



USAID
FROM THE AMERICAN PEOPLE

USAID PAANI PROGRAM FINAL SUMMARY VOLUME II

Photo credit: Manoj Chaudhary for USAID

Fisherman casting his net in the Middle Rapti watershed.

Aerial shot of local Tharu women fishing in Rapti River in Dang, Nepal using traditional gear called "Helka."



Photo credit: Aura Creations for USAID

INTRODUCTION

Volume II of the Paani e-Book has been compiled as a focused supplement to the main e-Book.

The volume is divided into two sections:

Section A. Reflections

Reflections by a wide cross-section of PANI partners and collaborators providing their perspectives on what has (and what hasn't) been accomplished over the past five years and what needs to come next.

The engagement of these partners and collaborators with the PANI project and lessons learned are important to share with the wider stakeholder community who care about Nepal's aquatic resources management so that future decisions and projects are well informed and do not end up re-inventing the wheel

Section B. Documentation

A comprehensive list of the documentation produced by the three components of PANI. Given the pathbreaking nature of this project -not just for Nepal, but also globally for reasons that will be discussed below- it was felt that a special effort was needed to go well beyond the "normal" practice of making project documents available on USAID's Development Experience Clearinghouse (DEC). The documents needed to be available in Nepal, and accessible not just to the international development community, but also to the next generation(s) of Nepalis who will pick up the baton and push for a more comprehensive understanding and more careful stewardship of Nepal's world-class water resources. All of the documents will be available at the new Freshwater Centre of Excellence (FWCoE) that is being established at the Central Department of Environmental

Sciences of Tribhuvan University with support from the Paani project.

PANI vs Paani: Clearing up any confusion

Following the completion of the Assessment of Water Resources Management & Freshwater Biodiversity in Nepal in 2014, USAID/Nepal designed the Program for Aquatic Natural Resources Improvement (PANI). The PANI program had three components:

- A research component implemented by the International Water Management Institute (IWMI) This component was named Digo Jal Bikas ("Sustainable Water Development")
- A program support component implemented by the Office of International Programs of the U.S. Forest Service (USDA/USFS-IP), and
- The large, multi-element Paani project described in Volume I of the e-Book and implemented by DAI.

A Pathbreaking Program

There were several things that were both interesting and pathbreaking about the PANI program:

- The Assessment that led to its development was funded not by USAID/Nepal but by the U.S. Forest Service (with USAID/Nepal providing local technical support and logistics through NDRI).
- Credit for the vision behind PANI goes to USAID/Nepal Environment Officer Bronwyn Llewellyn who is fondly considered "the mother of PANI".
- PANI was the first time USAID/Nepal had engaged directly in the water sector since the Irrigation Management Project (IMP) in the late 1980s¹. (Interestingly, IMP also

¹ USAID/Nepal has supported a string of projects working on hydroelectricity since the early 1990s. These have focused on energy generation rather than on water resources per se. It is anticipated that the engagement of the Nepal Hydropower Development Project with Paani through participation in the Nepal River Conservation Trust (NRCT)-organized

had an applied research project implemented by IVMI working to understand and support Farmer Managed Irrigation Systems (FMIS). Support for FMIS led to innovations not just in Nepal but around the world through its connections to the common property research work of Nobel Economic Laureate Dr. Elinor Ostrom. It was also one of the inspirations for the development of Farmer Managed Natural Regeneration (FMNR) in Sahelian West Africa – an innovation judged by the International Food Policy Research Institute (IFPRI) in a Gates Foundation-funded study of “proven success in agricultural development” around the world to have been one of the 19 most significant innovations². As it happens, another one of the 19 innovations – the rapid expansion of community forestry in Nepal following the adoption of the policy recommendations of the Master Plan for the Forestry Sector in 1989 – was also being proactively supported by USAID/Nepal and a group of like-minded donor organizations at the same time. A potential link between this work and a key piece of the Paani legacy will be discussed below.

- The engagement of all three elements of PANI in the National River Summits of 2017 and 2019 opened the project to a broader range of stakeholders and helped to promote diverse voices and multiple values in a national conversation that had been focused far too much on a single use: hydropower development.³
- Those designing PANI were unaware at the time that the project may well be USAID’s first-ever major project

[Nepal National River Summits in 2017 and 2019 will bring a substantially broader view of water resources to the table through USAID/Nepal's most recent energy project: Urja.](#)

- 2 IFPRI. 2009. Millions Fed—Proven Successes in Agricultural Development. D.J.Spielman and R. Pandya-Lorch, Eds. International Food Policy Research Institute, Washington DC. <https://www.ifpri.org/publication/millions-fed>
- 3 For additional details see Taylor, “Water and Social/ Environmental Justice in the Himalayas: the multiple roles of rivers.”

working on freshwater biodiversity anywhere in the world. If confirmed, this would be a singular achievement and a major feather in the cap of USAID/Nepal.⁴

- At the same time, PANI is the first significant effort by the Government of Nepal to start addressing aquatic biodiversity. As noted by Arun Rana in his contribution to this volume:

Nepal’s drive for biodiversity conservation has focused exclusively on terrestrial species since the advent of modern conservation, which started with the promulgation of the National Parks and Wildlife Conservation Act of 1973. Very few conservationists in Nepal have even heard of the Aquatic Animal Conservation Act, which was promulgated four years earlier in 1969. This law, which recognizes aquatic biodiversity and proposes measures to protect them, has sat on the shelf for half a century.

- Moving forward, the Government of Nepal and USAID have an opportunity to work together to address this lacuna by building on the pathbreaking accomplishments of the PANI program.

Two other potentially globally-significant innovations supported by USAID/Nepal through Paani.

The Paani e-Book identifies three key pieces of the Paani Story:

- #1. Identifying Aquatic Values, Threats and Needs
- #2. Putting Aquatic Conservation and Management into Local Hands

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- 4 Numerous queries over several months to the managers of USAID’s large, Congressionally-mandated Biodiversity Program have received no response. Consultations with senior current and retired USAID Environment Officers who have worked in Asia, Africa and Latin America appear to confirm our hypothesis. We believe the second project that would qualify under this category is a program supported by USAID/Cambodia on the Mekong River that was launched early in 2017.

#3. Building Aquatic Resilience and Livelihoods

It also highlights eight key elements of the Paani legacy.

Innovation #1 Locally-Empowered River Stretch Co-Management

Part of Story #2 is the development of locally-led, locally-empowered river stretch co-management. If this effort continues to be supported and is carefully nurtured and rigorously evaluated and improved, it has the potential to develop first into a national program along the lines of FECOFUN/Federation of Community Forestry Users Nepal and eventually into a global model.

Innovation #2 Using High Conservation Value Rivers and related analyses as a framework for moving decision making on hydropower development from “ad hoc” to proactive, rigorous, fact-based decision-making.

The other potentially significant innovation is using the three recently completed in-depth studies by Paani/WWF (High Conservation Value Rivers, Energy Options Assessment, and System Scale Planning) to grow the pilot efforts in river stretch co-management into a new model for the management of High Conservation Value Rivers while at the same time introducing rigorous analysis and fact-based decision-making into the siting and construction of hydropower plants on Nepal’s rivers.

You will find these and many other interesting and important ideas in the Reflections pieces that follow.

Getting the word out about PANI experience and accomplishments.

Both the Reflections in Section A and the Documentation resources in Section B will be available at the newly established Freshwater Centre of Excellence (FWCoE) in Kathmandu. Paani supported the design and establishment of the Freshwater Centre of Excellence (FWCoE) at Central Department of Environmental Studies-Tribhuvan University (CDES-TU) to share knowledge and tools related to freshwater biodiversity in Nepal. The FWCoE will be a publicly accessible online knowledge hub for freshwater biodiversity research, data and information that aims to

inform river basin planning, starting from the summer of 2021. The FWCoE will serve as a repository for knowledge products and tools prepared by all three elements of PANI to be accessed by Nepali policy/decision makers, planners, researchers, donors/development partners and other stakeholders. And, as the response to COVID-19 around the world has shown, online learning and use of online tools to disseminate information will become that much more important in situations where in-person contact is limited.

CDES-TU is a well-established department in Nepal's largest and oldest university and has been offering academic courses on environmental sciences, as well as expert services to various GON, multi-lateral organizations, INGOs, and NGOs. CDES-TU has implemented projects with support

from the EU, UNDP, WWF and ICIMOD. It demonstrated an active interest in developing and participating in an online knowledge platform such as the FWCoE along with the capacity to maintain and manage knowledge on freshwater biodiversity as it becomes available to ensure that this knowledge reaches a wide variety of end users both in Nepal and beyond its borders.

A Table of Contents has been included to help you navigate Sections A and B, along with a list of Acronyms to help decipher this element of "development speak".

Thanks to each of you who have taken the time to share your reflections with us. Thanks as well to the DAI staff who have taken the raw material for Volume II and transformed it

into this beautiful document: Pushkar Khanal, Jula DeCosse, and Bidhan Rajbhandari.

Finally, thanks to Allen Turner, who has been our co-conspirator from the start of this idea, and to USAID/Nepal's Kashmiri Kakati for her support of this rather unusual "non-required" deliverable from the DAI Paani Team.

With the hope and expectation that both the Government of Nepal and USAID/Nepal understand just how unusual and important the "PANI experiment" has been and the need to continue supporting work on broad-based water resources management and aquatic biodiversity in Nepal.

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Volume II B Documentation produced by the USAID PANI Program

Documentation produced by the IWMI/Digo Jal Bikas project

Documentation produced by the U.S. Forest Service/USAID-Nepal PAPA

Documentation produced by the USAID Paani program

ACRONYMS (for Volume II)

AABCB	Aquatic Animals and Biodiversity Conservation Bill (or Act?)	GLOFs	Glacial Lake Outburst Floods	NEA	Nepal Electricity Authority
ADB	Asian Development Bank	GoN	Government of Nepal	NENCID	Nepal National Committee pf ICID
AEC	Aquatic Ecology Centre (Kathmandu University)	GWRDB	Groundwater Resources Development Board	NFBP	Nepal Fish Biodiversity Project (CMDN)
BC	Business Case(s)	HCVR	High Conservation Value Rivers	NEFEJ	Nepal Forum of Environmental Journalists
BESS	Battery Energy Storage System	HEM	Hydro-Economic Model	NGO	Non Governmental Organization
BMP	Best Management Practice	HPP	Hydropower Project	NHDP	Nepal Hydropower Development Project (USAID)
CAACG	Community Aquatic Animal Conservation Group	ICID	International Commission on Irrigation and Drainage	NPC	National Planning Commission
CAS	Catch Assessment Survey	IFC	International Finance Corporation	NRCT	Nepal River Conservation Trust
CBD	Convention on Biodiversity	IJPMC	International Joint Partnership for Mahseer Conservation	NTB	Nepal Tourism Board
CBET	Cross-border Electricity Trade	INPS	Integrated Nepal Power System	NTNC	National Trust for Nature Conservation
CDES	Central Department of Environmental Sciences (TU)	IPPAN	Independent Power Producers of Nepal	NWCF	Nepal Water Conservation Foundation
CF	Climate Future	IRRP	Integrated Resource and Resiliency Planning	OIBN	Office of Investment Board of Nepal
CFMG	Capture Fisheries Management Guidelines	IWMI	International Water Management Institute	Paani	Component of PANI implemented by DAI
CIDA	Canadian International Development Agency	IMP	Irrigation Management Project (USAID)	PACT	Private Agencies Cooperating Together (now uses only PACT)
CMDN	Center for Molecular Dynamics Nepal	IRRP	Integrated Resource & Resilience Plan	PANI	Program for Aquatic Natural Resources Improvement (USAID/Nepal)
COP	Chief of Party	Jal Kachahari	Resilient Water Resources Management in the Karnali Basin	PEA	Political Economy Analysis
CSO	Civil society organization	JICA	Japan International Cooperation Agency	PPT	Powerpoint
CSR	Corporate Social Responsibilities	KarMo	Karnali-Mohana River Basin	PRA	Participatory Rural Appraisal
DAI	Development Alternatives International	KU	Kathmandu University	Ramsar	Ramsar Convention on Wetlands of International Importance
DFAT	Department of Foreign Affairs and Trade (Australia)	LG	Local governments	RCM	Regional Climate Model
DJB	Digo Jal Bikas [Sustainable Water Development] (implemented by IWMI)	LLP	Limited Liability Partnership	RoR	Run of River
DoED	Department of Electricity Development	masl	Meters above sea level	RPGCL	Rastriya Prasaran Grid Company Ltd
DOI	Department of Irrigation	MFSC	Ministry of Forests and Soil Conservation	SDG	Sustainable Development Goals
DoLI	Department of Local Infrastructure	MKWR	Mahakali, Karnali and West Rapti river basins	SEED	Social, Environmental and Economic Development Office (USAID/Nepal)
DoLIDAR	Department of Infrastructure Development and Agricultural Roads	MoA	Ministry of Agriculture	SME	Small and Medium Size Enterprises
DWIDM	Department of Water Induced Disaster Management	Also MOAD	Ministry of Agricultural Development	SoANaS	South Asian Nadi Samba
eDNA	Environmental DNA	MoCTCA	Ministry of Culture, Tourism and Civil Aviation	SSP	System Scale Planning
e-Flow	Environmental Flow	MoE	Ministry of Energy	SWN	Scott Wilson Nepal
EFRC	Environment Friendly Rural Road Construction Support Activity (SWN)	MoEWRI	Ministry of Energy, Water Resources and Irrigation	SWOT	Strengths, Weaknesses, Opportunities & THreats
EFTC	now ERC	MoFE	Ministry of Forest(s) and Environment	TAF	The Asia Foundation
ELI	Environmental Law Institute (Washington DC)	Mol	Ministry of Irrigation	TU	Tribhuvan University
EOA	Energy Options Assessment	MoLRM	Ministry of Land Reform and Management	Urja Nepal	"Energy" Nepal project (USAID)
ERC	Electricity Regulatory Commission	MoPE	Ministry of Population and Environment	USAID	United States Agency for International Development
ESG	Environmental, Social and Governance guidelines	MoWRI	Ministry of Water Resources and Irrigation	USFS	United States Forest Service
FC	Financial Closure	MTMP	Municipal Transport Master Plan	VDC	Village Development Committee??
FECOFUN	Federation of Community Forestry Users Nepal	MW	Megawatt	WB	World Bank
FWCoE	Freshwater Centre of Excellence (TU/CDES)	NAMI	Naaya Aayam MultiDisciplinary Institute (Jorpati, Kathmandu)	WEBS	Water, Energy Biodiversity & Sediment
GESI	Gender and Social Inclusion	NARC	National Agriculture Research Council	WECS	Water and Energy Commission Secretariat
GHGs	Greenhouse Gases	NBSAP	Nepal National Biodiversity Strategy and Action Plan 2014-2020	WWF	Worldwide Fund for Nature
		NCBI	National Center for Biotechnology Information		



Photo credit: Tevapradas/Wikimedia

Federal Parliament of Nepal

GOVERNMENT OF NEPAL

WECS – WATER AND ENERGY COMMISSION SECRETARIAT

■ SECRETARY, SAGAR KUMAR RAI

Nepal is a country rich in water resources and biodiversity, yet we have not seen much success achieving substantial benefits from those resources. Rather than being well maintained, Nepal's resources are being degraded and destroyed every day due to over-extraction and over-exploitation by people, and because of a lack of adequate knowledge and awareness about the values and importance of those resources, both in communities and by the government. Many also lack sufficient ideas,

skills, and scientific techniques to properly manage the resources. Nevertheless, our valuable and important resources are at risk and the consequences in the near future will be dire without programs to control, conserve, and sustainably utilize them. This issue matters to the government of Nepal, as seen in Nepal's National Water Resource Policy, which mandates the protection, promotion, and environmentally friendly and sustainable use of natural resources, as does the present constitution of Nepal.

Established in 1975, the Water and Energy Commission Secretariat (WECS) is Paani's Government of Nepal

(GON) counterpart. In short, it is a leading and authorized government institution for the planning, policy, and strategy of water and energy resources in Nepal. Among WECS' most significant documents are: Water Resource Strategy (2002), Himalayan Sediments Issues and Guidelines (2003), the National Water Plan (2005), Energy Supply and Demand Situation in Nepal (2012), and Hydropower Potential of Nepal (2020). In 2020, WECS prepared and published the National Water Resource Policy—the first policy on water resources prepared by the Government of Nepal.

The USAID Paani program has been working with the Water and Energy Commission Secretariat (WECS) for five years to help conserve water resources, manage watersheds, and protect aquatic biodiversity in the Karnali, Mahakali, and Rapti river basins. During this time, Paani has achieved a lot: from conducting studies on fish species and habitats and forming conservation communities; to preparing environmental and aquatic animal protection laws and support to promote fish and agriculture farming. Paani has balanced its conservation efforts with environmentally friendly development support, including the preparation of environmentally- friendly road and canal guidelines and financial and technical support for such infrastructure construction.

Thanks to Paani's efforts, local communities and governments now have a better understanding of their shared values and the importance of water resources and aquatic biodiversity. They also learned skills and techniques to better conserve those resources. Paani helped to create employment and research opportunities for local communities, NGOs, high-level experts, and institutions. New laws prepared by Paani can help protect and conserve water resources, watersheds, and aquatic biodiversity. Especially in far west Nepal, the program has been successful, and I have personally observed that stakeholders are quite happy and satisfied with Paani.

I see more opportunities to replicate this type of program in other areas of Nepal, such as the Gandaki and Koshi river basins, and for local and provincial governments to successfully take on ownership of the programs Paani has already started.

Many government and private sector institutions utilize water resources, but an urgent next step is to designate an institution—perhaps WECS—with the responsibility and authority to monitor, control, regulate, and conserve those resources. The work Paani started shows the good that can come when government and development partners cooperate. I believe the seeds of this strong partnership will bring more positive changes to come, both in conservation and livelihoods, especially in western Nepal. Another important action in continuing Paani's

work is the formation of community groups through an inclusive process, as Paani demonstrated.

I am impressed with Paani and I can conclusively say that Paani has made a remarkable contribution to Nepal. I strongly recommend the extension and scaling of the program in remaining part of Karnali, and replication in the middle and eastern parts of Nepal, in order to continue raising awareness about the importance of conserving water resources and aquatic biodiversity. The knowledge, experiences, and findings Paani leaves behind are valuable asset for us in the government of Nepal, and we will try to incorporate and implement those results and that knowledge in our planning, policymaking, and implementation.

On behalf of WECS, I would like to offer a special thanks to members of the Paani program team and to USAID Nepal, all of whom made great efforts and contributions to the success of the program. Similarly, I am very thankful to all the individuals, experts, communities, institutions, and local and provincial governments who have fully cooperated with and supported Paani and WECS. Lastly, I am very grateful to USAID for their continuous guidance and financial support.

MCA/MILLENNIUM CHALLENGE ACCOUNT

■ **KHADGA BISHT, FORMER PRESIDENT OF IPPAN/INDEPENDENT POWER PRODUCERS OF NEPAL AND EXECUTIVE DIRECTOR, MILLENNIUM CHALLENGE ACCOUNT, NEPAL**

After one hundred years of hydropower development, Nepal has moved from "lighting for all" based planning to a more industrial scale development of hydropower development. Since 2008, successive governments have been discussing how to generate 10,000 or 15,000 MWs or even more capacity from Nepalese rivers. In line with the government's vision, state utility and the private sector are scaling up their project sizes from miniature

and small hydro projects to large and even mega projects. As the country embarks on large-scale hydropower development, not just run of river type but peaking and storage type projects, there are critical risks associated with geological hazards, natural disasters, and climate change including financial and social changes not yet clearly identified.

Nepal is not the first country to embark of ambitious growth in hydropower. There are learnings from other countries who have abundantly developed hydropower for a long time and are now reflecting back on the impact and consequences of their unidimensional growth approach. As the projects become larger, there are many stakeholders and the issues of sustainability, benefit-sharing, environmental mitigation, and social and cultural impacts become pronounced. In Nepal, a project has to address all of these concerns to be both a financially successful venture and a project that contributes to sustainable development.

Nepal's private sector umbrella organization, Independent Power Producers' Association (IPPAN) on several occasions has committed its effort towards the sustainable growth of the hydropower sector and, in this effort, started working with the Sustainable Hydropower Development program of the United States Agency for International Development) USAID-PANI program. The use of hydro-meteorology data, climate change resilient design, disaster management procedures and river basin regulations (including river ecology techniques) were the key themes identified to be worked on.

The sustainable hydropower program included activities for capacity building of the sector by organizing discussion forums, workshops and trainings for hydropower developers and relevant stakeholders. As a starting point, a high-level Nepalese team visited Portland, USA on a Nepal-USA Hydropower Collaborative Tour from July 11-17, 2016. The tour focused on learning about the development of hydropower, environmental management and basin planning of the U.S. Pacific Northwest. The team comprised of Honorable Member of Parliament Gagan Thapa (Chair of the Agriculture and Water Resources Committee); Secretary Suman Sharma (Ministry of Energy); Secretary



A view of Columbia River in USA.

Udaya Thakur (Ministry of Forests and Soil Conservation); Secretary of WECS, Dhan Bahadur Tamang; Mukesh Kafle, Managing Director Nepal Electricity Authority (NEA); Dil Bahadur Chhetri, Section Officer, International Economic Cooperation Coordination Division, Ministry of Finance; Khadga Bisht, IPPAN President; Megh Ale, Chairman of the Nepal River Conservation Trust (NRCT); and Shanker Khagi of USAID-Nepal. The team visited the Bonneville dam, reservoir and power operating facilities along the



During a USFS-led study tour to Portland, USA, a team of high-level Nepalese officials shared learnings on sustainable hydropower development and basin planning.

Colombia River and also received information on the operation of multiple hydropower plants in cascade. The Colombia river basin alone produces over 38000 MW of hydropower and provides navigation to four U.S. pacific states.

Bonneville Power Administration (BPA) is an American federal agency operating in the Pacific Northwest. BPA was created by an act of the U.S .Congress in 1937 to



Fish ladder at Bonneville Dam



Almost 5km long fish ladder

market electric power from the Bonneville Dam located on the Columbia River. Fish ladders placed at the dam site were very well managed and one could see several fish migrating upward for spawning.

Basin planning and water and energy trade between Canada and the US were also discussed in the workshop. The role of U.S. Corps of Engineers was not only for the security of the large and important navigation along Colombia River but also important to how it supported disaster relief. This was noteworthy for all participants.

The visit to the Conduit dam location was very interesting. When it was first built, white salmon navigating from the Conduit River to the Pacific were obstructed in their life cycle. The Conduit Hydroelectric Project completed in 1913 to provide electrical power for local industry and is listed in the National Register of Historic Places as an engineering and architecture landmark. PacifiCorp decommissioned the project due to rising environmental costs, and the dam was intentionally breached on October 26, 2011 almost one hundred years after it was built, thereby leaving the salmon free to return to their natural patterns of migration.

The United States, through its treaty of 1855, convened a Walla Walla Council between the United States and sovereign tribal nations of the Cayuse, Nez Perce, Umatilla, Walla Walla, and Yakama. We were thrilled to visit the area chief of the Yakama Nation and learned a lot about the history and culture of the Native Americans and the emphasis they put on the coexistence of nature and modern development.

The visiting team took advantage of being in Oregon and initiated an interaction program with Nepalese people residing in Oregon and the Pacific Northwest. Mr. Khadga Bisht, then President of IPPAN, made a keynote presentation in which Honorable Member of Parliament Gagan Thapa and Mr. Suman Prasad Sharma Secretary Ministry of the Energy expressed their views on contemporary political status and hydropower development of Nepal.

Nepali visitors to hydropower site Interaction with Oregon Nepalese Society



Photo credit: Khadga Bisht for USAID

Nepal needs to learn from Native American experience.



Photo credit: Khadga Bisht for USAID

Yakama Nation chief with Nepalese team



Photo credit: Khadga Bisht for USAID

Nepali visitors to hydropower site



Photo credit: Khadga Bisht for USAID

Interaction with Oregon Nepalese Society

Sustainable Hydropower Development: Implementing Lessons

IPPAN signed a grant agreement with the USAID-PANI program to further the learning from the US Pacific Northwest visit, as well as five different capacity building activities for the hydropower fraternity with regards to sustainable hydropower development practices.

Some of the keys areas identified for capacity building of the hydropower sector to ensure adoption of sustainable practices and safeguard the investment and environmental resources in the long run were:

Use of Hydro-met Data

Hydropower developers use historical data for hydrological measurement to assess plant capacity. However, in the context of climate change, there is a likelihood that energy production of hydropower projects could be affected once projects enter the operation phase. There have been instances where power plants have not been able to meet contractual energy due to hydrological change. Hence, it is important for developers to use hydro-met information efficiently during the design to preclude energy production deviation in the operation phase. Hence, these topics were

envisaged to be included in a training on efficient use of hydro-met data and importance and status of river basin planning in Nepal to the hydropower sector.

Understanding of Compliance with Environmental and Social Safeguards

The program mainly focused on e-flow management, catchment area protection, and fish friendly hydropower design.

