influencing risk perception among communities living in disaster-prone areas, focusing on the relationship between family size, income, living conditions, and disaster perception. The analysis reveals that income significantly influences disaster perception, with higher income associated with lower levels of perceived risk. Additionally, longer periods of residence in the area lead to decreased perception of disaster, suggesting that familiarity with the environment reduces perceived risk. The connectivity analysis within social systems highlights the strong correlation between economic security (ECOS) and the utilization of common property resources and productivity (CPPR). This connection underscores the importance of communal resources in enhancing economic stability and resilience to disasters. The study highlights the divergent perspectives on disasters between local residents and external agencies. While outsiders perceive floods as disasters, local communities view them as opportunities for livelihood sustenance and cultural preservation.

Policy Briefs (not peer reviewed)

7. Paudel, P. K., Bohara, M., Timilsina, R. R. C., Bastola, R. (2023). Disaster-proofing our communities: The urgent need for local governments to prioritize development based on risk assessment. Policy Brief No. 01. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal.
<http://dx.doi.org/10.13140/RG.2.2.14384.23047>

Summary

Designing local development plans that consider site specific hazard risks is crucial. However, this consideration is often overlooked, even in areas with high hazard risks, resulting in significant damage to public resources. This policy brief examines the challenges that arise from ignoring local conditions by using Gobargada, a flood-prone village in Eastern Nepal, as a case study. In this village, local people construct houses using easily disassembled, cost-effective, and easily repairable local resources, whereas the government school consists of permanent concrete buildings that were destroyed due to the shift of the river channel, a regular occurrence in the region. Such inconsistencies in the government's programs reflect a complete disregard for local circumstances. In conclusion, local governments must prioritize local knowledge in disaster risk reduction to create more sustainable and resilient communities.

8. Paudel, P. K., Bohara, M., Timilsina, R. R. C., Bastola, R. (2023). Strengthening traditional institutions for community-based disaster risk reduction. Policy Brief No. 02. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.27806.00328>

Summary

The Koshi River in Nepal is prone to recurrent flooding. Local communities have been using their indigenous resources and knowledge to manage disasters through local institutions. However, government-led initiatives have largely ignored these institutions, resulting in missed opportunities to utilize proven and widely accepted practices at the local level to address the problem.

9. Paudel, P. K., Bohara, M., Timilsina, R. R. C. (2023). Local crop varieties strengthen community resilience to disasters: a policy brief for Nepal, India and Bangladesh. Policy Brief No.03. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.1007/978-3-319-93671->

Summary

Agriculture is vital for livelihoods in Nepal, India and Bangladesh. Local communities in these countries have developed unique farming systems well-adapted to their environments. This includes the use of local crop varieties with unique traits like flood, drought and disease resistance. Thus, community resilience to disasters was in place for centuries. However, such

practices are at risk due to the promotion of foreign and/or hybrid seeds. This policy brief draws case studies from Nepal, India and Bangladesh, and highlights the value of local crop varieties in strengthening community resilience to disasters.

10. Paudel, P. K., Bohara, M. (2023). Reinvigorating neglected land: a policy brief for harnessing economic opportunities in river floodplains. Policy Brief No. 04. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.34468.69763>

Summary

Floodplain areas in Nepal have been prime locations for agriculture-related activities, as these areas can be easily irrigated and consist of nutrient-rich soil. However, with the expansion of agricultural infrastructure in other areas (e.g., irrigation systems, chemical fertilizers, high-yielding seeds), many of these floodplains are now abandoned due to the risks of potential flood hazards. The Government of Nepal should focus on harnessing economic opportunities in these areas. This requires tailored-made programs focusing on agriculture production, animal husbandry, fisheries, and nature-based tourism.

11. Bohara, M., Paudel, P. K. (2023). Traditional knowledge of planting vegetation on verges and slopes for slope stabilization needs to be promoted in the local development program. Policy Brief No.05. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.32790.97603>

Summary

Landslides and soil erosion represent two common phenomena in mountainous regions, induced by heavy rainfall, floods, and human activities along the slopes. The practice of using vegetation to enhance slope stability is established in mountainous areas in Nepal and is deeply ingrained in traditional farming management, such as hedgerows, slope site plantation and agroforestry. Such techniques are gradually diminishing within the newer generations due to shifts in livelihood practices and a growing emphasis on engineering-based solutions. We advocate the integration of these practices into local development programs, which predominantly prioritize costly measures like embankments, gabion walls, and roadside canals. This shift not only offsets cost but also provides multiple benefits, including soil protection, the increase of green spaces, and biodiversity. There is a need for guidelines to promote traditional knowledge of planting vegetation on verges and slopes for slope stabilization.

12. Abedin, M. A. and Kibria, M. G. (2023). Indigenous knowledge and weather forecasting: A weapon to predict extreme weather events. Policy Brief No. 06. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal.