Disaster Risk Management for Hydropower

Nepal is one of the most disaster-prone countries in the world due to its topography and climatic conditions. Being in a seismically active zone, it is highly susceptible to earthquakes. Young mountains make it liable to landslides either due to heavy rainfall followed by landslides and flooding or earthquakes, which can lead to Landslide Dammed Outburst Floods (LDOF). Receding glacial lakes and subsequent overflow make incidents of Glacial Lake Outburst Floods (GLOF) more common; already 12 GLOF events have been reported since 1964. Consequences of such events are further exacerbated by unplanned settlements, increasing population pressures, low income and education. Recent events such as the Jure landslide on August 9, 2014 and the earthquake on April 25, 2015 illustrate the risks posed to infrastructure and community by such disasters.

The program envisaged how to train hydropower operators to prepare power plant-specific emergency preparedness plans to avert losses in emergency situations and inculcate best practices of disaster preparedness. Further, under the program, a joint program with the Department of Hydrology and Meteorology (DHM) was planned whereby DHM would prepare a basin hazard assessment study in partnership with the PANI Program.

Hydro met Data and River- Basin Program training 2-4 September, 2019

Conclusions

Under the Sustainable Hydropower Development Project, hydropower developers and investors in Nepal gained



Hydro met Data and River- Basin Program training 2-4 September, 2019

knowledge on the consideration of sustainability in plan design. Some of the developers are already working with fish ladders, particularly in larger size projects. Many power projects also considered emergency preparedness while designing their organization during construction, as well as during operation and maintenance.

The preparation of training materials such as these is an asset for an organization like IPPAN, which can use these

materials for future trainings and to plan advanced training courses.

Overall, PANI's Sustainable Hydropower Development activity has opened up an important discourse and consideration prior to embarking on large scale hydropower development. If the regulator and the policy maker are aligned with this thinking we will not need to decommission and undo an established dam like the Condit dam, one of

several that have been decommissioned in the U.S. Pacific Northwest, in order to affirm a broader view of the values of rivers and watersheds and the need to factor in ecosystem services as a central element of project design.



GOVERNMENT OF THE U.S.A.

USAID

United States Capitol Building

Photo credit: Wikipedia

■ BRONWYN LLEWELLYN, CONGRESSIONAL LIAISON OFFICER, BUREAU FOR LEGISLATIVE AND PUBLIC AFFAIRS. FORMER ENVIRONMENT OFFICER, USAID/NEPAL (2012-2016)

In 1997 my family was stuck in a long queue of traffic on the road to Pokhara. It was unclear what was causing the block, but we knew we might be there for hours. We got out of the car to stretch our legs, looking out over the Trisuli river. My brother spotted another family doing the same, immediately recognizing his friend and running over, with us joining him. I have always been fascinated by everything in the natural world, and it turned out the boy's father was Dr. David Edds,

who was in Nepal on a Fulbright Fellowship to continue his research on the freshwater fish of Nepal's rivers. He told me about the extraordinary diversity - how just like with Darwin's finches in the Galapagos, the many little streams in the high Himalayas created the perfect opportunities for isolation and adaptation, leading to species diversity. But that the construction of dams to create hydropower, which was desperately needed, threatened that diversity since we

didn't know enough about the habits of the fish to adequately mitigate the impacts of the construction.

If you'll forgive the pun, I was hooked.

Fast forward to 2012. In the intervening years I pursued that passion for wildlife, biodiversity, and how to conserve it while balancing development needs, both academically and in my career, becoming an Environment Officer with USAID.

■ KAROLYN UPHAM, NATURAL RESOURCE OFFICER, CENTER FOR ENVIRONMENT, ENERGY AND INFRASTRUCTURE (FORMER PANI PROGRAM MANAGER, SEED OFFICE, USAID/NEPAL)

PANI was the first major program that I supported after joining USAID. As such, it holds a special place in my memory. Prior to working on PANI, I'd only worked on relatively small projects that focused on a single species or a single important biological area. PANI was different—it was a large, complex effort designed to build upon the legacy of decades of successful conservation work in Nepal. While PANI was being developed, Nepal's terrestrial conservation successes—especially around community forestry and conservation of large mammals—had already become global models for best practice. PANI, on the other hand, was a new and ambitious direction for USAID/Nepal. It was intended to play a pivotal role in shaping the management of water resources—resources that underpin so many elements of Nepal's economy, from tourism, to energy, to agriculture. It also brought a new focus to freshwater biodiversity, something that had received very little attention not just in Nepal, but

in USAID's investments in biodiversity conservation around the globe.

Additionally, PANI was designed and implemented during a time of many challenges and transitions. Some, such as the 2015 earthquake, were unexpected and devastating. Others, like a new federal structure and decentralization, were long in the making and offered exciting new hopes for the future. When designing PANI, we knew it needed the combined efforts of many talented professionals, strong organizations, and effective partnerships with local communities in order to achieve its lofty goals. The support of the Government of Nepal was also crucial to its success.

In the end, all of these came together to make valuable contributions to conserving freshwater biodiversity and improving water resources management in Nepal. While I unfortunately left Nepal before the program came to a close, I was always eager to hear about how

the program was progressing. Key results of note include developing and rolling out a river stretch co-management model that has sustainable and equitable use at its core. Additionally, the program helped to develop a Flood Early Warning system, which in 2020 reached several thousand people with emergency text alerts when flood waters reached dangerous levels in the lower Karnali watershed. Another key contribution has been the development of new robust tools and technologies to help inform decision making and planning, such as the eDNA monitoring and environmental flow calculators. While there is still more work to be done, PANI has made significant progress towards protecting freshwater biodiversity and improving water resources management in Nepal, and I'm proud to have played a small role.

I was thrilled to be assigned back to Nepal, and eager to see what had been achieved in the intervening years. Some of the successes were obvious. Hillsides that were bare in the 90's were once again thickly forested, reducing landslides and providing direct income to the communities that managed them. Nepal was celebrating the second of several years of zero poaching of Rhinoceros. But when I asked about freshwater biodiversity, I found very little had been done, and there was no new information available, despite the construction of several small and medium dams.

When we completed our required Biodiversity and Tropical Forestry assessment, I made sure the researchers looked beyond the scope of the existing USAID portfolio to look at the whole country and determine what was the most important threat to biodiversity. The answer came back: watershed management. Changing flows due to dam development, upstream road construction and gravel mining,

and exacerbated by climate change, was impacting all of our target habitats, from the management of Chitwan and Bardia National Parks to fragile snow leopard habitat in the high Himalayas, and threatening the gains made in community forestry. At the same time, the World Bank and IFC were looking into financing the construction of much larger dams, but required biodiversity information, in particular fish habitat and migration requirements, to complete their EIAs.

To try to get some of the answers (or at least help us frame the right questions and direct future research), we did a rapid Water Resource Management and Freshwater Biodiversity study. I accompanied the team to the field, and I will never forget standing on top of the Kali Gandaki dam - exactly where I had gone on a kayaking adventure in 1996 - and looking down and upstream at the changed landscape. There is no question that Nepal needs electricity and that hydropower is the best option for the country's

development, but it can be done better. Traveling along the river brings you to rapidly urbanizing municipalities that are desperate for clean drinking water, and safe sanitation systems. Coming into the Terai brings images of massive floods wiping out homes and fields while the critical water sources in the national parks dry up.

Water is the future of Nepal, there is no question about that. PANI is just the first drop in the bucket to address that, but my hope now, as it was then, is that it inspires others, be it the government, private sector, conservation organizations, and other donors, to invest in that future through paying closer attention to this liquid gold; its management, conservation, and protection of the diversity of life within it, for the good of all Nepalis and the world.

■ **OLAF ZERBLOCK, SENIOR BIODIVERSITY AND FORESTRY ADVISOR, BIODIVERSITY DIVISION,
CENTER FOR ENVIRONMENT, ENERGY AND INFRASTRUCTURE**

As USAID/Nepal's Paani program comes to a close, there is much to celebrate and learn from. From a distance, I had the privilege of working with the USAID mission and the DAI Paani team over the last several years in strategic planning and adaptive management. There's no question that the Paani program was ambitious, setting out to break new ground in freshwater conservation across almost a third of the country. It faced important challenges, among which are natural disasters and the shifting landscape of federalism. Yet Paani's successes and lessons learned should be celebrated as important contributions to the future of freshwater conservation in Nepal.

Paani was the right program at the right time, forging new directions in conservation nationally while addressing an increasingly urgent and under-funded issue - freshwater resources and their biodiversity. Globally, freshwater systems, including rivers and wetlands and the biodiversity they harbor, are under threat as never before. The largest and most comprehensive global assessment of the state of nature to date, the 2019 report from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), identified five major threats to global biodiversity: land- and sea-use change; overexploitation; climate change; pollution; and invasive alien species. In the freshwater realm, more than 85 percent of the world's wetlands—critical ecosystems that store floodwaters, purify water, and provide fish and wildlife habitat—have been lost. Freshwater ecosystems absorb 80 percent of urban and industrial wastewater without adequate treatment, and mining runoff, dams and water diversions, hillside erosion, and overfishing combine to threaten freshwater biodiversity as never before. Nepal's river systems are confronting all these threats at once.

The IPBES report also found that nature's declining capacity to regulate environmental processes will undermine progress toward 80 percent of the targets of the Sustainable Development Goals. USAID's Biodiversity Policy acknowledges the importance of biodiversity conservation as an essential component of achieving

sustainable development, highlighting the critical role healthy ecosystems play in providing food security, helping societies adapt to climate change, and reducing the likelihood and impacts of natural disasters. In a country with thousands of kilometers of rivers slicing through dramatic topography, Nepal's watersheds support fishing livelihoods, agriculture, tourism, and energy production, and the country's rivers and wetlands are a critical element of its long-term sustainable development.

USAID/Nepal's PANI program took that to heart, working with an unusually broad spectrum of stakeholders to better understand, value, and make strategic decisions about critical natural resources. In many countries around the world, nature's contributions to human development are ignored or undervalued; while values for domestic



A long exposure view of Karnali River below Shreenagar village in Humla

use and agriculture can be fairly obvious, many of the multiple values of healthy rivers and wetlands are not fully understood or brought into discussions around alternate future scenarios. Freshwater biodiversity, and the threats it faces, is relatively poorly studied in many countries, but without a good base of information to start with, all of our efforts are just guesses and good intentions.

This was one of the major contributions of the Paani program—to advance the knowledge base for those critical discussions, making the case for conservation while recognizing the many other demands placed on limited resources. By addressing head-on the lack of information, through both participatory engagement of local communities and the application of cutting edge science, Paani was able to expand our knowledge of Nepal's critical resources, its fisheries, and the many communities and local economies that depend on them. By setting out to learn from and adaptively manage its own conservation efforts on the ground, the Paani program also gathered important insights into how this nascent aspect of conservation in Nepal can move forward in the future.

Critically, the Paani program reinforced the importance of participatory conservation and locally-led resource governance as a smart and strategic foundation for long term sustainability. Communities, when empowered and supported, are comfortable and enthusiastic partners in managing natural resources, and Paani built on the rich history of community voice and decision making for conservation in Nepal. Working with rural stakeholders to inventory their resources, monitor threats, and raise awareness of freshwater biodiversity ultimately helped the program to evolve alongside the shifting structure of government. In the long run, those communities will be better able to advocate and work with the government and other actors on a variety of long-term development issues. In this way, Paani has laid a foundation for improved resilience, strengthened democratic process, and long term prosperity—impacts that will be felt across the Karnali Basin, a long way from the river's edge.

Photo credit: Nabin Baral for USAID

U.S. STATE DEPARTMENT

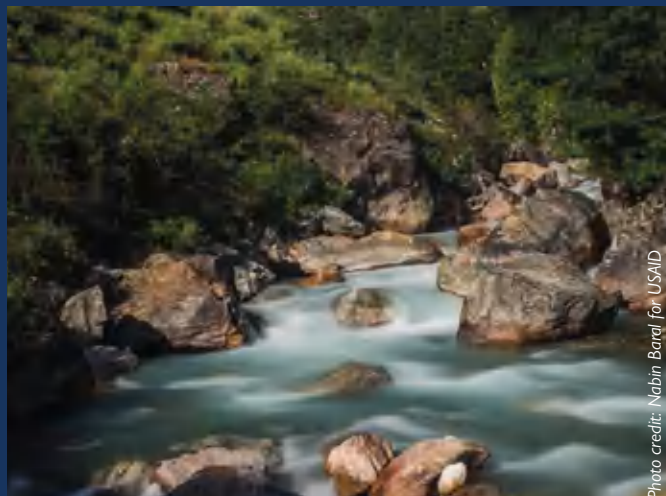
■ **ARI NATHAN**, FORMER REGIONAL ENVIRONMENT OFFICER FOR SOUTH ASIA BASED AT THE U.S. EMBASSY IN KATHMANDU

Having served for four years as State Department regional environment officer for South Asia (2013-17) working out of the US embassy in Kathmandu, two years as the Deputy Director of the Office of Conservation and Water (2017-2019) and two years as regional Indo-Pacific Strategy coordinator for South Asia (2019-present) working out of the US embassy in Colombo, I offer the following personal thoughts related to PAANI:

- Freshwater and related resources, particularly transboundary river resources, is a significant national and regional challenge in South Asia. This challenge, exacerbated by climate change and increasing pressures at all points on the food-water-energy nexus, will almost certainly increase in coming years.
- USAID's Paani Program—which enhances Nepal's ability to manage water resources for multiple uses and users through an integrated, whole-of-basin approach focused on climate change adaptation and the conservation of freshwater biodiversity—is a thoughtful and strategic approach to this challenge. I had the pleasure and privilege of working with USAID, particularly environment officer Bronwyn Llewellyn, during the development of Paani and felt that its flexible approach was one of its greatest strengths because it allowed the program to adapt to this multi-faceted and rapidly-evolving issue.
- Moving forward, I hope that Paani can serve as a model for other work on this complex issue, particularly in the South Asia region.



An old castle like structure carved into the rock along the Karnali River in Surkhet district of Nepal.



A long exposure view of Karnali River.

Photo credit: Nabin Baral for USAID

Photo credit: Nabin Baral for USAID

OTHER USAID-SUPPORTED PROJECTS

■ **ROB TAYLOR**, CHIEF OF PARTY, NEPAL USAID'S NEPAL HYDROPOWER DEVELOPMENT PROJECT AND URJA (ENERGY) PROJECT

INTRODUCTION

USAID's Nepal Hydropower Development Project (NHDP), implemented from July 2015 through August 2020, was tasked to provide wide-ranging support to the Government of Nepal (GoN) as it sought to expand domestic access to clean electricity services and to realize the nation's abundant hydropower potential in export markets. During its five-year term, NHDP provided direct assistance to the following sector institutions:

- Transactional support to the Office of Investment Board of Nepal (OIBN), the Ministry of Energy, Water Resources, and Irrigation (MoEWRI), the Department of Electricity Development (DoED), and to the Nepal Electricity Authority (NEA) as they sought to develop medium and large hydropower projects.
- Policy and Legislative Support to MoEWRI to facilitate sector reform and restructuring of the state-owned utility NEA; increase private sector participation in markets, ensure independent sector regulation; and develop a legal, regulatory, and institutional platform for regional buying and selling of electricity – Cross-border Electricity Trade (CBET).
- Institutional Development for GoN's legacy electricity sector institutions – MoEWRI, DoED, NEA — and for new administrative bodies, including the Electricity Regulatory Commission of Nepal (ERC), which NHDP helped to establish and make operational.

NHDP's support assisted the GoN to:

- Achieve Financial Closure (FC) on two, large Hydropower Projects (HPPs) – Arun-3 and Upper Trishuli-1 which will, upon reaching commercial operations in 2024 to 2025,



Hilsa is a small seasonal town in Nepal- Tibet border where the Mapchakhambab river becomes the Karnali.

Photo credit: Nabin Baral for USAID

From 2016 to 2020, in close collaboration with USAID’s SEED Partners, NHDP forged close and continuous ties with the DAI-implemented Paani component of the broader Program for Aquatic Natural Resources Improvement (PANI), in areas where their respective expertise could be leveraged to mutual advantage for the benefit of Nepal’s economy and environment. USAID encouraged their cooperation on multiple activities because both projects were active on the Karnali River, and ultimately their collaboration helped them to become greater than simply the sum of their parts. From NHDP’s perspective, their joint ventures were welcome because they allowed NHDP to contribute to work that was considered important and that fit into its mandate, but which, as a small project, it lacked the resources to carry out alone.

From the first months of the new project, the NHDP team recognized that effective generation planning needed to be fully integrated with the water resource planning and allocation activities of Nepal’s water resource institutions. For two years, however, there was very little overlap between electricity sector and water resource institutions. In 2018 the two responsible ministries, the Ministry of Energy (MoE) and the Ministry of Water Resources and Irrigation (MoWRI) were merged into the Ministry of Energy, Water Resources and Irrigation (MoEWRI). This provided the first spark of hope that the new body could find new ways of collaborating to rationally plan the allocation of Nepal’s most precious resource — water. Contemporaneously, a door was opened by the new ministry when it asked NHDP to assist with the establishment of Nepal’s Electricity Regulatory Commission; this provided an opportunity to link the authorization (licensing) to survey and construct new hydropower projects with water use planning and water allocation. Unfortunately, the fact that stars were aligned was no guarantee that they would shine on all the good intentions of the Paani and NHDP projects. Vested interests were well entrenched, and best planning practices remained years away. In the follow-on project, Urja Nepal is continuing to pursue integrated resource and resiliency planning at both NEA and MoEWRI.

double Nepal’s generation capacity as of September 2020.

- Establish the ERC, which in June 2020, issued its first consumer tariff order in response to a tariff application filed by NEA.
- Lodge a bill in Parliament for a new Electricity Act which will, upon promulgation:
- Introduce competition for projects and markets.
- Require third party access to state-owned electricity networks.
- Establish an electricity trading company under the regulatory control of ERC.

- Require NEA to develop a least cost generation plan.
- Facilitate the unbundling of NEA distribution functions pursuant to the requirements of Nepal’s new constitution.
- Require central authorities to coordinate the nation’s electricity development with government institutions at the provincial and local levels.

Working with project counterparts in pursuit of these goals, NHDP delivered more than 1,700 hours of training for GoN entities at the national, provincial, and local levels, conducted Knowledge Exchange Programs to Vietnam and the Republic of Georgia, and led two mini-study tours to India. Many of these activities are ongoing under USAID’s Urja (“Energy”) project, which commenced in September 2020 and which is also being delivered by Deloitte Consulting LLP.

1. LEGISLATIVE SUPPORT

In 2015, the Water and Energy Commission Secretariat (WECS), produced a draft National Watershed Resources Policy which underlined the need for (1) comprehensive river basin planning, and (2) the development of an effective legal and regulatory framework to govern all aspects of water use management. The Watershed Resources Policy also clearly identified the need to expand the development

of environmentally, technically, and economically feasible hydropower. Working closely with the Paani program:

- In 2017, NHDP reviewed the GoN's Water Resources Policy to ensure that water use allocations for hydropower projects properly prioritized the needs of agriculture, fisheries, and the use of water by local populations.
- In 2017, NHDP also presented a draft bill for the Nepal Electricity Regulatory Commission Act and conducted capacity building trainings at the Ministry of Energy

which highlighted the need to ensure that the issuance of HPP licenses be pre-conditioned on the applicant's having demonstrated that it had satisfied the planning requirements of WECS, and that the applicant had been granted sufficient water use rights. Unfortunately, the draft bill did not retain this provision and electricity licenses continued to be issued as in the past, by the Department of Electricity Development (Electricity Act 1991). Coordination with WECS on the hierarchy of water use rights was not included in the process.

OVERVIEW OF USAID NHDP AND PAANI COLLABORATION



In 2018, Nepal's new government merged the Ministry of Energy with the Ministry of Water Resources and Irrigation, thereby re-igniting efforts by USAID and other donor partners to push for more effective cross-sector planning. In May 2019, MoEWRI issued a white paper addressing the status of the Ministry's activities as a roadmap for the energy, water resources, and irrigation sector. Section 35 of that document emphasized that, "in order to manage probable disputes among the federal, provincial and local levels during the distribution of available water resources, there is a need to develop required policy and legal structure." This piece addresses this very issue in more detail in Part 3.

2. SECOND NATIONAL RIVER SUMMIT

From March 16 to 19, 2017, Rob Taylor, NHDP Chief of Party, participated in the Second National River Summit, which took place in Kathmandu and in the field, at Fishling-Theuwataar, and Chhebetar in Gorkha, Nepal. The Summit, organized by the Nepal River Conservation Trust (NRCT), the Youth Alliance for Development, Tribhuvan University, and Kathmandu University with support from the Waterkeeper Alliance, Paani and others, comprised of more than 160 participants, including students, investors, experts, rights workers, and researchers. International guests represented India, the United States, Pakistan, Bhutan, and the U.K. From USAID, the summit also had representation

from Paani, NHDP, the U.S. Forest Service (USFS), and the International Water Management Institute (IWMI).

Convening on the banks of the Trishuli River, the Summit issued a declaration highlighting the need for Nepal to develop an integrated watershed management system as well as a comprehensive plan to prioritize Nepal's river resource uses. One of NHDP's major takeaways from the Summit was the need to incorporate high-level training on the subject of water resource management in its continuing training at the MoE and DoED. In response, NHDP included a six-week module of training on the subject, which was conducted by Professor Subodh Sharma, Founding Director of the Aquatic Ecology Centre (AEC) of Kathmandu University.

3. THIRD NATIONAL RIVER SUMMIT

From March 28 to 30, 2019, NHDP led a delegation of hydropower developers who participated in the Third National River Summit, organized by USAID's Paani program in Surkhet and Rakam Karnali, on the banks of the Karnali River, just minutes from the Upper Karnali Hydropower project site. At the request of NHDP, the conference paid special attention to the technical aspects of HPP development. To that end, the USAID Paani program organizers invited multiple high-level Nepali experts to present their views on how best to balance the need

for economic development with the rapid expansion of Nepal's vast hydropower potential. NHDP assisted in the organization and moderation of the half-day program.

4. NHDP AND PAANI PROGRAM JOINT CASE STUDIES ACTIVITY

CASE STUDIES ON DISPUTE SETTLEMENT MECHANISMS IN WATER RESOURCES DISPUTES

Pursuant to Nepal's new constitution, the GoN is required to decentralize its water management activities

and institutions. Drafters and advisors alike considered it essential to include a dispute resolution mechanism to facilitate the resolution of conflicts that will inevitably arise across levels of government, as well as among water users and sectors. As sub-contractor to the Paani program, the Environmental Law Institute (ELI) was asked to provide support the MoEWRI in its development of a water dispute settlement mechanism at all levels of Nepal's new federal structure. Since NHDP worked daily with policy makers in the MoEWRI on policy, strategy, and legislative matters, Paani and NHDP decided jointly to collaborate to shed light on one of the thorniest aspects of water resource management in a federal state—the settlement of disputes. In the pre-drafting stage, a great deal of capacity building was required by the drafters. Paani and NHDP elected to tackle the issue by presenting five case studies comprised of five discrete approaches found in five federal states across the world.

CASE STUDY SELECTION CRITERIA

The five countries selected as case studies (Brazil, Canada, India, Pakistan, and the United States) each provided insights into various aspects of water dispute resolution as experienced in federal government systems. The countries represent varying levels of water stress and water-related infrastructure development, and distinct types of water conflicts. In addition, the five countries apply different levels of decentralization of water governance, which allowed the case studies to highlight the comparative advantages and challenges faced in situations ranging from an extremely high level of decentralized water governance authority (Canada and India) to cases in which federal oversight plays a more active role (United States and Pakistan).

LESSONS LEARNED: LEVELS OF DECENTRALIZATION, SUBSIDIARITY, BUILDING IN ENFORCEMENT, INSTITUTIONAL ATTRIBUTES AND AGREEMENTS

The five case studies identified important lessons learned in the areas of levels of decentralization, subsidiarity, building in enforcement, institutional attributes, and agreements. Details are available in the final report submitted to the Joint Secretary (Legal) at MoEWRI in August and September 2019.



Photo credit: Nabin Baral for USAID

Chief Minister of Karnali Province, the Honorable Mr. Mahendra Bahadur Shahi inaugurating Third National River Summit in Surkhet

URJA NEPAL: USAID'S NEXT STEPS IN ENERGY SECTOR

Photo credit: Nabin Baral for USAID

Aerial view of wild and scenic Karmali River Nabin Baral for USAID

URJA NEPAL'S MANDATE

Over the last five years, the Government of Nepal has made large strides in modernizing its electricity sector—bringing 1,100 MW of new hydropower capacity online, drawing in \$1.7 billion in private sector investment, establishing an independent sector regulator, and building a policy framework conducive to increased access to clean power and economic growth. Over the next five years, Nepal will enter a new stage in the evolution of its power sector. Building upon the achievements of NHDP, the Urja Nepal project—USAID's five-year project of \$18.7 million to advance development goals in the country through investment in the energy sector—will be at the center of this transition in Nepal's power sector; advising stakeholders on the adoption of advanced energy solutions in several key areas:• Assisting NEA and the MoEWRI to develop Integrated Resource and Resiliency Planning, which will be discussed below.

- Assisting NEA and MoEWRI to develop integrated resource and resiliency planning (IRRP).
- Improving NEA's commercial operations and unbundling NEA's distribution function under the mandates of Nepal's new federal constitution.
- Implementing competitive procurement processes.
- Assisting Kathmandu Municipal Corporation in implementing an EV charging infrastructure
- Helping to mainstream energy efficiency initiatives of GoN.
- Balancing dry season deficits by including RE in the energy mix and wet season surpluses by implementing formalized regional trading.

THE KEY: INTEGRATED RESOURCE AND RESILIENCY PLANNING (IRRP)

Municipal energy demands in Nepal are growing rapid, and the new Electricity Act currently before the Parliament may devolve some of NEA's current authority to the provincially based utilities. Developing a strategic energy plan would allow Nepal to better understand the country's potential for indigenous energy supply, optimal usage of regional markets, and how to take advantage of emerging technologies (including battery storage, smart grid, and energy management systems, among others). These would in turn be critical to deliver the most reliable

power at the most affordable price to Nepali consumers. There are four aspects to this: supply side, demand side, transmission, and climate change, including environmental aspects and vulnerability (resilience). On the supply side, Nepal is planning to grow generation capacity by up to 15,000 MW of hydropower. There will also be grid-connected solar, off-grid solar, biomass, wind, mini-grids, battery storage, regional exports and imports, and other new supply sources. On the demand side, there will need to be demand side management, energy efficiency initiatives, and category-wise load forecasts. For transmission, new inter and intra-country connections will be required. Climate impacts are expected to include floods, droughts, and glacial lake outburst floods (GLOFs), all of which could affect hydropower, the environment, and the implementation of resiliency measures.

Historically, Nepal has been in a state of electricity deficit. Therefore, whatever assets could come up “first” were prioritized without much emphasis on least-cost or diversification planning. The future holds promise. Soon, Nepal will be an energy surplus nation. Future planning will have to carefully draw resource optimization plans, especially with various sources accessible, including hydropower (run of river (RoR), partial RoR, reservoir, and pumped storage), solar, biomass cogeneration, imports, and new technologies (BESS/ battery energy storage systems, hydrogen to power etc.).

UNCERTAINTIES AND RISKS PREVAIL

Changing environmental and regional dynamics open the door to multiple uncertainties and risks. Being hydro dependent incurs the risk that any flooding, drought, or GLOF events could derail power production, and any political or regional turmoil could derail imports and exports. All these scenarios and sensitivities (including high growth rate, rise in fuel prices, etc.) will need to be included in the resource planning process. The planning process will also have to incorporate concentration (a majority of risks in one basket), regional risks, environmental risks, and risks associated with extreme growth or fall in demand.

Under Nepal’s traditional planning scenarios, the following entities conducted the following planning activities:

- Water resource planning was carried out by WECS



Chameliya Hydropower Plant (30 MW) at Chameliya River in Mahakali River Basin

Photo credit: Pradipt Gautam for USAID

- Stand-alone planning of generation, transmission, and distribution was carried out by NEA/DoED/Rastriya Prasaran Grid Company Ltd (PRGCL) – the state-owned trading power trading company
- Demand growth projections were conducted by NEA
- Analysis to determine available resources, gaps, and identified when they were needed, was carried out by DoED
- Analysis of resource options, availability and costs, selection, also by DoED
- Implementation of an investment plan to serve the load was carried out by MoE and NEA
- Fixing revenue requirement and the rates to cover it was carried out by EFTC (now ERC) and NEA.

An Integrated Resource and Resiliency Plan identifies and implements a long-term power sector resource plan that will cover the expected electricity demand over time and with the least cost. Load forecast (peak and energy growth) is a key driver of the planning process, as is the need to consider multiple types of resources. On the supply side, that means hydropower, renewables, and distributed generation. On the demand side, that includes energy efficiency measures and demand response measures. Transmission capabilities must also be figured into the plan, as well as financing options. Most plans will take a long-term prospective (10 to 20 years) and be periodically updated. IRRPs will also include the simultaneous consideration of constraints related to the availability of fuel, conduction of operations, environmental impacts, and climate change. Globally speaking, the outputs of the process will comprise of multiple plans, e.g., a resource

expansion plan, a dispatching plan, investment plan, a CO2 emissions plan, and various pricing plans.

RESILIENCY

The above-described planning approaches are commonplace. But today, they are joined by a “least-regrets” plan which, in addition to costs, considers a range of issues associated with the power sector operation and expansion, including resilience, reliability, and socio-environmental issues which will make the various plans more resilient to changing circumstances than a least-cost plan, and, where possible, include the costs of insurance against worst case scenarios. It is called least regrets because today, industries of all kinds are subject rapid and unanticipated change, driven by many drivers and technology agonistic solutions. These drivers interact with each other and with emerging drivers,

creating a business environment that could evolve along different paths. In the face of complexity and uncertainty, the temptation could be to gravitate around the path that seems the most likely—however, this approach is fraught with risks; commitment to a single forecast could serve as a limitation for strategic thinking and significant business risks could be ignored.

CONSTRAINTS

As the “IRRP Process Flow and Entities Involved in Planning in Nepal” chart illustrates, IRRP development faces multiple challenges, including: (1) the need for and the ability of NEA to acquire useful data along many vectors; (2) uncertainty on the issue of which GoN institution should own and drive the planning process; and (3) which combination of software platforms can most effectively deliver the

desired planning outputs, such as generation, transmission, distribution, domestic and regional dispatch. These issues are further complicated by the fact that for hydro, NEA currently uses a one size fits all pricing model (feed-in-tariff) which negates the benefits of merit order dispatch based on price. In sum, the implementation of IRRP in the electricity sector promises to be a long and drawn out process which will require government buy-in at the highest level and the appointment of an oversight body with the ability and vision to stay the long course.

LOOKING FORWARD

The draft of a bill for a Water Resources (Management and Regulation) Act is currently under the management of Secretary (Water Resources and Irrigation) Madhusudan Adhikari. In 2021, MoEWRI concluded a public engagement activity to collect comments from interested stakeholders. The bill remains under deliberation and has not been tabled in Parliament for the upcoming session. This delay may provide an opportunity to include additional provisions and to further integrate water resources planning and IRRP in the electricity sector. Given the lapse of time since the original work was accomplished, additional capacity building training may well be required.

Now is also the time to tie the provisions of MoEWRI's Water Resources Policy more firmly (2020) to IRRP for the electricity sector. MoEWRI's Water Resources Policy (2020) aims to promote economic prosperity and social transformation by conserving and supporting multi-use development for sustainable utilization of water resources in Nepal. The new policy looks beyond traditional least cost electricity generation models by recognizing the competing uses of water and the need for a comprehensive approach to planning. For example, the Policy specifically recognizes the need to promote alternate forms of energy, and that hydropower, irrigation, agriculture, and aquaculture (among others) represent competing interests which will need to be accounted for and addressed in line with legally established priorities. Lastly, the Policy also calls for new strategies to adapt to wet and dry season electricity generation level discrepancies, a principal feature of IRRP. The framework set out in the new policy, including the development of river

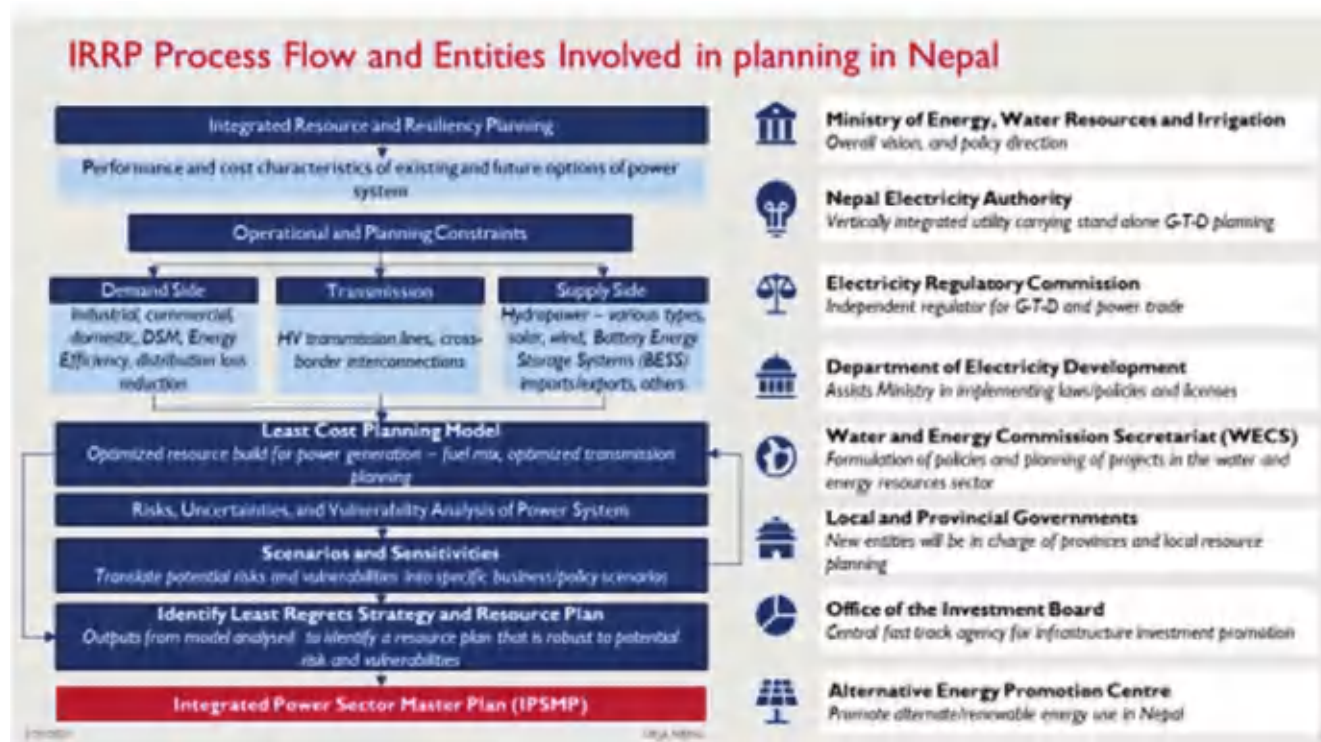


Figure 7 irrp process flow and entities involved in planning in nepal

basin master plans, should be firmly established in legislation.

Though projects naturally draw to a close, the lessons learned during the five years of Paani-NHDP collaboration should live on and continue to influence successor projects. The synergies of previous years should be revived and strengthened by leveraging the good work already accomplished by WWF et. al including: (1) the Report on High Conservation Value Rivers, (2) the Report on Energy Options Assessment, and (3) the Report on System Scale Planning—the last of which brings a high degree of leverage to the work that Urja Nepal is currently pursuing on generation planning.

As a matter of caution, these interventions are government matters and lie beyond the remit of any implementing partners. However, the fact that the Ministries of Water Resources and Irrigation and of Energy have now been fused provides a single administrative body upon which to focus. Assisting the GoN to resolve these two seemingly impenetrable issues (WSR dispute settlements across the federal jurisdictions and linking electricity sector IRRP to water resources planning) would be monumental accomplishments. The wider community of donor partners should also be alerted to the opportunity and convened to consider strategies for engagement.

The challenges which must be overcome in order to drive economic development by providing clean, quality, and sustainable electricity, while also protecting Nepal's natural patrimony and environment are great. But the far greater challenge is to bring drivers of change into the rooms where decisions are made. The time to implement these long-lasting changes is now, while plans, laws, and strategies have not yet been set in stone. The influencers of those drivers of change should, in the tradition of Paani and NHDP, be those with discrete yet complementary skill sets, yet with a common end in view.



THE THREE COMPONENTS OF THE PANI PROGRAM

IWMI/DIGO JAL BIKAS

■ LUNA BHARATI, IWMI

Up to and Beyond Development

The “Digo Jal Bikas (DJB)” project (April 2016 - March 2019) under the USAID-funded PANI program aimed at developing a knowledge base and acquiring evidence to promote sustainable water resources development in Western Nepal. The main purpose was to strive to balance economic growth, social justice, and healthy, resilient ecosystems in the future development of Western Nepal. Water resources development should ideally meet multiple sectorial demands and achieve various societal objectives (‘balanced’), without

exhausting environmental resources (“sustainable”), under a wide range of plausible futures (“resilient”). The definition of what is balanced, sustainable and resilient development will, however, depend on whom you ask. A single blueprint to achieve divergent societal objectives of economic growth, social justice, and maintenance of healthy ecosystems is not always clear. Currently, the shift in focus from productivity-focused growth to the consideration of equity, social justice, environmental health and sustainability has brought development discourses to a crossroads. Furthermore, the current model of development has put an inordinate amount of stress on sustainable livelihoods all over the world through overexploitation and pollution of natural resources. The democratic spaces where the value and benefits of development models could be discussed, negotiated and

contested often excludes the communities affected by these strains.

The DJB project assessed three divergent development strategies and ideologies:

1. State-led development, which incorporates large scale, centrally managed hydropower and irrigation infrastructure through a coordinated approach across sectors;

Camping at the bank of Karnali

2. Locally managed development which would include small-scale, community-managed hydropower and small-scale infrastructure with localized costs and benefits; and
3. Preserving ecosystem integrity with central policies but local enforcement, including conservation, eco-tourism and leveraging natural assets to meet energy and food production.

Our research found that although synergies between sectors such as hydropower and irrigation are possible, trade-offs with other objectives also exist. It will not always be possible to simultaneously achieve the goals of efficiency, profitability, sustainability, and poverty reduction, especially if property rights to the environmental resources are not distributed fairly within current generations, as well as between present and future generations. Therefore, it is very important to carefully consider priorities, the context and to broaden the democratic space for planning and negotiating future development goals and strategies.

■ SANITA DHAUBANJAR, CURRENTLY AT ICIMOD

These views and interpretations are my own and are not necessarily attributable to my current or past affiliated organizations.

I was one of the team members implementing the Digo Jal Bikas (DJB) project at the International Water Management Institute (IWMI). I primarily supported the downscaling of regional climate model projections, hydrological modelling, and hydro-economic modelling for western Nepal. These topics are also the core of my academic qualifications and research experiences as a water resources engineer. Besides DJB, I was also engaged as one of the advisory board members for WWF/Paani Assessment of High Conservation Value Rivers (HCVR) for Nepal. Overall, I am most familiar with the outputs of the IWMI-led DJB and DAI-led Paani projects, with some exposure to the e-DNA work by CMDN supported by the USFS.

Most of the time and resources in the PANI program were spent gathering qualitative and quantitative data to characterize various aspects of water resources management in western Nepal. While there were many notable accomplishments at small scales under the three main projects of the PANI program, the following stand out to me as the accomplishments that will be most useful and relevant beyond these projects:

- The DJB project developed localized climate projections, set up hydrological model for historical and future timeframes, performed a contingency valuation of environmental services, and set up an environmental flow calculator that combines hydrological and ecological needs of a river. These quantitative tools and assessments are directly useable by follow up studies in Karnali, while the methods can be replicated for other basins.
- The rigorous and data intensive HCVR classification efforts under WWF/Paani represents the first study of its kind cataloguing rivers and their various usage by humans and ecosystems through intensive engagement with multi-disciplinary experts. The HCVR classification will undoubtedly be the benchmark for river management and conservation in Nepal.
- The exploration and establishment of native fish biodiversity for the first time in Nepal under the USFS/CDMN project is a much-needed database to guide the conservation of aquatic biodiversity.
- The DAI-led Paani project introduced water resources management into the curriculum in western Nepal. Such intervention to equip the next generation to think about water management and conservation in conjunction with development infrastructure is notable.

While the above points are very concrete outputs, I personally consider it a welcome achievement that the various aspects of the Paani program have mainstreamed the understanding and use of multi-sector resource planning models and multi-criteria assessments into the Nepalese water management sphere. The points mentioned above represent the excellent set of datasets

generated by the project to describe and understand the water management systems in western Nepal. But more needs to be done to build on the knowledge and momentum gained this far. I see the following as key entry points to further push the vision set out by the PANI program:

Disseminate within and beyond the Water-Energy-Food-Environment sectors:

The stakeholders engaged by PANI was largely dominated by people from the water and environment sectors. It is clear from the water and energy modeling efforts undertaken by DJB and WWF/Paani that sectorial expertise needs to be channeled to set up long term resource planning models that adequately capture the ground truths. Both the DJB and WWF/Paani nexus models leveraging multi-objective optimization show with high certainty that many possibilities exist for balanced development. But the best choice for Nepal can only be made through negotiations between sectors and careful consideration of sectorial tradeoffs across the Water-Energy-Food-Environment nexus.

To this end, the results of the hydro-economic modeling by DJB or the system-scale planning by Paani, albeit plagued by assumptions, can initiate discussions on how different sectors are interrelated and what sectorial linkages and negotiations may look like. These models, their outputs and how they may be leveraged in the Nepalese nexus should thus be disseminated across various sectors to inspire and initiate conversations on balancing development and integrated water management. At minimum, the outputs need to be shared with the National Planning Commission (NPC), the Independent Power Producers Association of Nepal (IPPAN), Nepal Electrical Authority (NEA), National Tourism Board (NTB), Ministry of Agriculture (MoA) and provincial bodies in Karnali. Also, sharing the model results with other development agencies working in Nepal might create some positive synergies. Especially with regards to pushing for sustainable hydropower development, it is high time to engage people from beyond water, energy and environment, and include agriculture and tourism to identify balanced development pathways.

Enable national agencies to set up models and use them in decision making:

Long-term planning models for water or power such those developed under Paani would be best developed by a vested government body. Moreover, long-term energy and water resources planning cannot be done by only considering western Nepal in isolation. In addition to using Paani outputs to make sectorial actors aware of synergies and trade-off across sectors, we should push government agencies to institutionalize the use of these planning models. Such modeling is already being done in our neighboring countries of India and Pakistan. Doing so would also provide a quantitative basis for policy makers to not only plan water and power development across provinces within Nepal but also initiate cross-border trade with South Asian countries.

Explore other development alternatives for Karnali:

It is hard to get traction on the model results highlighting that water and energy can be sufficiently managed while leaving Karnali free flowing. This is partly due to the fact that Karnali remains poor and disconnected with limited growth visions for the locals besides those tied to hydropower development. At the end of the day, Karnali also wants the “development” seen in the rest of Nepal. There is strong focus on hydropower being the key to development. Hence, these strong ties between hydropower and development for Karnali need to be broken to educate and empower locals to protect their resources and find ways to develop Karnali with a bottom-up approach. Locals need to recognize and say no to development modalities that may leave them worse off. Thus, funds should

go into exploration of development alternatives for Karnali, identification of ways to scale up promising economic ventures and value chain development to support access and exchange of goods and services between Karnali and other parts of Nepal. One promising avenue is to explore the potential for replication of the successes in the Annapurna landscape. The conservation efforts by the National Trust for Nature Conservation (NTNC) and bottom-up tourism promotion by Mahabir Pun in the Annapurna could potentially be replicated to Karnali as well.

Broaden civil, water resources and electrical engineering curriculum to include water-energy-food-environment nexus:

We need to shift the larger national focus and fascination of large civil infrastructures as the symbol of development. Much of the innovation done under the PANI program uses new methods and concepts to identify future development pathways. To further ingrain these ideas of balanced development that minimizes conflict across the sectors interlinked by the water-energy-food-environment nexus, the next generation of engineers should be made aware of them. The DAI-led Paani program has set a good example of including integrated water resources management in school curriculums and supplementing such changes with internship opportunities to allow students to practice their new

knowledge. Faculty from leading universities in Nepal should be consulted to develop course work on the Nepalese nexus to help broaden the current scope of engineering education. Disrupting the current silos in engineering practice will be best done by starting at the very first step of the engineering education.

EMMA KARKI, CURRENTLY AT CIMMYT

The views and interpretations in this publication are my own and are not necessarily attributable to my current or past affiliated organizations.

I was part of the implementing team for the DJB project with IWMI, Nepal from November 2016-March 2019. I was one of the core team members who was primarily hired to contribute to the local watershed/village governance management as well as provide support to other components. I worked extensively to expand our stakeholder network and increase engagement to encompass relevant sectoral specialists. Further I contributed to policy and institutional analysis, mapping power structures and relations in Nepal's water sector with a key focus on the Karnali region. Towards the end of the project, I was also engaged in the socio-cultural component of the environmental flows assessment. In addition, I was represented DJB during relevant USAID partner meetings and interactions, which led to a very engaging breakfast meeting with the US Ambassador to Nepal.

Some of the key accomplishments based on my experience with the DJB project were:

- **Census Survey in three selected pilot sites and Household Survey in the Karnali-Mahakali basin** – The surveys were highly detailed and provided a robust database for the region.
- **Piloting technological interventions to increase water access to marginal farmers in hills and Terai** – Based on set criteria, three villages in two districts (Doti and Kailali) were selected to pilot low-cost pumps. In the hills, old and defunct communal ponds were restored to increase accessibility for agricultural use. In the Terai, the selected communities received solar pumps to provide low-cost solutions to enhance irrigation access. The interventions were selected after conducting a technical and social feasibility assessment to ensure our interventions do not exacerbate existing inequalities and contribute to enhancing access to smallholder farmers. Targeted communities represented households who had adjoining agricultural land to ensure equitable water access.
- **Stakeholder Power Mapping and Relationships** – From a policy perspective the multi-stakeholder engagement was quite successful in bringing together relevant stakeholders from the local to the national level. We engaged with some key stakeholders to conduct power mapping exercises to further our understanding of the formal and informal power relations that impact decision making within the water sector in Nepal. As a project, I think we were highly successful in engaging with a diverse set of stakeholders from representatives of major political parties to bureaucrats to private sector to civil society organizations. We took the Upper Karnali Hydropower Project as a case study to further analyse the impact of the current development agenda on the local communities and the diverse voices within the impacted communities. Based on our findings, we were able to amplify the voices of the Karnali through a photovoice study as part of IWMI's larger communication campaign.
- **Contribution to the socio-cultural dimensions of EFlows assessment** – The development of the

EFlows calculator for the Karnali basin is another major contribution from DJB and incorporates the ecological, hydrological as well as the socio-cultural needs of a river and its surrounding communities. This is highly useful for the region and can be set up for other major rivers in Nepal.

The outputs and achievements listed above represent some of work done by DJB that I was closely associated with. Overall, we have been successful in setting up database that allows for further work in the region. The sheer volume of information from these surveys contributed to several publications and there is significant amount of information yet to be analysed to enhance our current understanding of the region for future work. The knowledge and experience gained through this project remains invaluable and the engagement with multi-disciplinary and multi-level stakeholders indicates that the region requires careful planning to ensure the shared vision can be achieved for mutual benefit. There needs to be more work to build on the foundation that has been laid for the Karnali region encompassing the voices of the people of Karnali as the country evolves as a federal state.

Some reflections on my experience working in the Karnali and lessons learned are:

Vision for the Karnali:

The visions for the Karnali are diverse, different, and often difficult to comprehend depending on which side of the table you represent. For many, development in the Karnali has been delayed for so long that they find it difficult to articulate their future vision. My experience engaging with the communities surrounding the Karnali dam was a stark reminder of failed promises and delayed development. Communities, depending on whether they are upstream or downstream, present opposing views which have been further polarized based on political party affiliation. Further, the India versus China rhetoric adds another complicated layer to the local people's understanding of what is beneficial to them. The lack of a unified voice was concerning, especially because the lack of elected representatives provided a breeding ground for the dam developer to change the narrative

to their own benefit. What was lacking was a trusted source of information for the people to rely on to make a judgement call on what impact this large dam will have to their short term and long-term vision for their villages.

Competing voices and perspectives:

In addition, there were several voices who disagreed with civil society members residing in Kathmandu. They felt that the ones in Kathmandu were opposing a dam sitting in the comfort of their homes while the people in Dailekh are being denied a chance to experience "development." This sentiment is similar to the private sector representatives from Karnali whose views on development contrast the voices seeking to conserve the pristine Karnali from haphazard development. Further work in this region must bring these competing voices together to work towards a shared vision where relevant stakeholders are able to bring their concerns to the table to achieve sustainable and equitable development.

Multiple constraints to rural development:

Unemployment is a major issue in the Karnali region, and male outmigration--especially to India—is a common phenomenon. The lack of a road network and limited agricultural outputs in the hills and mountains severely hamper agricultural growth. While the pilot interventions provided a technological solution that can enhance irrigation access, the potential to sell the surplus is limited due to a lack of market access. At the same time, many households have limited and fragmented land which makes it difficult to manage.

Multiple burdens on female farmers:

Female farmers are often targeted in an effort to empower them via support in agricultural activities, but in my experience, I find that it often adds another layer of burden to their workload. Female farmers are expected to attend trainings and meetings as part of the project but not all women are able to apply the learnings since many have limited decision-making roles within their households. While conducting a gender training in Doti,

one woman explained if women take on all the tasks predominantly performed by men then what work is left for men to do? While this does not mean that we should not focus on women, it is important to ask what type of skills they are interested in learning. A bottom-up approach is required to target women and their diverse interests and needs to ensure their personal aspirations are factored into future interventions.