Summary

Indigenous knowledge and weather forecasting have played a crucial role in helping coastal communities in Bangladesh predict and prepare for extreme weather events. This knowledge, passed down through generations, has proven to be a valuable weapon against the devastating impact of cyclones, floods, and other weather-related disasters in this vulnerable region. Combining this wisdom with modern meteorological science can enhance the region's resilience in the face of climate change and its associated challenges.

13. Abedin, M. A., Kibria, M.G. (2023). Local practices to mitigate salinity problem in coastal Bangladesh: Lesson from the ground reality. Policy Brief No. 07. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal.

Summary

Salinity intrusion is a significant issue in coastal areas of Bangladesh, particularly during the dry season, and it poses various challenges for agriculture, drinking water, and overall livelihoods. The local communities are practicing different adaptation strategies based on the learning from the ground context. These local adaptation practices such as long-distance piped irrigation technique, water reservoir development, raised bed farming system and rainwater harvesting technology are very prominent in mitigating the adverse effects of salinity in coastal Bangladesh. Efforts to manage and mitigate soil salinity are crucial for sustaining agricultural productivity in coastal regions of Bangladesh, where millions of people depend on agriculture for their livelihoods and food supply.

14. Paudel, P. K., Bohara, M. (2023). Disasters in the Mountains of Nepal: The Impact of Poorly Planned Development Irrespective of Landforms. Policy Brief No.08. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal.
<http://dx.doi.org/10.13140/RG.2.2.10978.91849>

Summary

Nepal's diverse physiography, comprising the Himalayan north, hilly middle region, and Terai plains in the south, shapes distinct land use practices. Traditional wisdom in land use, driven by an understanding of the environment and disaster vulnerability, is being disrupted by rapid changes, notably driven by road construction. Linear settlements along floodplains, accelerated by road construction and hydropower projects, raise concerns about disaster risk. Challenges stem from the indiscriminate use of land, reflecting poor planning and the absence of a comprehensive land-use policy considering disaster risk. This is driven by multiple factors such as high out-migration for labor market abroad, rural to urban migration and change in livelihoods from agriculture to service-based. Policy recommendations include strategic land use planning, zoning regulations, and geographical vulnerability assessments to mitigate risks.

There is need of incentives for safe settlement practices, nature-based solutions, and a strengthened legal framework to promote sustainable land use practices in Nepal.

15. Timilsina, R. R. C., Paudel, P. K. (2023). The Role of Cultural Beliefs, Myths, and Faith Needs to Be Acknowledged in Strengthening Community Response to Disaster Risk Reduction. Policy Brief No.09. Center for Conservation Biology, Kathmandu Institute of Applied Sciences, Kathmandu, Nepal. <http://dx.doi.org/10.13140/RG.2.2.24400.69128>

Cultural beliefs, myths, and faith are integral components of local knowledge and practices, playing an important role in strengthening community responses to disaster risk reduction through various pathways. Firstly, these aspects influence people's understanding of the risks associated with disasters (e.g., risk perception) and their responses to such events. Gobargada Village in the Koshi region serves as a living example of how cultural beliefs, myths, and faith deeply influence community life. These traditions not only shape the identity of the residents but also act as strong pillars during the times of crisis. They are often intertwined with natural elements, historical events, local landscapes, and ecosystems, reflecting a deep understanding of the environment and its challenges. This policy brief suggests recognizing and incorporating cultural beliefs, myths, and faith into disaster plans, using Gobargada as a case study. It proposes that local governments value and promote these cultural elements into broader resilience strategies

Appendix 5: List of young researchers

S.N.	Name of Young Scientist	Country	Institute
1	Arjun Lamichhane	Nepal	KIAS
2	Saru Dhakal	Nepal	KIAS
3	Raja Ramchandra Timilsina	Nepal	KIAS
4	Kenisha Shrestha	Nepal	KIAS
5	Achala Shrestha	Nepal	KIAS
6	Dibya Magar	Nepal	KIAS
7	Surakshya Poudel	Nepal	KIAS
8	Prakriti Karki	Nepal	KIAS
9	Barsha Khanal	Nepal	KIAS
10	Suja Magar	Nepal	KIAS
11	Anima Singh	Nepal	KIAS
12	Sujan Bhattarai	Nepal	KIAS
13	Sailendra Sharma	Nepal	KIAS
14	Meena Bohara	Nepal	KIAS
15	Md. Hosenuzzaman	Bangladesh	BAU
16	Shobhit Singh	India	IIT Kanpur
17	Kanchan Mishra	India	IIT Kanpur
18	Asma Ahmed	Bangladesh	BAU
19	Mohammad Golam Kibria	Bangladesh	BAU

Appendix 6: Conference Presentation

Topic	Authors	Conference/Symposium/Seminar Name	Year
Living in Koshi Floodplain: Mobile Human Settlement and Reliance on Local Resources are Adaptation Strategies to Disaster Risk Reduction	Raja Ram Chandra Timilsina	EBA Kathmandu Conference III (September 28, 2022) By: Center Department of Environmental Science, Tribhuvan University, Nepal, Resources Himalaya Foundation, IUCN Nepal	2022