Supporting marginal and tenant farmers:

One of the major components of the technological interventions was to target marginal and tenant farmers. However, the dynamics of the community make it difficult to support only a select few without disturbing the existing status quo. Many development organizations have worked in the region, and several interventions have had little to no impact without fully understanding the underlying issues. We as a project also engaged with communities and sought to restore defunct ponds without full knowledge of the decision-making process that led to the construction of the pond in the first place. This is a recurring issue. The lack of information on prior interventions and beneficiaries makes it extremely

difficult to understand lessons learned from previous organizations. While the members of the communities provide their candid experiences, it becomes difficult to get an unbiased perspective. Issues of corruption and favoritism are rampant, and key informants often turn out to be untrusted by the members of the community. While there is no clear solution to this, constant and long-term engagement is required to understand the community before “intervening” to truly ensure the existing inequalities are not exacerbated and past mistakes are not repeated. Our interventions aimed to increase water access to the targeted communities whilst providing training and incentives to engage in vegetable farming for supplemental income. While we officially signed over the solar pumps and communal ponds away to the local authorities at the end of the project, I personally am unaware of the status of the interventions and its long-term impact on the people.

The field level interventions provide an initial understanding of potential technological solutions towards sustainable and equitable access of water across the diverse agro-ecological Karnali region. This work

links to the watershed level objectives within the Paani program to integrate water management and provides a foundation for future work. However, in terms of making a lasting impact on the issue of equity in an area where social and gender inclusion impact access to water sources, a long-term partnership is required where local stakeholders are closely involved. Communities in the Far-West are aware of the “checklist” approach followed by development programs and readily agree to include a token member of a marginalized community to receive support. Community members that rarely share a scarce resource, such as water, are brought together by development programs in hopes of communal use which is highly unsustainable once the project ends. Future development programs must be cognizant of the communal power dynamics at play before introducing a technology that can potentially exacerbate existing inequalities. In my opinion local government and institutions can fill this gap due to their long-term presence in the community. Community members also tend to place trust on institutions that will continue to function even after the project ends.



Morning view at the bank of Karnali in Rakam, Dailekh

U. S. FOREST SERVICE

■ JUSTIN GREEN, NEPAL PROGRAM MANAGER, USFS-INTERNATIONAL PROGRAMS, WASHINGTON DC



Bardiya National Park view from Surkhet

Photo credit: Olaf Zerbock for USAID

Date: April 4, 2021

Disclaimer: *The views expressed in this document are those of the authors. They do not necessarily reflect the views of the United States Agency for International Development or the United States Government.*

In 2014, the US Forest Service (USFS) was asked by the United States Agency for International Development Mission in Nepal (USAID/Nepal) to conduct a country-level watershed resource management (WRM) and freshwater biodiversity (FWB) assessment for Nepal. This assessment

was used to inform the design of a new five-year USAID/Nepal Natural Resources Management project (2015-2019) (Taylor et al., 2014). The original report was followed by a baseline assessment that summarized both terrestrial and freshwater biodiversity, specifically targeting water resource management. This baseline informed the design and objectives for the USAID-funded Project for Aquatic Natural Resources Initiative (PANI) (Bennet et al., 2016). Following these two assessments the USFS continued to work with USAID through PANI on WRM and FWB in Nepal until June 2019.

USFS began providing technical assistance to USAID/Nepal and its implementing partners to support efforts to improve Nepal's freshwater biodiversity and water resources management, through the interagency partnership with USAID/Nepal, Technical Assistance in Water Resource Management and Freshwater Biodiversity in Nepal project. Technical assistance focused on managing healthy watersheds, sustainable use of hydropower, and community engagement at the ground level. Efforts were closely coordinated with the USAID PANI Program and its implementing partner the Defense Agencies Initiative (DAI). This program built on previous USAID/Nepal programs, including the Hariyo Ban, or Green Forests, initiative, which focused on community forestry, climate change mitigation, and natural resource management from a terrestrial perspective.

USFS activities focused on a few specific areas: 1) improving knowledge of aquatic biodiversity by developing new cutting-edge scientific methods based on environmental DNA and next generation DNA sequencing technology; 2) capacity building in the areas of sustainable hydropower; 3) low-volume roads engineering (LVRE) planning, design, maintenance, and management; and 4) watershed resource management.

Environmental DNA

Improving knowledge of aquatic biodiversity was done in collaboration with the Center for Molecular Dynamics, Nepal (CMDN) on their Nepal Fish Biodiversity Project (NFBP). The NFBP specifically focused on fish biodiversity of the Karnali river system. The project aimed to create the first genetic reference database of native fish in the Karnali system. As a pilot study, this project also helped determine the feasibility of using cutting-edge environmental DNA (eDNA) technology to study species distribution and fish ecology in Nepal.

The development of the eDNA tool was carried out in several stages over a two-year period. The specific objectives of the NFBP were ¹:

1 [CMDN, 2017. Nepal Fish Biodiversity Project – Closure Report, Phase I ad II. February 2017](#)

1. To collect a variety of fish species from different sites in the Karnali river basin for morphological identification and DNA extraction.
2. To perform Polymerase Chain Reaction (PCR) for amplification of three mitochondrial genes (COI, 16S and 12S) on each sample, to be used for genetic barcoding fish.
3. To sequence amplified PCR products and perform sequence analysis using bioinformatic tools that allow for identification of all fishes.
4. To compare results of genetic identification with morphologically identified fishes.
5. To collect and extract floating eDNA of various fish species from water at nine sites in the Karnali River.
6. To perform PCR for amplification of eDNA, and to meta-barcode existing fish species with this technology.
7. To perform bioinformatics analysis on retrieved DNA sequences, and to match eDNA results with the earlier created fish sequence library to get the taxonomic identification of fish.

NFBP has created Nepal's first comprehensive baseline genetic database of fish. Data shows that eDNA metabarcoding has proved to be a powerful tool in identifying low abundance and sparsely distributed fish species. NFBP has also created a foundation for a new age of aquatic biodiversity research, generated interest among local researchers and academia, shown widespread application of genetic/molecular technologies for impact assessment studies, and filled a void in the knowledge gap of aquatic biodiversity in Nepal.

Over the next 5-10 years the eDNA tool should continue to be scaled up to provide needed information on water flows, species distribution, and fish ecology in response to hydropower development. This process should continue to be refined and mandated by law to be used in the environmental assessment stages of proposed new hydropower plants, as well as ongoing monitoring throughout the life span of project that are approved and built. This work is already underway through collaborations between CMDN, PANI, IWMI, and other partners.



New road and settlement construction along the Karnali River, Nepal, which increases access and may exacerbate erosion and other threats to freshwater biodiversity.

Photo credit: Olaf Zerback for USAID

Low Volume Roads Training²

In collaboration with the DAI-implemented PANI project, the USFS conducted a series of three Low Volume Roads Engineering Best Management Practices Workshops in Surkhet, Gorkha, and Nepalgunj. These workshops were components of USFS technical assistance to USAID to promote and support climate-smart and sustainable rural road construction practices. These workshops were designed to specifically address three of the nine program emphasis areas of the 2014 Assessment:

- 2 [Excerpts were taken from US Forest Service Workshop Report: Low Volume Roads Engineering: Best Management Practices Workshop, 2018](#)

1. Addressing the impacts of infrastructure development on WRM and FWB (Objective #4 - Taylor et al., 2014)
2. Understanding WRM and FWB by identifying critical knowledge and research gaps (Objective #1 - Taylor et al., 2014)
3. Developing watershed management best practices (Objective #5 - Taylor et al., 2014)

The core concepts of the training were to provide an overview of the key planning, location, design, construction, and maintenance aspects of roads that simultaneously maximize design life of the road, minimize annual maintenance costs, and reduce adverse environmental impacts. Classroom work and field demonstrations were dually important during these

trainings. Field sites included examples of good and bad road work, bridge location, fords, culverts and examples of steep road grades and drainage problems, slope instability, gravel extraction from rivers, and other typical conditions and problems that can be discussed in the field.

Participants were also afforded the opportunity to discuss local infrastructure and explore the reasons low volume road failures are so common. Participants identified primary issues as basic engineering design, end-of-year financial constraints, lack of enforcement mechanisms for construction accountability, un-engineered local road construction, and damages due to heavy rains during the monsoon season. The Surkhet training was conducted at the Mid-Western University to aid in institutionalization of the

information. Participants and training facilitators identified opportunities for intervention as:

1. Educate community members and decision makers on road construction standards
2. Support development of a permit system to introduce accountability in the local process
3. Consider a Sajhedari-Bikaas type model of governance where local user groups can transparently monitor and influence road building decisions through community-based economic growth and income generation, expanded access to development resources, adoption of inclusive management systems, and strengthening local government and civil society relationships

The ability of engineers to provide technical input is eclipsed by the rate of rural road construction under the new decentralized government process. Additional activities in the next 5-10 years should focus on making road engineering a political imperative for change at the national, province, municipal, and community levels. Creating an imperative requires building a data set that shows the rates of failure per rupee spent. Hard data are needed. Karnali could be good case study area. A compliance mechanism could include provincial level funding coming with strings attached that require compliance with DoLIDAR standards, which are based on a history of sustainability and success.

Sustainable Hydropower Series³

In July of 2016, a Nepali delegation visited government- and privately-operated hydropower projects in the Pacific Northwest region of the United States and heard from government, private sector, and tribal authorities on how the United States (and Canada) developed and manages the Columbia River Basin. Participants represented the following organizations and agencies: The Committee on Agriculture and Water Resources, Ministry of Energy, Ministry of Forests and Soil Conservation, Water and Energy Commission, Ministry of Finance, Independent Power Producers Association (IPPAN), and the National Rivers Conservation Trust. Participants heard how the United States' initial failure to take environmental and cultural resources into account resulted in billions of dollars of work to retrofit or decommission dams. Speakers highlighted institutionalized structures, such as the Columbia River Basin Federal Caucus, that allow for interagency collaboration and provide a venue for local communities to have a say in how water resources are managed. USFS representatives shared data on Nepal's biodiversity, industry best practices, and helped in organizing field activities for the delegation. The Nepali delegation reflected on the need for Nepal to take a holistic look at river basin management and establish coordination and communication tools that weigh the various economic, environmental, and social considerations. One participant

³ Excerpts were taken from US Forest Service summary reports and workshop documentation.

Paani facilitates a panel discussion on the government of Nepal's role in establishing and monitoring environmental flows (e-flows) in Nepal during a training on "Hydropower and Environmental Flows" organized by the International Financial Corporation (IFC) and International Centre for Hydropower - Norway in collaboration with Paani on Oct. 23, 2019 in Kathmandu.



Photo credit: Sarah Gray for USAID Paani Program

commented that Nepal has a chance now “to do what is right” and should be “courageous... to make the best decisions possible,” adding that “twenty years from now will be too late.”

Upon returning to Nepal, IPPAN President Bisht, in collaboration with WECS Secretary Tamang, attempted to organize a follow-up gathering but the changes in government during August 2016 curtailed this effort. Moving forward, representatives from IPPAN and WECS should plan to convene and discuss changes, successes, and challenges to sustainable hydropower in the region. Continual discussion of this topic is integral to re-building momentum and ensuring Nepal has the tools and expertise needed to move forward.

Watershed Management Seminar⁴

The Technical and Social Aspects of Watershed Management Workshop was conducted from February 25–28, 2018 at the Hotel Annapurna in Kathmandu, Nepal. This seminar focused on three key themes: integrated planning and assessment for watershed health, community participation and conflict resolution, and economic value of water. These seminars provided participants with an overview of watershed management, direct experience in applying concepts and methods in the field, opportunities for personal and professional development, and exposure to professionals from all over the world. There were eight Nepali participants in the Watershed Management Seminar from USAID, the Government of Nepal, and NGOs in 2016 and 2017, and three participants attended in 2018. The Nepal Workshop on the Technical and Social Aspects of Watershed Management, co-organized and designed by the USAID-funded Nepal Paani Program, USFS, and WMG aimed to build on the momentum and network created by these participants to simulate a similar Watershed Management Seminar for Nepali participants, focused on Nepali issues, held in Nepal. The target audience for this training was a diverse group of USAID-funded program managers, local governments, NGOs, and students.

4 Excerpts were taken from US Forest Service Workshop Report: Technical and Social Aspects of Watershed Management Workshop



School of Mahseer fish in Babai River

The core objectives of the training were to:

1. Build a common understanding of watershed definitions and benefits of watershed health
2. Strategize on how to assess watershed health and delineate watershed boundaries in Nepal
3. Introduce helpful tools to consider in watershed management in Nepal
4. Explore best practices in the multi stakeholder approach to watershed management in Nepal
5. Evaluate resources needs and stakeholder engagement necessary to identify and implement local watershed management ideas and solutions in Nepal

This training was a pilot for duplicating components of the USFS international seminar program to IP countries and tailoring them to the needs of USFS partners. The training also successfully showed that ISWM alumni can be utilized for giving valuable input in organizing in-country trainings. Due to the successful nature of this pilot program, the seminar series should continue in the years to come, supplemented by continual communication and knowledge sharing between seminar alumni.

*NFBP Internship Program*⁵

As part of the human resource component of the NFBP project, an internship program was set up to insure capacity building opportunities for young and talented students. Students from Tribhuvan University and Kathmandu University were a core part of the field and lab team. The interns were trained in fish biology, field methodology for fish samples collection, field preservation methods, field safety, sample processing, DNA extraction and other lab work. CMDN hired 2 interns after the completion of their internship as part of their young scientific staff.

When asked for their reason for participation in the program, participants answered that the kind of practical research was of particular interest. Students expressed that new knowledge is very useful in pursuing a professional career and creates more job opportunities. One of the interns, who was later hired by CMDN, emphasized the practical experience and increased level of responsibility, which allowed her to acquire the position of team leader with her new employer. Once at CMDN, the former student passed on the knowledge gained through the internship to their new team, as part of their new supervisory position. Another participant stated that he shared the knowledge with fellow students at Kathmandu University through classroom presentations. All interns interviewed stated that they shared their experience and new knowledge with other students or colleagues upon completion of the program.

This type of internship program shows great potential for the next 5-10 years and has demonstrated success in providing greater employment opportunities for youth in the

5 CMDN, 2017. Nepal Fish Biodiversity Project – Closure Report, Phase I and II. February 2017



As part of Paani's groundbreaking e-DNA study, citizen scientists (public citizens who collaborate in scientific data collection and monitoring) helped collect and test samples

region. A continuation of this program or implementation of similarly structured programs is recommended.

■ NICOLAI STOEHR, IN-COUNTRY PROGRAM MANAGER, NEPAL

I have been told that the idea of the Nepal Fish Biodiversity Project started during a late afternoon conversation over three years ago between Dibesh Karmacharya, Director of the Center of Molecular Dynamics Nepal and Gordie Reeves, a USFS freshwater ecologist at the USFS Rocky Mountain Research Station. Gordie was part of a USFS team conducting a Natural Resource Baseline Assessment, which was needed to design a larger USAID water resource management program. This program ended up being called PANI.

I was not in Nepal yet, but rumor has it that this late afternoon conversation turned into an all-nighter with Dibesh and Gordie talking shop about using new methods in science to find out about the hidden treasures of aquatic life in Nepal's rivers, lakes and wetlands. The idea of the eDNA pilot study was born and with it the USFS and USAID partnership on aquatic biodiversity conservation with the Center for Molecular Dynamics Nepal (CMDN) based in Kathmandu.

The eDNA technology lets Nepal identify which fish species are present at a specific site by analyzing the DNA traces in water samples. Analyzing a scoop of water can replace weeks of labor-intensive sampling work. That means the tool is a quick and accurate input for environment impact assessment and other research. The eDNA project is also a great example of partnership leading to practical scientific progress with real-world applications



Participants learn how to build bamboo crib walls on road side slopes to increase soil stability and combat landslides in a bio-engineering training organized by Paani

in the planning for hydropower development and other infrastructure across Nepal. The very cool and cutting-edge technology also became the first use of eDNA analysis of its kind in South Asia.

The partnership between USFS and CMDN was part of the Forest Service's wider activities in sustainable water resource management in Nepal.

As an interagency partner of USAID Nepal, the U.S. Forest Service – or USFS - had already provided technical assistance for several years to USAID's environmental programs. USFS activities have covered a large variety of topics. Besides working in biodiversity conservation, USFS has been active in the fields of water resource management, sustainable hydropower and ecotourism.

Utilizing USFS expertise and its network with other government agencies, NGOs, and research facilities – we were able to train Nepalis from government, civil society, and academia on rural roads engineering, ecotourism, and watershed management.

As part of PANI, the Low Volume Roads Engineering training workshops first focused on government engineers learning green engineering techniques to reduce erosion caused by secondary road construction and therefore lessen the sedimentation of rivers thereby protecting these valuable habitats. Soon we learned to include young students of civil engineering and environmental engineering in these trainings to help create a new generation of engineers that have the environmental impacts of infrastructure projects in mind from the beginning. A highlight was the partnership with PACT and the USAID-funded Sajhedari Bikaas project that provided support for local level governance including Nepal's recovery after the devastating 2015 earthquakes. Sajhedari Bikaas did great work helping communities to organize small-scale infrastructure projects, but lacked road engineering expertise. USFS did not only provide training for Sajhidari Bikaas engineers but supported the implementation of one of their road projects in the Gorkha region.

Other Nepali participants have traveled to the United States for USFS International Seminar programs on Protected Area Management, Forest Landscape Restoration, Mining,

Ecotourism, and Watershed Management. But sending participants half around the world for a three-week seminar is costly and can only support a few selected participants. So we invited some of the seminar instructors from the USFS International Seminar on Watershed Management (IWRM) to Nepal and give a crash course in community-based water resource management to the staff of several USAID agriculture and environment programs. Fortunately, we could draw on the expertise of IWRM alumni to contribute to the workshop.

As part of our PANI contribution we also sent a high-level Nepali delegation on a Sustainable Hydropower Study & Learning Tour to the Columbia River Basin in the Pacific Northwest of the United States. The participants quickly learned that the trip was not only about showing best management practices, modern hydropower facilities, or effective natural resource management policy. The study tour was also about showing the mistakes made in decades of unsustainable use of water resources and the costs of fixing the resulting damage to the social, environmental, and economic systems of the Pacific Northwest. Bringing the salmon back to that river system cost \$3.5 billion.

Learning from these mistakes in hydropower development, while also having a potent tool available to assess and monitor aquatic biodiversity, will help to build up Nepal's energy supply through hydropower in an environmental-friendly and sustainable way, protecting its unique freshwater species and protecting the livelihoods that depend on them.

After having left Nepal, I continued to follow the achievements of PANI and CMDN's Nepal Fish Biodiversity Project. I was glad to see how the eDNA pilot study had moved to the next stage as a fundamental part in two new partnerships with the IFC and with the DAI-implemented Paani program. I noticed that this group of people that I was fortunate to meet during my years in Nepal, continue to use their ingenuity, passion and their firm belief in their own abilities to help Nepal on its way to prosperity including saving it's magnificent renewable natural resources for future generations.

■ **MARK WEINHOLD, NATIONAL
STREAM AND AQUATIC ECOLOGY
CENTER, USDA FOREST SERVICE**

Connection to USAID/Nepal PANI Program:

- Co-author of the 2014 Assessment of Water Resource Management & Freshwater Biodiversity in Nepal
- Co-author of the 2015 Natural Resource Baseline Assessment - Nepal
- Author of the 2017 Needs Assessment for Road-related Training following the 2015 earthquake
- Instructor for 2017-2018 low volume roads trainings in Surkhet (April 2017), Gorkha (September 2017) and Nepalgunj (January 2018)
- Panelist for NENCID's Commission on Irrigation and Drainage conference—Irrigation in Support of a Green Revolution in Kathmandu (May 2018)
- Consulting engineer/hydrologist to design and implement demonstration projects to highlight “green road” standards on existing failed roads in Aathabis Municipality (April 2019).

Key Results

In general, the most important results of my contributions to the PANI program stemmed from the program direction created by the 2014 Assessment of Water Resource Management and Freshwater Biodiversity in Nepal. The nine themes presented in this assessment set the course for the program with a particular focus on freshwater biodiversity and the threats posed by accelerated hydropower and road development. The follow up Natural Resource Baseline Assessment in 2015 took a more detailed view of the risks to aquatic biodiversity which led to a program to quantify distribution of species in the Karnali Basin through genetic sampling and e-DNA. Both of these assessments are a key part of the program's e-summary, and don't need further explanation here, except to say that they both established a focus on the unchecked development of local roads across the country, where engineering input was essentially

absent and failure after a single monsoon season was the norm.

Consequently, a key result was the PANI focus on encouraging “green road” design and construction techniques for these low volume roads that were being built to connect villages to the District center. A needs assessment for roads-related training was conducted in 2017 to establish a direction going forward. Key issues identified through conversations with Nepali road managers included the following:

1. Much of the road construction occurring at the village level is happening without engineering support from the District Technical Office or DoLIDAR. Village Development Councils (VDCs) receive funding from the Central Government and use that to finance the construction of roads they feel are needed. Typically, no formal design is completed, and the road is built by an equipment operator, often with no provisions for drainage or steep slopes. As a result, many of these roads become impassable after the first monsoon season. One estimate suggested that 75 percent of newly constructed roads were impassable after a year (Shuva Sharma, Scott Wilson Nepal engineering, personal communication).
2. Road segments chosen for construction by Village Development Councils (VDC) are selected in response to political priorities, rather than based on estimated traffic volume or technical feasibility.
3. Often there is no integrated planning for construction of roads at the village level. In some cases, parallel roads have been constructed to the same destination.
4. Many roads are constructed without a plan or funding for long-term maintenance. Consequently, many become impassable either seasonally or permanently due to monsoon rains and subsequent landslides, and funds are often unavailable to repair them.
5. DoLIDAR estimates that up to 75 percent of village roads are constructed without adequate surface rock, and are thus become impassable during the monsoon season due to soft, saturated soils.
6. Even on engineered roads, paying for appropriate surface water management is a lower priority than funding



Example of local road construction and impacts to aquatic systems

Photo credit: Mark Weinhold

additional miles of new road, even though poor drainage is the cause of most road failures.

7. Revegetation and bioengineering are often not included in the road construction contract or cost estimate, so chronic erosion is common.
8. Quality control during construction is not emphasized, partly due to minimal experience of field engineers overseeing the project.

Impacts

A week-long training on low volume road best practices was developed by the U.S. Forest Service to target engineers charged with expanding the rural road network throughout Nepal's countryside. To date, three trainings have been conducted in PANI's priority watersheds in western Nepal: Surkhet in April 2017, Gorkha in September 2018, and Nepalgunj in January 2018. These trainings resulted in two demonstration projects in local communities to highlight appropriate road construction techniques; the first was in partnership with USAID's Sajhedari Bikaas project near Gorkha, the second was in Aathabis Municipality. My interactions with participants suggest that the trainings had a positive effect on how road design and construction would be approached in the future, at least by the small number of people we reached.

Lessons Learned/Challenges Encountered

The first week-long roads training targeted government engineers, many of whom were managers as opposed to designers. While the training was well-received and successful at refreshing participants in critical road design concepts, it missed the target audience of people actually doing design work on a day-to-day basis. Subsequent trainings targeted younger engineers, often in private practice or working for NGOs, who could immediately practice concepts from the training.

The contents of the training are very applicable to the situation in Nepal, but the training contents need to be translated and delivered in Nepali language to have broader reach. This is especially true since the messaging around roads needs to

extend to equipment operators and villagers alike. Given the proliferation of new rural road construction in Nepal, future trainings were suggested at four levels:

- Engineers and sub-engineers – Prepare a multi-day training, similar to the one conducted in Surkhet, which addresses key engineering aspects of road design, maintenance and Best Management Practices (BMPs). The sub-engineers have less formal education than engineers and will likely have difficulty with a training delivered in English. Moving forward, we should consider training a handful of Nepali engineers to deliver this training (train the trainer), since language is ultimately a limiting factor.
- Skilled village workers and road builders – A key element to a successful training is to find a road segment to build/upgrade that showcases common BMPs for road construction and maintenance. Focusing the training on an actual intervention allows the opportunity to train skilled workers and contractors on how to apply common BMPs to address drainage and slope stability issues that affect road usability and longevity.
- Community members and decision makers – Prepare a short, easily understood presentation that highlight issues with roads so that local decision makers know what to require of DoLIDAR and/or road construction contractors. Villagers want roads near their houses but do not understand the impacts and the long-term maintenance commitments. Communities are spending precious financial resources to build roads that quickly become impassable, create significant erosion and impacts to water resources, and require expensive maintenance or reconstruction.
 - o This presentation should also include a clear and direct display of the causal link between sedimentation from roads and the detrimental effects to aquatic biodiversity. This should stress effects to livelihoods and food supply as fish and other aquatic animals are affected by sedimentation and habitat fragmentation. It was also suggested that community awareness campaigns be tied to local festivals to take advantage of large, ready-made audiences.

- University courses – The curriculum at Nepali universities would benefit from courses focusing on low volume road design and construction. Current curricula are geared toward highway design, so students have little or no practical knowledge to apply to the majority of road construction that is occurring in the country. The key academic institutions of Kathmandu University and Tribhuvan University should be brought into this discussion. Our team members of Dr. Nawa Raj Katiwada (Kathmandu University) and Dr. Tara Nidhi Bhattarai (Tribhuvan University) are a logical place to start. The green engineering curriculum being developed at Mid-Western University can be a starting point since it has some emphasis on low volume roads.

Important Tasks Remaining

The issues related to road proliferation, with associated detrimental effects to water quality, land use and aquatic biodiversity, are most directly addressed through education. The lure of a new road, where none has existed before, is an understandable attraction for local communities. But roads have physical and financial trade-offs that need to be understood by these same communities. This is particularly true given the number of roads that are impassable after one monsoon season—poor people are spending precious resources on a transportation dream that will not materialize under the current scenario.

To move the conversation forward, the strongest voices in the government need to be aware of the issue and amplify the message of sustainable and economic road design and construction. This means taking the 100-year view of what is needed versus what is currently happening in rural areas across the hills of Nepal. As mentioned previously, some reports suggest that only 25 percent of newly constructed local roads are passable after a year. This number needs to be validated in different areas around the country and used as a rallying cry to significantly change the practices around funding and building local roads. In the outbrief to USAID after the last roads training in 2019, I mentioned creating a “political imperative” for change with suggested messaging for the public. The summary slide deck from this outbrief is included in Volume II B of the PANI e-book.

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CMDN/CENTER FOR MOLECULAR DYNAMICS NEPAL

■ **DIBESH KARMACHARYA, FOUNDER AND EXECUTIVE DIRECTOR**

Assessing Aquatic Biodiversity Using eDNA Technology:

Fresh water fish identification and profiling in the Karnali river basin

The aquatic biodiversity of Nepal is quite large. Approximately 186 indigenous and 11 exogenous fish species inhabit various aquatic ecosystems including freshwater rivers, streams, and high-altitude lakes and ponds. The 186 indigenous fish species occupy aquatic systems from the Terai lowlands to the Himalayas, and approximately 59 of these species are categorized as cold-water fish (Petr and Swar et al. 2002). These fish species all have higher social, economic, and environmental value, and are significant for sport and research purposes.

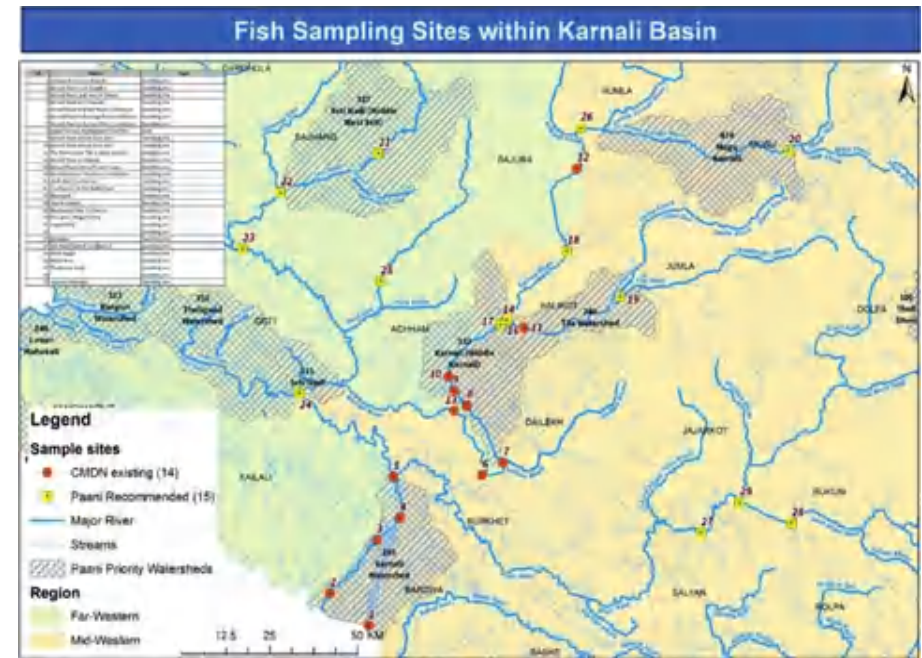


Photo credit: Dinesh Karnacharya, CMDN

Snowmelt-fed rivers are the main reservoir of cold-water fish in Nepal; mahseer/sahar (*Tor spp.*), katle (*Barbodes hexagonolepis*) and snow trout (*Schizothoracichthys spp.* and *Schizothorax spp.*) are examples of significant cold-water species. These cold-water fish are a major source of protein and income for local communities (approx. 400,000 people) who depend on fishing and are also frequently utilized as sport fish. Rainbow trout (*Oncorhynchus mykiss*) and Brown trout (*Salmo trutta*) are considered non-native, but are increasingly used for protein, food, and sport fishing (Petr and Swar et al. 2002). Ecological systems studies on species habitat preference and distribution leads to appropriate ecological management and is a necessary step for biodiversity conservation.

Generally, regular visual target detection and counting of designated flora and fauna is considered the proper course of effective ecological management (Rees et al. 2014). However, specific knowledge on the ecological, genetic, and evolutionary aspects of native fish inhabiting various Nepali aquatic systems

is relatively limited compared to wildlife in terrestrial ecosystems. Thus, it is urgent to characterize the ecology and genetics of native fish in Nepal.



Inland water resources in Nepal harbor approximately 745,000 ha of water in aquatic systems, mainly in about 6,000 rivers, streams, wetlands, ponds and lakes (Sharma and Shrestha et al. 2001). The three major rivers of Nepal are Koshi (east), Gandaki (centre) and Karnali (west), all of which flow from the Himalayas (north) to the Ganges basin (south). The Karnali river is a perennial trans-boundary river originating on the Tibetan Plateau near Lake Mansarovar. With a length of 507 km (315 miles), it is the longest river in Nepal. Aquatic biodiversity, especially fish, have not been well studied in the Karnali.

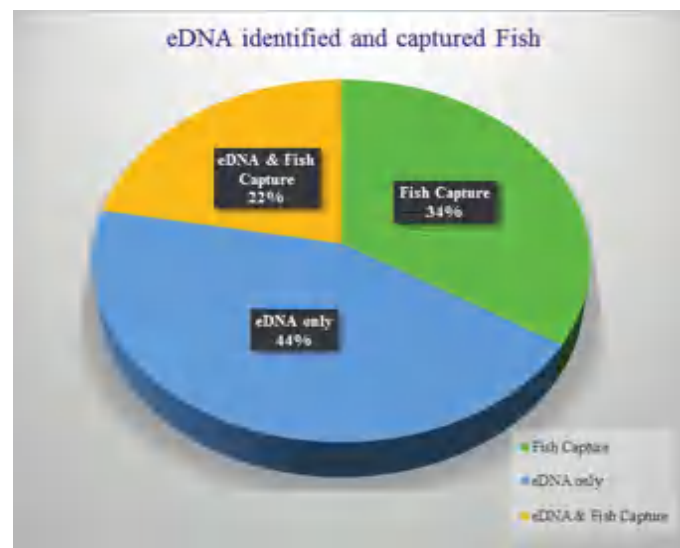
The aquatic biodiversity study done through the U.S. Forest Service component of the Nepal Fish Biodiversity Project and PANI program aimed to determine the feasibility of using eDNA technology to understand the ecology and distribution of native fish biodiversity in the Karnali river basins in western Nepal. This study focused on creating the first genetic reference database of Nepali native fish using fish DNA barcoding and eDNA meta-barcoding technology. The Center for Molecular Dynamics Nepal (CMDN) implemented this study in partnership with the Nepal Agriculture Research Council (NARC).



Environmental DNA refers to the free-floating DNA from various aquatic organisms (flora and fauna) present in an aquatic environment. This DNA mostly comes from excreted cells/tissues, urine, hair, skin, or dead individuals. eDNA meta-barcoding is a rapid method of biodiversity assessment that combines two technologies: DNA based identification and high-throughput DNA sequencing (Taberlet et. al 2012).

This study was able to provide information on:

- 1) Genetic makeup of native fish populations;
- 2) Describe abundance of native species;
- 3) Identify which species are at risk;
- 4) Identify new, uncharacterized species; and
- 5) Classify exogenous species invading the aquatic systems.



We detected 50 different freshwater fish species in samples collected in two seasons and created a voucher specimen collection for future references. All of the genetic information has been deposited in a global DNA database (National Center

SN	Species	Designation
1	<i>Barilius sp. CBM ZF 11313</i>	eDNA & Fish Capture
2	<i>Tor putitora</i>	eDNA & Fish Capture
3	<i>Labeo boggut</i>	eDNA & Fish Capture
4	<i>Pseudecheneis sulcata</i>	eDNA & Fish Capture
5	<i>Acanthocobitis botia</i>	eDNA & Fish Capture
6	<i>Neolissochilus hexagonolepis</i>	eDNA & Fish Capture
7	<i>Glyptothorax trilineatus</i>	eDNA & Fish Capture
8	<i>Botia lohachata</i>	eDNA & Fish Capture
9	<i>Schizothorax sp.</i>	eDNA & Fish Capture
10	<i>Barilius bendelisis</i>	eDNA & Fish Capture
11	<i>Garra sp. CBM ZF 11369</i>	eDNA & Fish Capture
12	<i>Pethia conchonus</i>	eDNA only
13	<i>Schistura corica</i>	eDNA only
14	<i>Channa punctata</i>	eDNA only
15	<i>Puntius jerdoni</i>	eDNA only
16	<i>Triplophysa dorsalis</i>	eDNA only
17	<i>Hypophthalmichthys nobilis</i>	eDNA only
18	<i>Schistura rupecula</i>	eDNA only
19	<i>Triplophysa sp. 3 YW-2016</i>	eDNA only
20	<i>Glyptothorax cavia</i>	eDNA only
21	<i>Cyprinus carpio</i>	eDNA only
22	<i>Puntius sophore</i>	eDNA only
23	<i>Triplophysa tibetana</i>	eDNA only
24	<i>Puntigrus tetrazona</i>	eDNA only
25	<i>Carassius auratus</i>	eDNA only
26	<i>Pterophyllum scalare</i>	eDNA only
27	<i>Cirrhinus cirrhosus</i>	eDNA only
28	<i>Channa striata</i>	eDNA only
29	<i>Carassius auratus x Cyprinus car</i>	eDNA only
30	<i>Puntius sophore</i>	eDNA only
31	<i>Carassius gibelio</i>	eDNA only
32	<i>Clarias gariepinus</i>	eDNA only
33	<i>Schistura sp. CBM:ZF:15598</i>	eDNA only
34	<i>Barilius barna</i>	Fish Capture Only
35	<i>Barilius vagra</i>	Fish Capture Only
36	<i>Channa gachua</i>	Fish Capture Only
37	<i>Crassocheilus latius</i>	Fish Capture Only
38	<i>Garra cf. annandalei CTOL3904</i>	Fish Capture Only
39	<i>Garra sp. 1 SK-2014</i>	Fish Capture Only
40	<i>Glyptothorax pectinopterus</i>	Fish Capture Only
41	<i>Glyptothorax gracilis</i>	Fish Capture Only
42	<i>Labeo bata</i>	Fish Capture Only
43	<i>Mastacembelus armatus</i>	Fish Capture Only
44	<i>Opsarius cf. shacra CTOL02808</i>	Fish Capture Only
45	<i>Puntius chelynooides</i>	Fish Capture Only
46	<i>Aspidoparia morar</i>	Fish Capture Only
47	<i>Schistura savona</i>	Fish Capture Only
48	<i>Schizothorax plagiostomus</i>	Fish Capture Only
49	<i>Schizothorax pragastus</i>	Fish Capture Only
50	<i>Schizothorax richardsonii</i>	Fish Capture Only

for Biotechnology Information, NCBI). The study also helped train local university students and government officials in field sample collection and fish identification.



Photo credit: Dibesh Karmacharya, CMDN

We also created an online interactive Fish database which can be accessed publicly by visiting- http://god.edufinity.net/pages/fish_map

Additional information is available in the Final Report of the Nepal Fish Biodiversity Project and on the project website at www.fish.org.np.

Looking forward

Much remains to be done to understand aquatic biodiversity in Nepal. With the project supported by PANI, we now have the required effective tool to conduct biodiversity surveys using highly accurate and relatively easy eDNA technology. This technology has already been used as part of the environmental assessment of one of the largest hydro-power development



projects in Nepal (Upper Trisuli). International Finance Corporation (IFC), a part of the World Bank group, further invested in polishing this technology with the Center for Molecular Dynamics Nepal-

(https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/fish+tech+could+improve+hydro+sustainability+in+nepal).

There is now a growing interest in utilizing this technology in broader fish research. And we are partnering with some international groups like the International Joint Partnership for Mahseer Conservation (IJPNC) and the Mahseer Trust to further use this technology to map our fish biodiversity in various river systems of the region and the globe.



DAI/PAANI

DAI

■ ALLEN TURNER, CHIEF OF PARTY, PAANI (APRIL 2016-OCTOBER 2018)
AND PAANI SENIOR TECHNICAL ADVISOR

Reflections at Paani's end June 2021

Returning to Nepal after a twenty-year absence, the Paani project gave me a second entry into the turbulent stream of change flowing throughout Nepal. How extraordinarily fortunate to have encountered this five-year opening—a moment between earthquake and pandemic—with peace restored, a new constitution, on the threshold of new local leadership.

Pateshwori Chaudhary, Chairperson of Baikha CAACG, leads members of the Baikha fishing group to patrol against destructive fishing practices in the Rapti River

Photo credit: Sudin Bajracharya for USAID

In this political opening of power and its call for good governance, Paani sought long-term well-being through balancing wealth and nature: to improve the quality of lives within the capacity of Nepal's river systems to support that life. Paani sought to make space for people to create shared vision and to exchange ideas on how to "use" nature without using it up.

On a new endeavor—few efforts before Paani had looked at rivers as living systems—and in a brief five years, the most one can do, whether as architect or as gardener, is to set a few foundation stones or plant a few seeds. Having earlier taken lessons from Nepal to other lands, I had learned something of the value and adaptability of multi-stakeholder approaches, but also of limitations: What, really, does a wandering stranger bring? With so many ways to see, what merit in yet another stranger's perspective? Having left Nepal comfortably in 1995 before the violence grew, how to understand this context anew? Charged with putting grand ideas bankrolled by a foreign nation into action, how does one begin?

Decades ago, while walking the hills by the West Rapti, the Babai, and the Sano Bheri rivers, I often met people truly at home in their dwelling place. Whether schooled or illiterate, in the mountains or on the plain, along the trail or around the hearth, their confidence and generosity was striking. Their open-hearted spirit made me feel at once both little brother and sacred guest. In my wanderings, in Nepal and beyond, I had learned that the most applicable lessons arise from such people—"the people of the place." How fortunate I was to have had teachers and guides that unconditionally respected people, no matter their status or background or education. How fortunate, too, on Paani, to have had teammates and partners who delighted in dialog with local people, the sharing of wisdoms and aspirations. How helpful, the mix of perspectives in understanding what and how know-how and lessons "fit" for which people and places.

Paani's contributions to holistic management and conservation of river systems, and whatever seeds or foundations it encouraged, depended on people coming together and working together: the many levels and agencies of government; the knowledge and skills of ecologists and engineers; NGOs and CBOs and federations; communities

and families. My simple desire was to include in these collaborations women and youth and elders and children who are at home by those waters and who, day-by-day, live from those waters, with understanding building on their day-to-day experience and distilled from that of countless grandmothers and grandfathers.

I did not appreciate until well after my first stay in Nepal more than 25 years ago, how extraordinary that time's opening was. As Nepal reshaped its forest policy, how fortunate it was that some of those in power had been willing and, in small but significant ways, able to relinquish power to enable a new policy—through a simple process for handover of forest areas to communities—to come to life.

Part of the challenge has been helping the people see how their lives are integrated with the river system, to clearly see and speak their vested interests—the stakes they hold. Yet, with the diversity of interests in Nepal (where the vested interests of some are not the interests of others) how do we come together? How do we build relationships and develop trust? Here, a significant part of the challenge has been to encourage those with power to see the value of sharing that power. For that, my whole-hearted thanks for all those who—whether from within or without powerful institutions—have helped create openings amidst oft-hidden decision-making to connect varied human imaginations—Nepal's greatest resource. Paani's work with local communities began the creation of shared vision and ideas for collectively using well and wisely Nepal's riverine resources. I am especially grateful that our partnership with the Water and Energy Commission Secretariat (WECS) gave us openings at the national level.

A greater challenge now—of encouraging and growing this nascent multi-level stakeholder engagement, of learning to "use" without "using up"—falls to powerful line agencies. Bringing to life these values inherent in Nepal's constitution requires their acknowledging voices from within the river basins. It may require reversing earlier closed-door decisions. It will certainly require their relinquishing some measure of power. And, as with Nepal's forests in the 1990s, it will certainly benefit from continued awakening of the international community to a responsibility to work together.

■ JONATHAN RANDALL SENIOR GLOBAL PRACTICE MANAGER; NATURAL RESOURCE MANAGEMENT, BIODIVERSITY AND CLIMATE CHANGE

Reflections on Paani Key Results, Lessons Learned, Next Steps

I am very proud to say that I have been involved with the Nepal Paani project since its inception in 2015; first as the technical lead of DAI's proposal to USAID, and then as a senior technical advisor during program implementation. In many ways, I feel like a proud parent that has the chance to contribute to the program's success and growth over the years and have gleaned a number of lessons learned and reflections over that time. A few of the many key lessons and next steps are highlighted below.

Paani's team. Nepal's many stakeholders who depend on freshwater resources for their livelihoods, as well as the Government of Nepal, USAID, and DAI, are so fortunate to have had a wonderful group of people devoted to the Paani program over the past five years. Paani's core team included staff in Kathmandu, a regional office in Nepalgunj, subregional offices within eight priority watersheds, home office backstopping in the U.S., as well as local and international grantees, consultants, and other service providers who supported all aspects of the program. Collectively, the knowledge and commitment of the Paani team significantly advanced the conservation of Nepal's freshwater biodiversity and major rivers, made scientific discoveries that are influencing policy decisions, secured resources to sustain in-country capacity, and positively changed the country's governance systems to better integrate ecosystem protection. The program's many accomplishments are owed to the strong commitment, skill, experience, and character of the more than 200 people who contributed to implementation of the program. Special recognition goes to Paani's leadership – Allen Turner and Nilu Basynat – who served as Chiefs of Party. Both Allen and Nilu brought amazing amounts of passion for Nepal and deep knowledge of the country's environmental, political and cultural context. Their leadership styles excelled at



Din Bahadur Kumal, a fisher from Jhimruk Watershed, promotes nondestructive fishing in Jhimruk River

Photo credits: Bhaskar Chaudhary for USAID

building consensus within the Paani team, and with government and non-government stakeholders, which has not only delivered sustainable results across disciplines, but also fostered a national movement for river conservation. The Paani program has been very fortunate to have such first-rate leaders at the helm of the program.

Early lessons. Recalling the very early days of start-up, Paani began in a temporary office space before moving into the program's permanent offices. The initial days, weeks, and months of the program were focused on extensive team building and ultimately generating a shared understanding of the program's objectives, mechanisms, and opportunities for protecting Nepal's freshwater biodiversity and climate change adaptation. Importantly, the early days established the necessary internal and external connections between people and institutions for driving results and making change happen. One early lesson is to recognize the amount of time it takes to onboard a new team, socialize a complex program, and transition from a scope of work and set of activities into a functioning program on the ground. The concept of "silo-smashing" needs to begin at the very start of the program with the program operations and technical teams working collaboratively so that there is shared understanding of technical activities to be implemented in tandem with the requirements, limitations, and potential of the various mechanisms that can be used to undertake activities. The use of co-creation is critical for generating buy-in for program designs; however the process can sometimes be slow, so a balance needs to be struck between allowing program staff and stakeholders the time and resources to own and deliver program results and integrate learning, while also ensuring that program timelines are closely adhered to. Fostering a culture of mentoring both internally within the Paani team, and externally with key stakeholders in government, civil society, and communities is critical for efficiently building and sustaining capacity at both individual and institutional levels.

Flexibility in program design. An important component of Paani's success has been the ability for the program to quickly respond to emerging opportunities and pivot as conditions change. For example, the availability of a flexible grants mechanism with annual program statements allowed local innovators and service providers to implement local solutions to problems relevant to the Paani program, such as the use of eDNA technology to identify fish species in river. Similarly, during the COVID-19 pandemic, the program was able to pivot to implement a new activity on integrated fish farming to improve food security and offer economic recovery opportunities to communities negatively impacted from the quarantine.

Karnali River Basin Conservation Fund. The Karnali River Basin Conservation Fund (KRBCF) and the Freshwater Centre of Excellence (FWCoE) are two examples of initiatives intended to provide long-term resources, knowledge, and advocacy platforms for freshwater conservation in Nepal beyond the life of the program. The KRBCF is a great example of an activity that started with the seed of an idea – establishing a permanent fund for river conservation – that Paani successfully created and launched. Many lessons have been generated through the experience of creating the KRBCF. First, there is clearly an active interest between Nepal’s financial sector (e.g., impact funds, commercial banks) in investing in socially and environmentally sustainable investments; local business owners in accessing finance to expand conservation-related enterprises; and in government (e.g., Karnali Province), civil society and community stakeholders to find ways to engage the private sector in environmentally sound and inclusive development. Another lesson is the value of using co-creation as a way to identify and bring together Nepal’s “problem-solvers” in a collaborative way so that they can use their own experiences, ideas and networks to create conservation funds like the KRBCF. The River Basin Conservation Fund Scoping Report was an important first step to see if a fund was feasible, who the key stakeholders would be, assess risks, and gauge demand. Following the study, the co-creation workshop was critical in further identifying the right set of implementing partners, recognizing and overcoming potential barriers, giving form to the concept, and outlining a roadmap for fund creation. The value of the co-creation process was in generating a set of new ideas of what the fund would look like (e.g., grants fund and impact investment fund) and connected new partners for implementation which would not have been achieved through a typical procurement mechanism. USAID is to be congratulated for supporting the Paani project to explore the potential for developing the KRBCF which has now been legally established and successfully received a funding commitment from Worldlink, among others, to support sustainable development in the Karnali River Basin.

Freshwater Centre of Excellence. The value of the FWCoE, hosted by Tribhuvan University (TU), is the ability to create and sustain a permanent repository

for the extensive research, data, and learning from the Paani project that includes over 40 studies, assessments, datasets, and analyses—as well as serve as focal point for future resources to be developed. Critical to the success of the FWCoE is to identify the institutional partner early, and to secure commitments from the institution to provide ongoing support to manage the FWCoE once the program funding has ended. The Paani program provided support from an IT firm to develop the web presence, and an in-kind grant for IT equipment with a server to host the background with TU providing long-term maintenance and dissemination activities.

Government engagement and Aquatic Animal Biodiversity Conservation Acts. One of Paani’s many successes has been engaging with government, both at national and sub-national level. The development and passage of the Aquatic Animal Biodiversity Conservation (AABC) Bills at Provincial and Municipal levels demonstrates

just how well the Paani program was able to take advantage of Nepal’s shift to a more de-centralized, federalist model under the new constitution. With newly empowered Municipalities and Provinces coming online, Paani was able to assist the government in integrating environmental considerations into local and regional policy and then in establishing community co-management along river stretches. With their new roles, many government staff wanted to show that they were being proactive and delivering for their community, and the Paani program capitalized on this local interest. The Paani team’s understanding of the political economy of Nepal, both at the national and local levels, played an important role in successfully passing the AABC Acts. Future programming in Nepal should scale up AABCs throughout Nepal with linkages to national-level policy, as well as continue to “think and work politically” consistent with the latest international best practices for natural resource management.



Local women in Thuligaad Watershed fishing with traditional techniques

Photo credit: Gajendra Singh for USAID



Nepal River Basin Fund Scoping Team in Kalikot (2018). From left to right: Robin Young, Narayan Belbase, Bhola Dhakal, Jonathan Randall, Bhupendra Shahi

Watershed Profiles and Watershed Health Reports.

A foundational activity for Paani was the development of watershed profiles and health reports within each of the target watersheds in close collaboration with local stakeholders. The purpose of the profiles and health reports was to identify and mobilize local stakeholders, raise awareness, prioritize issues that could be addressed through Paani programming, and set a baseline of watershed health that could be monitored over time. The exercise successfully demonstrated how multi-stakeholder fora and focus group discussions could be used to generate

buy-in for the Paani program as well as raise the visibility of freshwater biodiversity as a critical issue. It was also an important tool for ground-truthing the available data on such indicators as water quality, climate, and forest cover—as well as the specific drivers of habitat loss at the local level. The community mapping of issues, such as points where agricultural fertilizers and pesticides enter waterways, informed the evidence base. More importantly, these community mapping exercises prompted new discussion about the underlying causes of environmental degradation and the steps needed to resolve them. A next

step for the watershed profiles and health reports is to re-visit the lessons learned in collaboration with provincial and national-level stakeholders, such as the Ministry of Forests and Environment, WECS, and the Department of Soil and Water Conservation so that a national standard can be established. The watershed health reports can play an important role in nation-wide monitoring of river and water body health to identify and undertake environmental actions in the future.

Looking forward. While Paani has made tremendous progress over 5 years, the program should be seen as a first

step towards safeguarding Nepal's rivers and freshwater biodiversity for the future. USAID/Nepal must build on the momentum generated by Paani and continue to invest in this work. Threats such as climate change, development pressures from hydropower, gravel mining and road construction and

overexploitation of natural resources continues. Rivers play a critical role in connecting upstream and downstream users while also providing a host of cross-cutting services, such as irrigation for agriculture, biodiversity protection, hydropower, drinking water, and flood control that,

collectively, build resilience. Drawing on lessons from Paani, USAID should continue investing in river basin management because it serves as a unifying framework across populations, geographies, and development objectives that strengthens environmental protection and human well-being.

■ JEREMY KEETON, DEPUTY CHIEF OF PARTY, PAANI (OCTOBER 2018-JULY 2020)

It is rare in the development field to have the opportunity to work on a relatively new sector or area. Long neglected, freshwater biodiversity conservation presented such an opportunity in Nepal. While much attention has been given to terrestrial conservation—and in particular charismatic megafauna including rhinos, elephants, and tigers—prior to USAID's Nepal Paani program, lowly fish and other aquatic animals garnered little interest. But the plight of riverine ecosystems in Nepal is as dire as any other conservation challenge. Just like their land-based counterparts, aquatic animals face threats from climate change, unchecked development, and overharvesting. The Paani program presented a unique opportunity to look at these challenges while attempting to balance the very real needs for sustainable development in Nepal.

Two Steps Forward, One Step Stuck

I had the incredibly fortunate opportunity to serve as the project's Deputy Chief of Party for the last few years of the program. While the project worked across a spectrum of issues, I was personally drawn to some specific ones, both in terms of the opportunities they presented, and in some cases the seemingly insurmountable alignment of incentives against conservation priorities. Paani tried completely new approaches to river conservation by applying co-management models borrowed from the forestry sector. The program established a first of its kind river basin conservation foundation and fund. Yet, unfortunately, challenges of trade-offs between rural development and environmental impact mitigation will likely long continue to see aquatic ecosystems losing out.

Can Rivers Be Co-managed?

Rivers in Nepal present a classic “tragedy of the commons” problem. Supply of aquatic animals is limited, while uncontrolled demand compels fisherfolk to extract every last fish from the river. Excluding individual fishers is hard in a completely unregulated environment. Fish populations tell the story all too clearly, with iconic species such as the Golden Mahseer listed as endangered and anecdotes from fishing communities marking a sharp decline over the last few decades. Beyond fishing, localized environmental threats remain un-mitigated while upstream/downstream challenges are beyond the reach of any individual community.

Borrowing from successes in the forestry sector, the Paani program consulted local groups on their interest in piloting an approach to bring fisherfolk together and attempt to regulate and locally manage river stretches. While political economists may debate whether all local governments were genuinely interested in the topic of fish conservation, there is no doubt the opportunity to exercise their newfound lawmaking powers under Nepal's nascent federal constitution was too good to pass up. So, interests aligned, and the Paani team developed a package of interventions. Traditionally marginalized fisher groups would organize themselves into community aquatic animal conservation groups (CAACGs – adopted from the community forest user groups concept) made official through the passing of local community aquatic animal conservation acts (CAACAs). Under the model, small stretches of river were handed over to the groups for their exclusive use, along with rights to regulate catches and patrol for rulebreakers within their areas.

The first such group to be duly enshrined in law in accordance with the Aquatic Animal and Biodiversity Conservation Act (AABCA) was the Belkhet Saikhola CAACG, Ward 3,

Lamalbazar Municipality, Middle Karnali Watershed, which received a river stretch to monitor on February 10, 2019.

The longer-term hope is that local CAACGs will see benefits from further coordination amongst each other under increasingly larger umbrellas from river stretches, to watersheds, to river basins. Along with geographical growth, issue expansion could also help encompass increasingly wider areas of conservation interest and political power. Community forestry groups in Nepal number over 20,000, manage a third of all forests and, with multiple national umbrella organizations (most notably the FECOFUN federation) representing their interests, command a seat at decision-making tables. When community forestry started in Nepal in the 1980s with support from USAID and many others, no one could have dreamed it would scale up to this level, have the impacts it has had across Nepal, and serve as a global model for forest management and conservation. With steady, long-term, proactive support, a similar path for CAACGs and the co-management of Nepal's rivers and aquatic resources is possible.

The Karnali River Basin Conservation Fund

River conservation financing also lags behind its terrestrial cousin. Although over 6,000 rivers and streams provide freshwater ecosystems services to over 29 million Nepalis and hundreds of millions more downstream in the Ganga River Basin, the political establishment barely recognizes rivers as a discrete need and requisite financial flows are almost non-existent. The Paani program addressed this issue through establishing a first of its kind river conservation fund in Nepal. During the course of the program and through an inclusive co-design process, the fund's scope was focused on the Karnali River Basin, with the primary goal being to identify investment opportunities that had co-benefits for river conservation.



Road Construction and Gravel Extraction – Bulldozing and Undermining River Conservation

While the Paani team enjoyed success in a number of areas, some problems seem almost intractable. In the area of riverside and slope-side soil management for watershed protection, the overwhelming drive for economic development threatens to quite literally bulldoze conservation goals made in other areas to oblivion. The unrelenting demand for gravel and aggregate materials as inputs for infrastructure development threaten critical freshwater habitats, while soil erosion from road construction often seriously disrupts the normal cycle of sediment flow into freshwater systems. The perception, based on short-term needs with little or no attention to long-term impacts, remains that economic benefits far outweigh conservation needs.

Incentives remain almost universally aligned for large-scale, systematic gravel mining and against attempts to mitigate either the volume of gravel extracted or locations from where it is extracted. While legislation requires environmental examinations, mitigation plans, and places caps on the volume of aggregate that miners can extract in a day, local markets accrue widespread benefits despite attempts at regulation. Starting at

the riverbed, gravel extraction provides steady labor to miners, middlemen aggregators, transporters, and secondary service markets the constant flow of tractors, and trucks require, and ultimately cheap inputs to road construction, supplements for concrete, and other infrastructure (all likely exacerbated during COVID-19 as inter-Pradesh travel became limited and local sources became the only sources of materials). Local governments often license and tax extraction operations providing a much-needed complement to their own-source revenue base. As a result, communities enjoy new housing, schools, clinics, roads, and bridges. Sanctions are non-existent and any local government first mover would likely suffer politically. Ke garne?

Similarly, but perhaps more tractable, rural road construction continues to be dominated by short-sightedness in favor of quick development to satisfy short-term political gains. Local governments are under pressure to extend the economic benefits of rural roads to every last village and homestead, irrespective of topographic suitability. The opportunity here, however, is that what makes a road environmentally friendly (proper drainage, wide and low sloping switchbacks, permeable surface materials) also tends to make it safe and

lasting. Although sustainable practices measured against the current widespread practice of untrained bulldozer operators cutting paths into the sides of hills may increase costs in the short-term by a factor of ten (based on estimates from the Paani project), un-engineered bulldozed paths can become so degraded as to make repairs impossible, potentially cutting remote areas off for decades until the landscape can recuperate. Again, political will and the (in)ability to enforce regulations, not technical capacity, seem to be the major barrier to sustainable development. As one mayor and deputy mayor told a Paani field-visiting team, “we know all about environmentally friendly road practices but can reach more people cheaply using the bulldozers.” Road traffic accidents on rural roads, and the fact that many bulldozed paths are washed away in the next monsoon may leave this approach short-lived, and politicians may ultimately view environmentally friendly engineering techniques as a sounder investment. Future initiatives in this area may want to consider re-branding away from “environmentally friendly” infrastructure and instead focus on safety and resiliency (especially from the standpoint of municipal budgets and access to rural markets) as more impactful selling points to local politicians for infrastructure investments over less salient environmental concerns.

Perhaps ironically, according to some environmental economists building on the work of Simon Kuznets, more economic development with the accompanied unmitigated environmental destruction may be exactly what is needed before communities start to value sustainability over unimpeded economic development. According to this theory, as a consequence of the early stages of economic growth, per capita income rises along with pollution and environmental degradation, but beyond some level of economic growth, the trend reverses as basic needs are met and communities turn their attention back to their local environment. Let’s hope that for certain species in the remote rivers of Nepal, this reversal does not come too late.

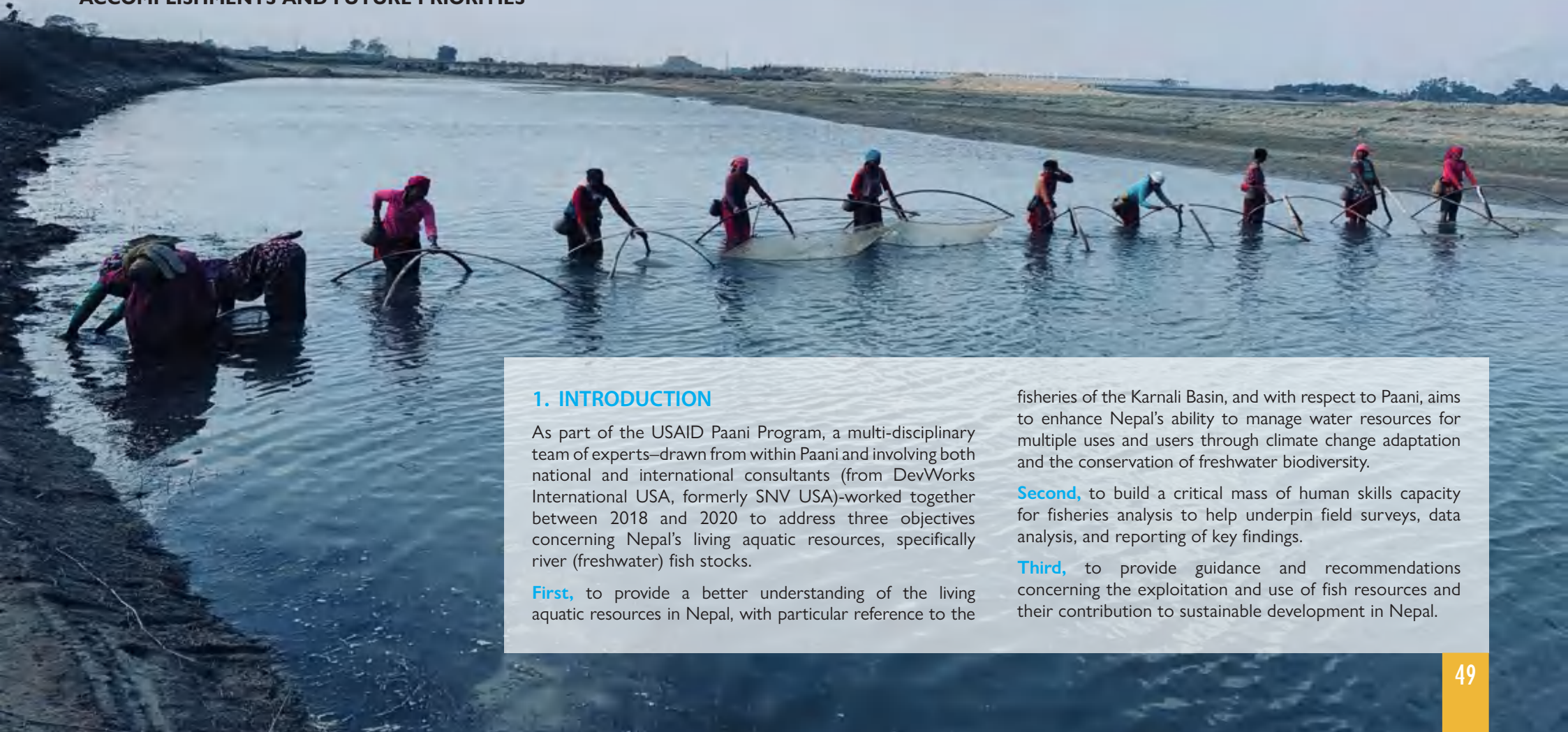
Investments in natural resources management must be long-term in nature. USAID is to be congratulated for its initial work in freshwater biodiversity conservation as one of the few development partners working in this space. However, investments must continue if the forward movement catalyzed by Paani is to bear fruit.

GROUPS SUPPORTED BY DAI/PAANI

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■ ARTHUR NEILAND, MARTIN L. VAN BRAKEL, MADHAV SHRESTHA, DEEPAK RIJAL AND SURESH WAGLE

THE PAANI PROGRAM AND LIVING AQUATIC RESOURCES IN NEPAL:
ACCOMPLISHMENTS AND FUTURE PRIORITIES



1. INTRODUCTION

As part of the USAID Paani Program, a multi-disciplinary team of experts—drawn from within Paani and involving both national and international consultants (from DevWorks International USA, formerly SNV USA)—worked together between 2018 and 2020 to address three objectives concerning Nepal’s living aquatic resources, specifically river (freshwater) fish stocks.

First, to provide a better understanding of the living aquatic resources in Nepal, with particular reference to the

fisheries of the Karnali Basin, and with respect to Paani, aims to enhance Nepal’s ability to manage water resources for multiple uses and users through climate change adaptation and the conservation of freshwater biodiversity.

Second, to build a critical mass of human skills capacity for fisheries analysis to help underpin field surveys, data analysis, and reporting of key findings.

Third, to provide guidance and recommendations concerning the exploitation and use of fish resources and their contribution to sustainable development in Nepal.

The design and implementation of the program of work involved both desk-based planning and analytical activities as well as a series of fieldwork missions in the Karnali Basin and in other parts of Nepal to collect relevant data and information.

The fisheries team worked with many different stakeholders in Nepal. Senior government officials at both national and provincial levels engaged actively, along with local government officers, fisher community leaders, fishers, fish traders, fishing equipment suppliers, and many other individuals and organisations involved with the fisheries sector. We are grateful to all these stakeholders for their invaluable contributions to the Paani fisheries team and its work.

2. ACCOMPLISHMENTS AND FUTURE PRIORITIES

(i) Improved Understanding of Key Issues, Fisheries Production and Economic Value

Key Theme - If the potential value of fish resources for sustainable development can be revealed then government, working with a full range of relevant stakeholders, can take action to harness this through the design and implementation of appropriate fisheries management

systems and fish value chains, leading to the generation of a wide range of sustainable benefits, such as income and fish for household consumption.

Reliable information is essential for effective analysis and the decision-making processes which underpins fisheries policy and fisheries management. In common with many countries, some weaknesses and gaps in Nepal's fisheries information base and information systems undoubtedly constrain progress at the present time. A lack of public investment in national fisheries information systems contributes to this situation. The sector is often perceived to be unimportant and therefore not a priority.

On the basis of a series of initial scoping studies in 2018, the Paani fisheries team recognised that the real value of river fisheries in Nepal's rural economy and food security is generally overlooked and the information base concerning the river fisheries of the Karnali is relatively weak. The underlying data showed significant variations in quality and robustness. Many basic statistics also needed to be updated.

To start, the Paani team decided to tackle two fundamental questions – (i) what is the potential and current total annual fish production (or fish landings) in the Karnali Basin? And (ii) what is the potential and current economic value of this fish production?

UNDERSTANDING FISHING LIVELIHOODS

“Majority of respondents in Middle Karnali were full time fishers, while nearly half of the respondents in Lower Karnali were part time fishers. This indicates that fishers in Middle Karnali are largely dependent on capture fisheries but the majority of the fishers in Lower Karnali manage their livelihoods and incomes from multiple livelihood options.”

Dr. Ram Devi Tachamo, Livelihoods Expert, USAID Paani Program, extract from Paani Fisheries Team Livelihood Survey, 2020

Without knowing the answer to these questions, it is difficult to convince government policy-makers or private investors that fish resources or fisheries deserve greater attention in the future at some appropriate level (national, provincial, or local) in order to underpin the generation of a full range of benefits (e.g. fishing incomes, business profits, and food supply). In other words, we set out to clarify the potential future role of Nepal's fish resources for sustainable development which might be enabled by further public and/or private investment.

Furthermore, reliable information is essential to help contribute to the on-going discussion about the use of riverine water resources in Nepal, with reference to the role and development of particular sectors (e.g. hydropower, irrigation) in relation to other sectors (e.g. fisheries, aquaculture, bio-diversity and wildlife conservation, tourism).

The Paani team developed a series of field surveys to tackle the key questions above. In particular, a Catch Assessment Survey (CAS) involving local fishers and conducted exclusively by mobile phone (due to the restrictions imposed by the COVID-19 pandemic) generated crucial data and information about the volume and value of the fish catch, complemented by surveys focused on the fish

PANNI FISHERIES TEAM – INTERACTION WITH STAKEHOLDERS

“Over the conversation, he repeatedly mentioned about the Community Aquatic Animal Conservation Groups (CAACG) formed in that river stretch. He mentioned about the group restricting unsustainable fishing and [making people aware] that they were not allowed to fish with gears that would harm the fingerlings. He also seemed to know about Paani supporting fishing groups to weave fishing gear and I explained [to] him in detail about the objective of Paani. I clarified [to] him that Paani was aiming not to harm or affect the business of fish collectors like him or the livelihood opportunities of fishing dependent communities. It was rather to control destructive fishing in the river so that they and their business would continue getting benefitted for a longer run. He said that he completely supports such groups and that despite being a fish contractor, he would not encourage destructive fishing because he would want his sons to continue the profession for living.”

Extract from interview with fish collector in the Karnali Basin, Paani Fisheries Team, 2020

RECOGNISING STAKEHOLDER PERCEPTIONS

“Mr. Jaishi runs a rafting business. Local Karnali fish is among one of the packages he provides for rafting. Fish has supported the rafting business 50-60 percent from increased domestic tourists. Guests stay in the homestay he runs in the village because of fish. This brings additional business such as local chicken, drinks etc.”

“The supply of fish till date is all based on trust as there is no means for the buyer to separate either the fish is from Karnali or elsewhere, or even to distinguish the species. There needs to be a proper branding for the marketing of fish.”

Extracts from stakeholder interviews in the Karnali Basin, Paani Fisheries Team, 2020

market and value chain, livelihoods, aquaculture, and eco-tourism.

The picture emerged of a poorly regulated fishery, but one with commercial potential, which might be realised in the future under improved governance arrangements. We estimate that annual fish landings in the lower and middle Karnali are currently 375 metric tonnes and valued at around USD 1.5 million (first sale value or turnover). However, the nature of the fishery varies by location. In the Lower Karnali, fishing is an opportunistic activity pursued by local people and those coming in from other areas. By contrast, the fishery in the Middle Karnali appears to be of a more dedicated and specialized nature, with links to tourism, and many fishing households are more exclusively dependent on the fishery for their income and livelihoods.

Looking to the future, using a business case approach for a proposed new Karnali River Fisheries Cooperative, we show that investment in processing of low volumes of high-quality wild river fish could generate significant returns compared to the without investment scenario (and no processing), including more revenue and profit, giving a fishery the value of at least USD 17 million (capitalised value). The generation and use of the potential economic value of the Karnali fisheries, on a sustainable basis, would undoubtedly contribute to local economic development. The success of the investment in fish processing and the value chain rests upon a parallel development of effective fisheries management

systems. More regulated fishing activity would ensure the sustainability of the fish stocks and associated fish production (the key assumption).

(ii) Upgrading of Human Skills Capacity for Fisheries Analysis and Fisheries Planning

Key theme - Fisheries development and fisheries management processes in any setting requires a range of skills and the application of specific methodologies and techniques such as fish stock assessment, fisheries surveys, environmental assessments, economic analysis of fishing operations, policy design and implementation, fisheries management systems design and operation and many others.

UPGRADING CAPACITY AND SKILLS

“The Paani fisheries workstream helped upgrade the human skills capacity in Nepal by holding regular meetings and workshops over three years. Participants included Paani staff, government officers, university and research staff, and other stakeholders.”

Nilu P. Basnyat Chief of Party, USAID Paani Program, 2020

We focused our attention on three methodologies, as follows:

First, a portfolio of participatory rapid appraisal (PRA) methods underpinned a series of early scoping studies on the fisheries of the Karnali. These included (a) timelines; (b) Strength Weakness Opportunity and Threat (SWOT) analysis; (c) fishery mapping; (d) visioning; and (e) net-mapping. The latter approach proved to be particularly useful. Our training focused on how to describe and characterise the fish value chain in a workshop setting. Interestingly, the net-mapping created a keen awareness, amongst the stakeholders involved, of the level of fisheries production, the nature of fishing activities and the potential economic value, which had been previously overlooked in official statistics.

Second, we designed and implemented a catch assessment survey (CAS) in the Karnali Basin. This exercise was noteworthy for a number of reasons. A formal CAS had never been designed and implemented in Nepal before. Overtaken by the COVID-19 pandemic, the methodology and implementation had to be adapted. A large part of the CAS was coordinated by telephone and online communication between international and national consultants, the Paani team, and the local field staff. It can be claimed that this was the first time a CAS had been implemented in Nepal and the first time a CAS had been coordinated remotely and internationally (perhaps anywhere in the world!).

Third, we designed and produced a series of business cases (BC), as follows: (i) BC on a Fisheries Cooperative and Wild Fisheries; (ii) BC on a Fisheries Cooperative and Aquaculture; and (iii) BC on a Fisheries Cooperative and Eco-Tourism. The value proposition for fisheries, explored earlier, provided the entry point for each BC, namely increased returns and net benefits realised from improved fish processing, product development and value chains underpinned and enabled by sustainable fish landings from well-managed fisheries. The BC were also developed with reference to possible future opportunities for investment from public and private sources. The cooperative model is well-known in Nepal and we have shown that it could

FISHERIES AND THE RURAL ECONOMY IN NEPAL

“Fishing and fish value chain activities are an important part of the rural economy and rural livelihoods in the Karnali, often integrated with other activities, especially agriculture.”

Extract from stakeholder interviews in the Karnali Basin, as part of the development of the Fisheries Conservation Framework (FCF), Paani Fisheries Team, 2019

be adapted and harnessed even further in the fisheries sector in the future.

(iii) Key Findings and Recommendations and Future Priorities

The work completed by the Paani fisheries team between 2018 and 2020 provides a valuable contribution to our understanding of river fish resources and fisheries in Nepal and particularly in the Karnali Basin.

[A] Early Scoping Studies – Using a portfolio of PRA techniques, we compiled a detailed overview of the fisheries and the related fish value chains. The results show that fishing and the fish value chain activities are an important part of the rural economy and rural livelihoods, often integrated with other activities. At the same time, the fish stocks are increasingly threatened by both endogenous and exogenous factors. Fisheries operate under free-and-open access conditions and remain extremely vulnerable to overexploitation. The riverine environment is also subject to serious impacts from other sectors – hydropower development, irrigation schemes, gravel mining and



The SNV Study Team explains the results of a net mapping exercise of the fish value chain in Nepal conducted during Paani's "Fisheries Conservation Framework and Market Development Strategy" workshop in Surkhet on September 8, 2019

urbanisation. The resulting environmental changes to the rivers and floodplain aquatic habitats threaten the viability of fish stocks and the future for sustainable fisheries exploitation. The early findings of the scoping studies were used to inform the design of a Fisheries Conservation Framework (FCF) for Nepal. Recommendations and future priorities:¹

1. Government policymakers should be made fully aware of the contribution of fish and wild fisheries to the rural economy and rural livelihoods, as well as the threats

posed by weak fisheries governance and exogenous (other sector) impacts. Furthermore, the impact on sustainable development (economic, social and environmental net benefits) of decisions which adversely affect fisheries systems should be revealed and made transparent for all members of society in Nepal.

2. In terms of future priorities, attention should be given to three areas:

1. The FCF, incorporating a Fish Market Strategy, was designed by the Paani fisheries team in 2019, drawing upon the results of detailed stakeholder engagement activities undertaken in Nepal, at both federal and provincial levels, combined with lessons drawn from international best practice in key areas such as fisheries management and market development. From the beginning, it was acknowledged that there is no standard definition of a fisheries conservation framework. The FCF design process involved working with stakeholders, at all levels, to establish a clear goal ("the fisheries sector makes a significant contribution to sustainable development (SD) in Nepal achieving conservation, economic and social goals as defined by national policy"), and to develop a mechanism and a set of activity components and implementation pathway. This focused on four key components – (a) creating an enabling environment for fisheries conservation and development; (b) improved fisheries and aquaculture management systems; (c) strengthened fish market and fish value chain arrangements; and (d) support and encouragement for the private sector (non-government) to develop the fisheries and aquaculture sector. An implementation schedule, over 10 years, was proposed. The total overall budget required for the FCF was estimated to be at least USD 50 million (or USD 5 million annually) for western Nepal, or USD 150 million (or USD 15 million annually) for the whole country, using an international benchmark approach.

- (i) Use of improved and pragmatic information systems – for example, the use of a simple and effective PRA methodology and supporting database, to underpin an information system, could provide a pragmatic and cost-effective means to document and monitor fisheries and the wider aquatic environment;
- (ii) Design, testing and implementation of appropriate fisheries management systems for fisheries in Nepal, underpinned by appropriate human skills capacity-building; and
- (iii) Inclusion of fisheries and fisheries stakeholders in a nationwide forum on policy coherence convened by government to consider the strategies, policies and impacts within and between sectors (e.g. hydropower and fisheries) and the consequences for sustainable development (economic, social and environmental dimensions, including poverty alleviation, food security, climate change mitigation and biodiversity conservation).

[B] The **Catch Assessment Surveys** (above) provided detailed information on the structure and operation of the fisheries in the Karnali River for the first time. The methodology was shown to be workable even under the difficult circumstances created by the COVID-19 pandemic. The key questions of the scale of fish production in the Karnali (previously unknown) and the economic value of this production (using market survey data) were addressed. The fact that these valuations (production and economic value) have been produced by a systematic survey allows the discussion of possible investment options to proceed with a higher degree of confidence than previously – a fact which is very important for Nepal with a new set of government arrangements and the serious question of how to prioritise investments in local rural economies, such as that in the Karnali Province.

Recommendations and future priorities:

1. The CAS methodology tested in the Lower and Middle Karnali during 2020 provided detailed information on the structure and operation of the fisheries in the Karnali River for the first time, even under the difficult



Tharu Women Fishing with traditional gear in Middle Rapti Water.

Photo credit: HWEPC for USAID

circumstances created by the pandemic. The results produced represent a step-up from the earlier PRA results and provide a systematic source of data to enable the calculation of key statistics including total fish production—along with economic valuation statistics, when combined with market surveys. All of these parameters can help to inform improved fisheries policy and fisheries management in the future.

2. In terms of future priorities, attention should be given to three areas:
 - (i) The design and establishment of a new and expanded CAS for the whole of the Karnali River, possibly linked to a multi-disciplinary PRA-based information system (above);
 - (ii) Alternatively, the design and implementation of a formal fisheries information and statistics system (if investment is available); and
 - (iii) The design and implementation of a human skills capacity-building programme, providing a critical mass of human capacity to underpin sustained future operation of the information system put in place.

[C] The Business Cases identified and compared the options for investment in wild fisheries (alone) and in combination with other sub-sectors including aquaculture and eco-tourism. The BC model was centred on the design and establishment of a Fisheries Cooperative—to act as an innovative institutional hub—which would coordinate and facilitate investments along the value chain. This would include fisheries management, fish processing, fish marketing along with the operation of a community investment chest—to enable the re-investment of cooperative business surpluses within the local economy. The three BC were found to be worthwhile investments, subject to certain conditions and assumptions, evaluated using standard investment appraisal and sensitivity analysis methodologies.

Recommendations and future priorities:

1. The fisheries sector – including both wild fisheries and aquaculture – offers a number of worthwhile opportunities for investment – for both the public and private sectors – subject to specific key assumptions. The possibility of utilising a cooperative model at the community level to enable and facilitate a singular or integrated approach appears advantageous given Nepal's long experience with similar arrangements. However, the specific cooperative model would have to be worked out for fisheries and aquaculture – and one

USE OF A BUSINESS CASE APPROACH

“The business cases help us to identify investment opportunities in capture fisheries that generate green jobs, increase income opportunities, and strengthen livelihood options.”

Dr. Deepak Rijal, Chief Technical Specialist USAID Paani Program

which incorporates value chain considerations, adopts a business model open to all stakeholders, and deals with the thorny issues of fisheries management, fish supply and management of finances and surpluses/dividends could be workable and valuable.

2. In terms of future priorities, attention should be given to three areas:
 - (i) the development of an approach by which government decision-makers could work with and avail themselves of the opportunity to use a BC approach and methodology to guide [sustainable] fisheries and aquaculture development and investment at all levels (national, provincial, local), including the design and implementation of a capacity-building programme for fisheries and aquaculture cooperatives;
 - (ii) Supporting the design and operation of a set of pilot fisheries and aquaculture cooperatives, offering expertise and mentoring in business management, institutional reform, value chain management, finance and investment management, marketing and product development, and credit and insurance schemes;
 - (iii) creation of a link between (i) and (ii), above, and fish conservation priorities, providing a convincing argument and value proposition for improved fisheries (collaborative) management with river-dependent communities engaged in and accountable for local river-stretch management, and conservation, underpinning strengthened local river-dependent economies, including eco-tourism.

DSV ADVISORS

■ JOSEPH SILVANUS, DOLMA FUND;
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Paani Program Lessons – Some Reflections

1. There is an increasing interest among nationally prominent private sector firms to include conservation and environment work as part of their corporate social responsibility (CSR) work.

In the summer of 2020, DSV Advisors reached out to NMB Bank and WorldLink Communications (Nepal's largest internet service provider) to join hands in the work in the Karnali Province. Both firms readily agreed, and each signed a MoU with DSV Advisors. The bank wanted to focus on digital banking and lending to SME/entrepreneurship, while the ISP wanted to make “Digital Karnali” its entry point for collaboration. Likewise, when DSV Advisors reached out to other private sector firms such as United Traders (Toyota Motors-Nepal), Yeti Airlines and the Nepal SBI Bank, they all expressed an interest to work together to invest in Karnali. The lesson here is that these firms and others see the Karnali region as potential investment destinations where private sector-led development must embrace conservation,

the environment, and the communities as critical ingredients. As such, economic growth in the Karnali region will not come at the expense of those ingredients.

2. Well-structured and well-run business incubation services help develop an entrepreneurial mindset among the youth and existing small business owners.

In January 2021, DSV Advisors hosted a 5-day incubation program for 20 entrepreneurs in Surkhet. Through the use of practical examples and field trips to interview potential customers, the program taught the participants how to figure out what their customers want and, based on the market feedback, how to reformat their products and services per the potential customer's demand. This learning changed the mindset of the participants from being product-centric to customer-centric. Many reported that this change in mindset alone was worth the value of the incubation program, for they clearly saw where and why their previous attempts at sales had failed.

3. Provincial and local governments are keen to work with national private sector firms to create local jobs, to reskill and upskill their employment-ready population, to put women into the workforce, to reduce the allure of overseas migrant work, and



A local fisher woman in Rakam, Middle Karnali Watershed uses traditional methods to fish in the Karnali River

Photo credit: Sudhin Bajracharya for USAID Paani program

to support businesses that turn locally sourced raw materials into finished products.

Despite brimming with potential for conservation-centric high-earning opportunities such as national parks, adventure sports, herb processing work, agro-forestry products, trekking trails, hospitality, religious tourism, renewable energy, and the like, Karnali remains Nepal's least developed and least invested region. Through the course of DSV Advisors' outreach work, it found that both provincial and local government bodies are keen to turn what is naturally available in the region into products and services that they can sell to others, thereby creating jobs for the local people. For this, the government bodies are open to working with private sector firms that can bring in subject matter expertise and set up logistics to run and manage ecotourism centers, training and skilling centers, employment centers, and so on. To give force to this interest, DSV Advisors expects to play the role of an honest broker – bringing national-level firms to the attention of local government bodies so that the former can explore ways to outsource some of their work to the region.

4. The Karnali region remains a risky, pre-frontier market in terms of attracting domestic and international investments.

The rate of capital formation is low in the Karnali region. Despite its geographical heft, which is full of breathtaking, if punishing, terrain, its share of the national GDP is less than five percent. Most able-bodied young men and women leave the region to work as migrant workers in India and elsewhere.

On one hand, this magnifies the status of the Karnali region as a pre-frontier market with potential. But on the other hand, it reduces its chances of securing large private sector investments up front. DSV Advisors addressed this obvious mismatch between the opportunity and the challenge by first setting up a non-profit foundation, which would run training sessions on topics such as financial literacy, investment awareness, and business operations improvement. The spillover learning and benefits from the foundation's work would

help DSV's Fund to account for and market the Karnali region's commercial potential for development-oriented climate or impact funds as a pre-frontier investment destination where it could make significant impacts by moving in as the investor of first resort. As such, the region needs to be marketed honestly and effectively to investors who care both about impact and returns.

5. Setting up an impact investment fund can be a way to combine economic development with investment in small businesses and entrepreneurial ventures by designing potential, measurable impacts ahead of time.

An impact investment fund has the heart of an NGO but the mindset of a private sector firm. It wants financial returns but not at the expense of agreed-upon development impact outcomes like measurable change in women's empowerment, job creation, market linkages, or environmental sustainability. As such, this type of an investment vehicle is ideal for a pre-frontier market which carries both opportunity and risks. On the opportunity side, because there is little precedent, much can be done by the first mover fund. On the other hand, establishing basic financial, social, and cultural infrastructure for the fund presents an exhausting and costly risk during start-up.

Still, such a fund (once capitalized and running), can support local small-holder farmers, entrepreneurs, supply chain connectors, women business owners and tech-savvy youth by training them and insisting on certain agreed-upon environmental, social, and governance (ESG) outcomes. Such work thus combines the element of both economic development and business investment, while focusing on environmental, conservation, and social results.

The learning for DSV Advisors in this space has been that all parties – potential funders, provincial and local governments, local entrepreneurs, national-level corporates – are genuinely excited to come together for the creation of such a fund. Since this is a relatively novel idea, explaining and marketing it takes much diligence on the part of DSV Advisors.

ISET-NEPAL

■ **AJAYA DIXIT, FORMER EXECUTIVE DIRECTOR ISET-NEPAL AND CONVENOR, SOUTH ASIA NADI SAMBAD (SOANAS)**

Reflecting on the PANI Program

In more than 40 years working on water issues, I have been guided by a social and environmental ethos. Yet I had not had an opportunity to work on the challenges faced by aquatic biodiversity. I looked at these issues as an outsider but with empathy highlighting the need for unpolluted nature and rivers. Indeed, today it is broadly accepted that “our economies are embedded within Nature, not external to it.”¹ In 1997, along with Dr. Imtiaz Ahmed and Dr. Ashis Nandy, I wrote the South Asian Manifesto on the Politics of Water, Power and People. The manifesto said, “rivers also have their rights, including the right to be relatively pollution-free, to be a safe habitat for riverine forms of life and, within limits, to flow freely”². In most rivers, built structures interrupt flow. What we wrote more than 20 years ago, would be a starting point for restoring degraded rivers and conserving them for people and aquatic biodiversity.

In 2016 the United States Agency for International Development (USAID) funded the PANI program, implemented by DAI Global LLC (DAI) in Nepal's Mahakali, Karnali, and West Rapti (MKWR) river basins along with components implemented by the International Water Management Institute (IWMI) and the U.S. Forest Service. The project aimed to “raise the profile of freshwater issues through policy engagement, academic research, curriculum development, and sponsorship of international forums. The project emphasizes user-centered design to analyze how various stakeholders, including fishermen, government officials, and hydropower developers, use water resources to better incentivize their engagement in water conservation and management activities.”³

In 2018, a consortium led by ISET-Nepal, along with the Nepal Economic Forum and NITI Foundation was awarded the task

³ <https://www.dai.com/our-work/projects/Nepal-Program-for-Aquatic-Natural-Resources-Improvement-PANI>

of undertaking a political economy analysis (PEA) to identify champions for freshwater policy change and conservation of aquatic biodiversity in MKWR. I led the study.⁴ Personally, this was a new opportunity to learn about the multiple dimensions and nuances of aquatic biodiversity.

As a child, I was intrigued by fishes that I would see in the then much cleaner Bagmati River. My education as a civil engineer and later in hydraulic science included nothing about the aquatic biodiversity dimensions of river systems. Our education taught us to consider rivers only as water and during the monsoon as water and sediments, which everyone seemed to avoid. In the mid-1980s, I began to realize that rivers were much more than what I was teaching in my hydraulic lectures, important though the subject is. I sought to understand how a larger water development approach was needed to deal with aquatic lives in rivers. I asked one of my seniors how would one deal with them when designing and developing hydraulic structures. An engineer trained in the traditional model, he was unhappy that I, a civil engineer, would worry about fishes. I respectfully disagreed.

As the years passed, it became clear to me that at a societal level, challenges of inefficiency, ecological degradation and inequity are widespread in the way water was, and, even today, is managed in South Asia. Women, children, and socially marginalized people still do not have access to basic drinking water and sanitation services. Aquatic biodiversity faces threat of extinctions. These are outcomes of the prevailing water development approach and widespread governance failure. In this region water development and management over the past 200 years have focused on the construction of physical infrastructure like barrages, dams, and embankments. However, such infrastructure is poorly matched with the region's unique environmental and social contexts, and thus the approach continues to yield unsatisfactory results. South Asian agriculture, for example, is still predominantly dependent on the mercy of the monsoon. Flooding disasters across the region are more common and

4 Dixit, A. et al (2020) Political Economy Analysis to Identify Champions for Freshwater Policy Change and Conservation of Aquatic Biodiversity Submitted to USAID's PAANI (Water) Project By ISET-Nepal, NEF, NITI Foundation



in recent times urban flooding has become frequent. The governments at the forefront of water development have failed to pay attention to the need to promote cooperation between central and local governments, build institutions, and develop trust with neighboring countries.⁵

5 See Dixit <https://soanas.org/water-challenges-in-south-asia/>

This emphasis on construction is widespread in Nepal. Dam building has not seriously contemplated how the hydro energy generated would be used to transit Nepal to a greener economy. Nepal's energy mix is dominated by bio-mass (70 percent), imported petroleum products (18 percent)⁶ and

6 Nepal Economic Survey (2019/20).

hydropower is around 5 percent⁷. In 2020, Nepal's installed capacity was 1,332.858 MW that supplied about 6,012 GWh to the Integrated Nepal Power System (INPS)⁸. In addition, 7,680 MW of hydropower capacity are under construction. Generation licenses have been issued for 2,600 MW⁹ and survey licenses have been given for an additional 7,000 MW. Yet, the country's petroleum import bill (Rs. 200 billion in 2020) and the quantity of petroleum imported continues to go up.

From 2010 to 2018 the country's petroleum imports (all of which must come overland from India) increased by about three times. Although Nepal is one of the lowest emitters of GHGs in the world, over the same period its carbon emissions increased by 179 percent¹⁰. There is no strategic effort to develop a diverse and resilient energy mix, and inject sustainability into the development of hydropower in a way that insures that the flows of rivers are not fragmented and sustainability guides the endeavor. As a result, the country is neither on a path to decarbonize its economy nor has it been able to stop—much less reverse—the degradation of its precious rivers.

There is little or no attention paid to basin-wide planning or strategic environmental assessment including attention to the cumulative impacts of multiple hydropower projects along portions of a single river. As hydropower dams continue to be built, even under the so-called “run-of-river” design, flows are diverted through a series of tunnels and rivers are fragmented. The Government of Nepal (GoN)'s 2001 Hydropower Development Policy calls for releasing from the dam/weir 10 percent of the minimum monthly average discharge of the river or the minimum suggested by environment impact assessment as e-flows. This policy is not complied with in most projects.¹¹

In the meantime, riverbeds and banks are indiscriminately gouged for construction-grade materials (stones for aggregates and sand). Untreated solid wastes from cities and settlements and untreated liquid wastes are dumped in rivers and water bodies. Lack of water in river reaches not only impacts fish passage and production, but also compromises other uses, values and meanings of water including recreation, tourism, and cultural values such as ablution, along with intrinsic and aesthetic services. Adapting to the risk of climate change cascading through the hydrological cycles receives lip service but talk of decarbonization and green development end up merely as politically correct statements that can be announced in international fora.

7 Based on NEA 2019/20 and Economic Survey (2019/20).

8 NEA (2020).

9 www.doed.gov.np (accessed on 30th March 2020).

10 Global Carbon Project

11 See Shrestha, R. K and Dixit, A., (2020): Rivers, Hydropower and e-flow: Development and Conservation Challenges in Nepal, Institute for Social and Environmental Transition-Nepal, Kathmandu and



A copy of Political Economy Analysis to Identify Champions for Freshwater Policy Change and Conservation of Aquatic Biodiversity



Jhimruk Hydropower dam in Jhimruk Watershed.

A few months before our team began the political economy analysis mentioned above, I was also involved in conducting series of dialogues on the idea of free-flowing rivers in the Koshi basin. Supported by The Asia Foundation (TAF) with funding from the Department of Foreign Affairs and Trade (DFAT), Australia, the dialogues aimed at understanding perspectives of various stakeholders about free-flowing rivers¹². The stakeholders could be grouped into four types: government officials, entrepreneurs (hydropower developers and rafting company representatives), ecologists, and communities living along river banks. The study used group discussions and a one-to-one dialogue approach. All participants agreed that rivers must have minimum clean flowing water and that the public policy on e-flows must be complied with. Yet it is not. Non-compliance to the policy of e-flows or other public concerns such as air pollution reflects a lack of public sector accountability in Nepal's governance. The question of how and who will operationalize monitoring of e-flows was, and is still, unclear.

The arrival of COVID-19 in early 2020 has exposed major limitations in the waterscape of Nepal and South Asia.

12 Dixit unpublished Report to TAF, ISET-Nepal. The dialogue also underscored the need for a reader friendly publication on Koshi in Nepali language. Dixit A. (2020) Nadi Sanrakchan ka Chunauti, Koshi nadi ko sandsarva (Challenges of River Conservation. The Context of Koshi River, An Atlas), ISET-Nepal, TAF and DFAT.

Not only did the virus show us the fragility of South Asian countries' public health systems, it has also driven millions of migrant workers from cities back to their villages, increasing pressure on local water sources for domestic and health needs. Because of fundamental and multiple values of water for life, livelihood, development, well-being, and nature, it is imperative that the degradation trends be reversed. Where does one begin? The lockdown of the past year has forced millions globally and across South Asia to begin rethinking and recalibrating their relationships(s) with nature and with each other.

Water challenges in continental South Asia¹³ are located in the broader context of the Hindu Kush Himalaya (HKH) region which the classical Sanskrit Scholar Kalidas of the fifth century called "the measuring rod of the earth."¹⁴ It is a region whose hydrology is characterized by high rainfall for four months with pulses of sediment a vitally important constituent of the natural system. Water, energy, biodiversity, and sediment (WEBS) are inseparable constituents of a river¹⁵. The prevailing approach to water development has picked up water for energy while disregarding the other two

13 Nepal, India, Bangladesh, Bhutan, China and Afghanistan

14 See Singh, R. (1992) The Ganges, Thames and Hudson, (pp 14).

15 See Bandyopadhyay, J. <https://soanas.org/holistic-perception-is-the-starting-point-for-integrated-water-governance/>

constituents. This is a fatal flaw in the region's approach to water resources management (WRM) that needs to change.

Addressing this disjunction requires a reorientation of the current practice of water education and development. In South Asia, this recalibration must be guided by the objective of maintaining the integrity of the Hindu Kush Himalayan (HKH) region, "the planet's pulse" as Kathmandu-based International Center for Integrated Mountain Development (ICIMOD) has labeled it. Nepal, sitting in the center of this geographical entity, must be in the forefront in this endeavor. The shift should begin by promoting creative dialogue among natural scientists and social scientists and be informed by indigenous practices. Not only did Nepal miss out by not investing in developing a natural and social science base, both generally and in water, but the country also allowed its indigenous knowledge stream to deteriorate.

The narrative of Nepal as a water resource-rich country did not see significant investment in water knowledge encompassing natural and social science. It was only in the early 1960s that the Department to monitor hydrometeorological processes was established with support from the USAID, which also provided support in groundwater exploration in Nepal Tarai. In the mid-1980s, USAID supported the Irrigation Management Project (IMP) that worked both with large government-run irrigation systems in the Tarai as well as through IWMI with many farmer-built and farmer-managed irrigation systems (FMIS). Several decades after IMP, the PANI project made support available to examine the complicated (and critically important) aspect of aquatic biodiversity conservation in Nepal.

It is not the intention of this piece to argue if this support could have been channeled differently. Yet, with the current phase of PANI coming to an end, answers to the following questions would help in achieving better value for money in new ventures that US taxpayers contribute to the people of Nepal through the former's foreign aid architecture: what knowledge base did the program produce, what and whose capacity was built, what support did the program provide to build local institutions, and what contribution did it make in informing the public dialogue? It must be recognized that the PANI program's five-year period is



Photo credit: Nabin Baral for USAID

insufficient to lay a deep foundation in each of these areas, yet answers would help in creating a necessary knowledge base within and outside of universities, the GoN, and civil society organizations to assist in meeting the fundamental objectives of river and water conservation.

There are many water challenges: delivering clean, affordable drinking water to everyone; developing and implementing standards to protect rivers, wetlands, and groundwater from untreated solid and liquid wastes; regulating the extraction of materials from the river bed and banks; preventing river fragmentation; harvesting but not mining of groundwater; developing hydropower in ways that meet ESG (environmental, social and

governance) best practices; revising water curriculum and practices to deal with consequences of extreme weather events and so on. The vast and dynamic waterscape of South Asia, including that of Nepal, encompasses diverse hydrological, social, and political contexts. Pathways to sustainable water solutions will be found through greater dialogue and the sharing of perspectives across disciplines and regions.

To begin such sharing, while in the COVID-19 lockdown in Kathmandu, I have worked with of my colleagues and associates to initiate the South Asian Nadi Sambad “river dialogue” (SoANaS) a platform for the exchange of views within and across disciplines and sectors about water

challenges in South Asia.¹⁶ SoANaS, is aimed at a dialogue beyond the confines of the nation-state to better understand, promote and champion the unfragmented hydrological cycle as central for sustainable water solutions. Arriving at such solutions would require altering “the structure and nature of current decision-making models, and the educational context within which they are generated, not only to accommodate a plurality of views, but also to generate options that would reflect the larger reality of water in nature and human society.”¹⁷

16 Details at <https://soanas.org>

17 Ibid Imtiaz Ahmed, Ajaya Dixit and Ashis Nandy (1997).

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River Health Mapping: An Approach for Sustainable River Management



Photo credit: Nabin Baral for USAID

Free-flowing Karnali in Rakam stretch in Dailekh

Nepal Rivers' biodiversity

Rivers are the lifeline of landscapes, providing habitats to numerous aquatic organisms from charismatic mega-species like dolphins and gharials to microscopic organisms such as diatoms and algae. Rivers also provide food for people and can be used to generate electricity. Nepalese rivers are exceptionally rich in aquatic biodiversity—and, in particular, beta-diversity—due to their vast elevational gradients from below 100 m above sea level (ASL) to above 8000 m ASL within 200 km.^{1,2} One of the three species of relict dragonfly, *Epiophlebia laidlawi*, can be found in the mountain streams of the country.³ Therefore, the country is considered as an open global laboratory for freshwater biodiversity study.⁴ Despite their high ecological and economic significance, rivers are being continuously abused through the influx of sewage; municipal, industrial, and commercial waste; and alteration in hydrological regimes and morphological characteristics. Aquatic biodiversity is in crisis in many river reaches that flow through semi-urban and urban areas. For instance, the Bagmati River in Kathmandu valley is devoid of aquatic insects and fish due to habitat destruction caused by discharge of untreated sewage, extraction of river aggregates, and river channelization.⁵ Similarly, hydropower projects have already fragmented many rivers. Loss of aquatic biodiversity could lead to irreversible ecosystem ramifications given its role in directly or indirectly regulating and supporting ecosystem functioning. Therefore, regular assessments and timely restoration are imperative before the ecosystems are broken down.

- 1 Tachamo Shah R. D., Sharma S., Haase P., Jähnig S., Pauls S. 2015. Climatic Change
- 2 Jüttner, I., Chimonides, P.D.J., Ormerod, S.J., Cox, E.J. 2010.. Fundamental and Applied Limnology, 177.
- 3 Jüttner, I., Chimonides, P.D.J., Ormerod, S.J., Cox, E.J. 2010.. Fundamental and Applied Limnology, 177.
- 4 Gurung, T. B. 2012. Nepalese Journal of Biosciences, 2, 71-79.
- 5 Tachamo Shah R. D., Shah D.N. 2013. Journal of Earth System Science 122: 1125-1139.

Rivers of Western Nepal

Freshwater ecosystems cover nearly 5 percent of total area of the country, in which rivers alone contribute over 48 percent of water resources (MoFSC, 2014). The Karnali River is the longest snow-fed river as well as one of the last free flowing rivers in Nepal, as yet undisturbed by damming or other large-scale water regulation projects. However, many hydro-power projects including the 900 MW Upper Karnali Hydropower Project, the 750 MW West Seti Hydropower Project, and Karnali (Chisapani) Multipurpose Project (10,800 MW) are planned in the river basin. Construction and operation of these projects certainly induces significant changes in flow regimes and morphology of the rivers, impacting the biotic communities living in the system and along the riverbanks. Karnali River and its tributaries are of high significance in terms of biodiversity as the river basin alone represents over 35 percent of protected areas in the country, while 14 percent of its basin is protected as national parks or hunting reserves situated along the banks of the river. The river system provides critical habitats for many IUCN Red List species such as River Dolphin,⁶ Golden Mahseer; and a relict Himalayan dragonfly.⁷ The river basin is inhabited by many endemic fish species such as *Schizothorax macrophthalmus*, *Schizothorax nepalensis*, and *Schizothorax raraensis*.⁸

The West Rapti River is the largest river amongst non-snow fed rivers in Nepal and has a drainage area of 6250 km² within Nepal. Unlike the Karnali, the West Rapti River has been used for hydropower generation, like Jhimruk Khola Hydropower Project (12.5 MW), and many smaller and large-scale hydropower projects are underway like the Lung Khola Hydropower Project (2.4 MW). Also, many local irrigation schemes have been developed with major plans underway for large scale irrigation schemes.

The timely intervention of the Paani program has ensured the assessment of aquatic biodiversity prior to the alteration of the Karnali River Basin and documentation of hydropower induced changes in aquatic biodiversity in Jhimruk watershed.

Kathmandu University's Aquatic Ecology Centre, with financial support from the USAID Paani, program conducted an intensive study in the five Paani prioritized watersheds: Tila, Middle Karnali, Thuli Gad, Lower Karnali in Karnali and Jhimruk in West Rapti in 2018 and 2019, and developed river health maps based on benthic macroinvertebrates community composition, sensory features, and ferro-sulphide reduction recorded on site during pre-monsoon season field work.

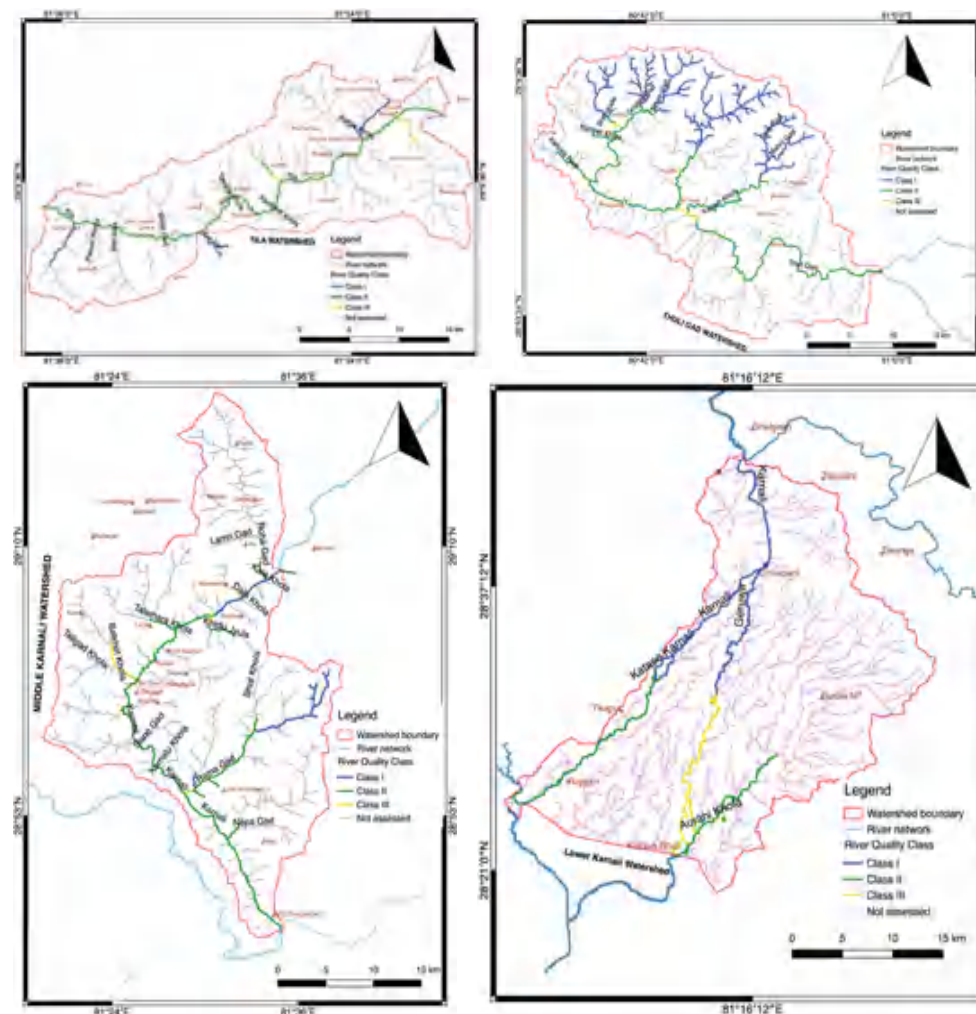
6 Shah D.N., Poudyal A., Sharma G., Levine S., Subedi N., Dhakal M. 2020. Journal of Threatened Taxa 12 (1).

7 Tachamo Shah R.D., Shah D.N., Sharma S. 2019. Final report-"River Health and Biodiversity Profiling in the Karnali and West Rapti Watersheds: Implications to Basin Planning and Sustainable Water Resource Management in the Western Nepal- (Aquatic Biodiversity and Community Resilience)". Submitted to USAID-Paani Program.

8 Shrestha T.K. 2019. Himalayan Ecosystem. Kathmandu, Nepal, 2019, 1-388. 10.

Key results:

- Most of the river stretches studied represent river quality class (RQC) 1 and 2, indicating high and good status, while RQC 3 was recorded for several other river stretches (Figure 1).
- Organic pollution was minimal in these watersheds. Hydro-morphological degradation including riverbed excavation were found to be major stressing factors in most of the river stretches in the Karnali River Basin and Jhimruk watershed of the Rapti basin. Tila and Middle Karnali were mostly affected by stressors related to activities and facilities.



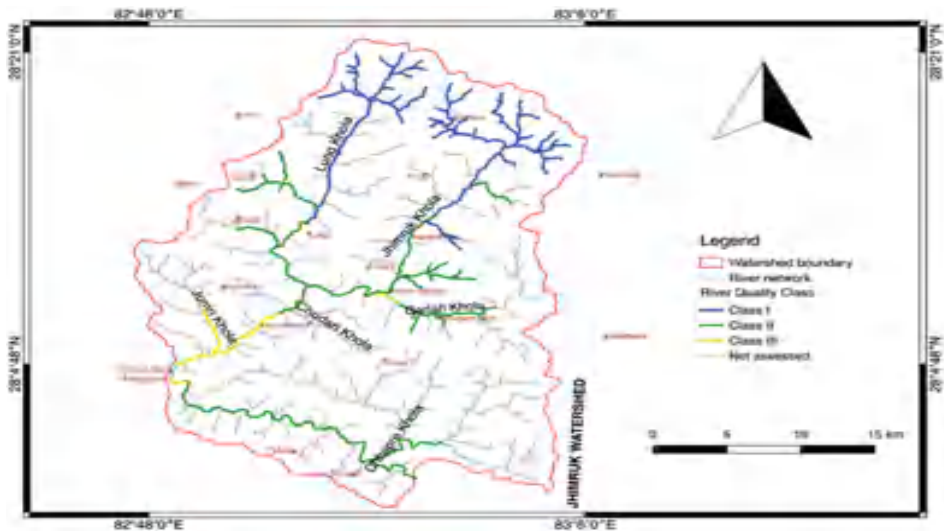


Figure 1: River quality maps of five Paani prioritized watersheds

Aquatic biodiversity

A total of 153 macroinvertebrate taxa belonging to 99 families representing 24 orders were recorded in the five Paani prioritized watersheds of Karnali and West Rapti. Trichoptera was found to be the most diverse order in benthic macroinvertebrates.

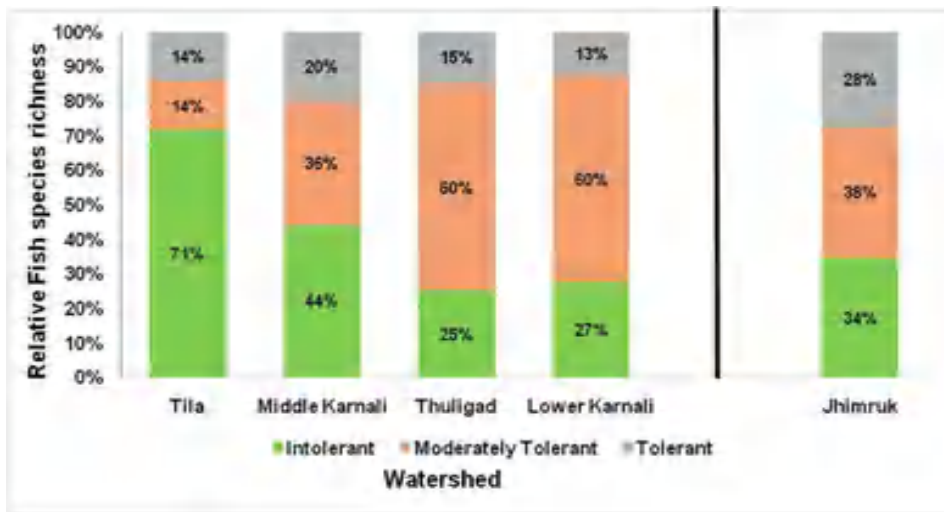


Figure 2: Composition of fish species as per their tolerance level across the watersheds. Proportion of color bar indicates changes in composition of sensitive fish species across the watersheds.

Similarly, 79 fish species and 35 diatoms and algae were identified in the watersheds. Both fish and macroinvertebrate richness were to be found higher in Lower Karnali compared to Jhimruk, Thuli Gad, Tila, and Middle Karnali.

In the case of fish, intolerant fish species declined from Tila to Lower Karnali watershed. About 50 percent of faunal diversity (macroinvertebrates-48 percent and fishes -58 percent) were similar between rivers and feeder lake (Bhagaraiya) in Lower Karnali watershed.

The highest proportion of tolerant fish species were recorded in Jhimruk watershed (Figure 2). Maximum number of juveniles of migratory fish (*Tor putitora*) were observed in tributaries of Thuli Gad and Middle Karnali watersheds indicating favorable spawning ground for the species (Figure 3).

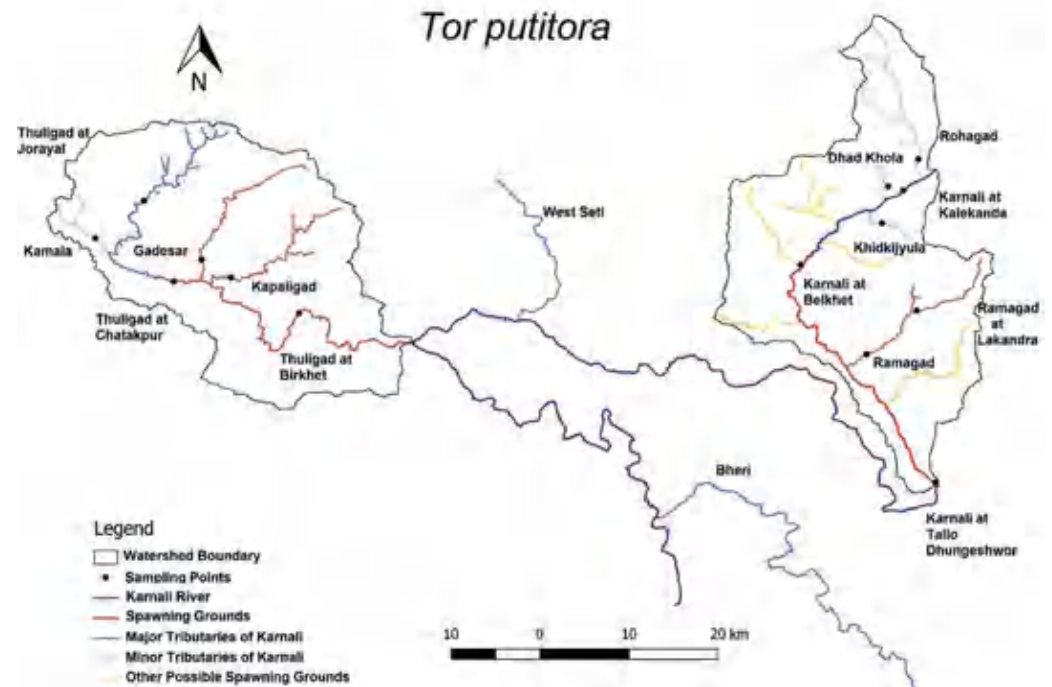


Figure 3: Distribution map of migratory fish (*Tor putitora*).

Citizen Scientists

One of the major objectives of the KU-led research activity in the five Paani prioritized watersheds was to develop bio-monitoring champions who could monitor the rivers regularly. During the project implementation, a total of 25 citizen scientists from 5 watersheds were trained in river bio-assessment (Photo 1). Training and involving local people who are interested in the field can collect a large amount of data in a short period of time. This is relatively cost effective compared

Migratory Species in Peril! Jhimruk Watershed

Larger Tor spp. were only located in the downstream reaches below the dam in Pyuthan and Airawati. Tor tor was found at the dam in the pool section which weighed about 900 g. This suggests that although migration in Tor spp. is still occurring, as shown by their presence in the downstream reaches, their effectiveness in travelling to the upstream reaches have been limited due to presence of the dam. Furthermore, after maturing, adults of Tor spp. cannot travel downstream since discharge downstream at the dam is low.



to the involvement of highly skilled researchers. Similarly, involving citizen scientists can bring sustainability to monitoring programs as they are the people living in the vicinity of the area and are available most of the time.

Study Impacts

- River health maps prepared based on benthic macroinvertebrates that best reflect the holistic ecological condition of the study watersheds.
- Generation of baseline data of macroinvertebrate diversity, parameters of water quality, fish diversity, periphyton, hydrological characteristics, stressors etc., for the five Paani prioritized watersheds over pre-monsoon and post-monsoon seasons.
- Identification of the impacts of operation of hydropower on instream biotic communities including fish assemblages.



Photo 1: Training on river bioassessment to local people in river of Kohalpur during regional training to citizen scientists in June 2019 (Photo by Dr. Ram Devi Tachamo Shah)

- Development of bio-monitoring champions—citizen scientists—at watershed level who can contribute to the assessment of rivers and prepare watershed health maps at regular intervals.
- Eight under/graduate students of Environmental Science were trained through field engagement and internships during the project.
- Bachelor dissertations: Two dissertation reports were supported during the project.
 - Title: Ecological Assessment of Rivers in the Middle Karnali and Tila Watersheds of Western Nepal. 2019 (Soni Lama: Supervised by Dr. Ram Devi Tachamo Shah).
 - Title: Ecological Assessment of Lakes in Mid-hills and Low-lands of Western Nepal. 2019. (Tapasya Subedi: Supervised by Dr. Ram Devi Tachamo Shah).
- Publication of research findings in peer reviewed journal [“Structure of Benthic Macroinvertebrate Communities in the Rivers of Western Himalaya, Nepal” by Ram

Devi Tachamo Shah, Subodh Sharma, Deep Narayan Shah, Deepak Rijal, Geosciences 10 (4), 150].

Lessons Learned and Challenges Encountered During the Implementation of the Paani Program

- The study was carried out in only 5 of 12 Paani prioritized watersheds, which has led to biodiversity profiling for a limited number of watersheds of the basin. Similarly, the study was done during pre-monsoon and post-monsoon seasons in 2018 to 2019 and only one-time seasonal data could be collected. This inhibits analysis of changes in biodiversity across space under different stressors over the time periods, and also limits insights into inter-annual biodiversity variability in the region.
- Interpretation of the data generated on water quality parameters from numerous study sites over the seasons and synthesis of results that is meaningful to diverse stakeholders demands the adoption of a water quality index suitable for the rivers in the region.
- A more extensive sampling in the headwater reaches and spring sources to understand the reference conditions in each watershed is imperative but has proved to be very challenging in terms of accessibility, logistics arrangements, and time constraints in the suitable seasonal windows.
- Evaluation of the intensities of stressors on river health is largely subjective and has limited ability to explain the overall impact of diverse stressors present in the watersheds.
- To attain a comprehensive inventory of fish demands, additional sampling and the use of different fishing methods—especially in bigger streams and lakes—is essential. Similarly, study of different environmental factors like flow, physicochemical parameters, altitudinal gradient, etc., in relation to the differences in the diversity and distribution of fish in different watersheds or stream sections is crucial.
- Limited study duration has limited the dissemination of the results at the watershed levels.
- Lack of regular financial resources had impeded continuous mobilization of citizen scientists in the basins.

Thoughts and Suggestions about Priorities in 2021 and Next Steps

- River quality maps serve as useful reference for the local government and the water resources planners at the national level.
- Aquatic biodiversity studies every five years is recommended to understand the scale of manifestation, or impairment, because of infrastructural development. Academic institutions could lead such research activities involving students from different batches.
- Intensive sampling of fishes should be conducted with special focus on using different techniques for different substrate and flow habitats in the streams, pool sections, and lakes.
- Further study of migration and spawning behavior should be prioritized for effective conservation of migratory species in watersheds and basins impacted, or likely to be impacted, by infrastructural development in the rivers.
- Certain sensitive species can be used as surrogate species for conservation of threatened taxa.



Din Bahadur Kumal, a fisher from Jhumruk Watershed

The framework for the analysis of the impact of stressors on river health should be further standardized by revising the stressor categories, defining the criteria for the intensity classes more objectively for field observations and by assigning different weights to the stressors in terms of their relative degrees of effects on water quality, aquatic biodiversity, and ecological health of the rivers.

NEFEJ/NEPAL FORUM OF ENVIRONMENTAL JOURNALISTS

■ RABINDRA RAJ PANDEY

While serving as the Executive Producer of the Paani TV program, I had the opportunity to witness the heroes—both celebrated and unsung—of watershed conservation. Some of the heroes I met are quite aware of their contribution towards a healthy aquatic biodiversity. They are knowingly involved and appreciate the value of healthy watershed management. Their goal is to continue what they are doing and enjoy every moment from the output of their impact.

At the same time, there are many people who must work very hard to sustain their livelihoods. After having morning meal, they are not sure whether they can have the next meal or not. One such person whom I met is Din Bahadur Kumal of Pyuthan, a 60-year-old man whose life revolves in and around Jhimruk Khola (Jhimruk River). He has been fishing for more than five decades and has no plan of stopping. Nonetheless, his contribution towards healthy aquatic biodiversity is enormous. His motto of life is, “I’ll rather die hungry than kill fishes who are spawning.” In many the years in which he has upheld this practice, he has contributed to healthy aquatic biodiversity without knowing the value of his actions. Featuring him in the Paani TV program was an added value for the promotion of healthy watershed management. By demonstrating the way Din Bahadur Kumal approached his livelihood,



Chain Kumari Tharu, the first champion featured in NEFEJ television episodes

other people could be motivated towards the value of conserving aquatic biodiversity.

Din Bahadur Kumal's story was an individual's effort for fish conservation. At a larger scale, the Paani project was successful in helping to establish aquatic biodiversity conservation groups as well. These community initiatives reflect people's awareness and motivation to do something for healthy watershed management. Four such conservation groups were formed; one each in Middle Rapti watershed

area, Middle Karnali watershed area, Rangoon Khola watershed area and Jhimruk Khola watershed area.

By covering the stories of healthy watersheds in Paani TV program, we have made the characters more serious towards the conservation. One can get such example from Chain Kumari Chaudhari of Badkisisniya of Dang. In the beginning we featured a story about their way of fishing in traditional way and their strong opposition against usage of electric shocks and bombs to kill the fishes. After the broadcast of that story, they felt that they were special to be featured on TV and thus became more serious towards conservation. As a result, they officially formed a women's group to conserve the river biodiversity and made strict laws not to use electric shock, bombs, and even big fishing nets to catch fish. This was a big achievement which led us to carry out follow-up stories on them. Paani TV established itself as a visual toolkit for the promotion of healthy watershed management.

Women play an important role in the conservation sector. The Paani team came across many women's groups who were actively involved in aquatic biodiversity conservation and watershed management. On International Women's Day, a story highlighting the role of a women's group from Baratu rural municipality, Kalikot, was featured. Women's voices supporting conservation initiatives were raised with priority.

You can see another example of community initiative in Barah Kunda of Bhimdutta municipality, Kanchanpur



Before and after picture of Bharakunda Lake at Bhimdutta Municipality in Lower Mahakali Watershed

District. The first time the Paani team carried out a story in this area, the local people were just starting to be aware of restoration of lakes and were making plans for the betterment of their area. After the broadcast of the first story, they felt inspired and thus started to implement their thoughts and plans in a serious way. We carried out a follow up story after a year, where we found a huge difference. The local people, local government and provincial government had made concrete plans for restoration of the lakes. Our reporting was effective in promoting good watershed practices among the local people.

Conservation initiatives are also effective when indigenous practices are integrated with new technologies. For example, in the Badghar tradition of Rajapur, Bardia, the community must contribute their labor towards developmental work in the village. Per Badghar tradition, the leader of the village is called "Chaudhari." The leader supports the division of labor, which is determined by the size of one's land. Moreover, the community utilizes the irrigation facility in a very scientific way. They have a farmer's group for their commercial farming, and all of their activities are carried out in a transparent way. This is a very good example of the participatory approach implemented from generation to generation. Also, this can be taken as an excellent example of the indigenous knowledge and the skills.

Some indigenous communities face many barriers to exercising their rights to water-based natural resources. Paani collected stories from the Sonaha community of Bardiya and Kanchanpur, the Majhi community of Rakam, the Raji community of Surkhet, and the Badi community from Ramghat. These communities are completely dependent upon the water-based resources for their livelihood. The Sonaha community are a minority fishing community whose livelihood is sustained through fishing and mining of alluvial gold dust. After this traditional livelihood that had sustained them for generations was criminalized, the Sonaha community has been struggling for their fishing rights.

Haphazard road construction is the major reason leading to the heavy sediment loads in the rivers. Our team carried out many stories to make the communities and the local government bodies aware of its negative impacts on the



A town hall meeting on the conservation of Phoksundo lake held on its bank in 2019.

Photo credit: NEFEJ for USAID

downstream river basins. We reported stories from the mountainous regions to the Terai plains. These stories captured the plight of some of the communities facing water scarcity for household and agricultural purposes, while the downstream Terai communities faced disasters every year due to inundations and floods.

We also featured stories of farmers whose livelihoods are highly interdependent with the watersheds. For example, Ram Chandra Chaudhari, a farmer and Secretary of Jana Abhiyan Farmers Group from Ambasa, Tikapur-6, did not use pesticides and other fertilizers in his land to prevent the fertilizer-based agriculture runoff from mixing into the nearby rivers. He has been a good example to other farmers, using tunnel farming (aka linear greenhouses) to grow vegetables both in and out of season, increasing the demand for his product and helping him to earn a better livelihood.

Paani has captured these good local practices and also created awareness about the negative practices. During story production, we came across many ill practices that had detrimental effects on the watershed areas. This included usage of electrical current and “bombs” for killing fish. We

immediately raised such issues and created awareness about their negative effects in the long run. Our efforts to raise awareness did not go in vain as many local governments and local community groups actively took part in policy formulation for the watershed conservation. Policies were formulated in Airawati rural municipality of Pyuthan district, Badhikedar rural municipality and Joroyal rural municipality of Doti district, and Mohanyal rural municipality and Chure rural municipality of Kailali district.

Community awareness on significant issues is important, but that alone is not enough. Therefore, Paani appealed to various stakeholders and national entities to solve the watershed issues that could not be solved through community efforts alone. We also carried out lobbying and advocacy at the local level through healthy, engaged discussions. In addition, mobile screening of videos was carried out in the remote areas where the local communities did not have access to television. This approach proved to be highly effective to raise communities awareness about the importance of healthy watersheds.

In addition, we provided capacity development trainings to local journalists so that they could raise the watershed



Townhall meeting on Bhagraiya Lake Management in Madhubaan Rural Municipality

Photo credit: NEFEJ for USAID

issues effectively in the media. In addition, we also increased the capacity of NEFEJ staff to report for the TV program. We had recruited radio journalists who did not have prior experience of producing TV program. Currently, many of our Paani journalists are contributing as program producers for national TV stations. After the completion of the Paani project, NEFEJ recruited two staff, one reporter and one video editor, from the Paani team.

Paani was successful in featuring positive stories of the local people, influencing communities, shedding light on the issues faced by indigenous communities, and contributing to the formulation of policies at the local level. Nevertheless, the impacts of our activities do not end here. I believe that we will reap additional direct and indirect impacts of our Paani-supported media initiative in the days to come as well.



A member of Raute Community fishing in Thuligaad Watershed

Photo credit: NEFEJ for USAID

THE NEPAL RIVER CONSERVATION TRUST (NRCT) AND THE PAANI PROJECT: COLLABORATION ON MULTIPLE FRONTS

■ **MEGH ALE, FOUNDER-PRESIDENT, NEPAL RIVER CONSERVATION TRUST (NRCT); MAUSAM KHANAL, EXECUTIVE DIRECTOR, NEPAL RIVER CONSERVATION TRUST (NRCT)**

The Nepal River Conservation Trust has collaborated with Paani on a variety of programs and projects. The largest and most important of these was the Karnali River Corridor Management Project (KRCMP) described in some detail below,

Other important areas of collaboration have included:

- Paani support for both the Second and Third National River Summits in 2017 and 2019;
- Participation by Megh Ale, Founder and current President of the Executive Committee of NRCT, in several high-profile events including the launch of the series of USAID/IFC/Australian Government Sustainable Hydropower Development Training Workshops and the USA/Nepal Collaborative Hydropower Learning Tour to the Pacific Northwest with senior Nepali decision makers in July 2016; and, most recently,
- Support for the development of a Center for Ecotourism on the banks of the Karnali at Rakam Karnali. Currently in the design and early implementation phase, this project builds directly from the Karnali River Corridor Management Framework and is being supported by the Paani-initiated Karnali Basin Conservation Foundation (KBCF) and Fund being managed by DSV Advisors (Dolma Fund, Safal Partners and VRock)

Karnali River Corridor Management Project (KRCMP)

This project aimed to provide a scientific foundation for a culturally informed, locally supported integrated water resource management framework. An interdisciplinary team of experts assessed and described the ecological and social values of the Karnali River (the only remaining free-flowing mainstem river system) in Nepal. This project collected the necessary data to initiate a substantive multi-stakeholder dialogue about balancing conservation and development in the Karnali region and to develop timely and empirically-informed conclusions that can be used to inform development projects and future legislative and policy efforts in Nepal. To achieve this larger goal, the project described and documented the environmental features governing the stream system processes of the Karnali River Basin, as well as the cultural and political factors that shape socio-ecological relations for the development of a Sacred River Corridor Management Framework that can support a proposal for Wild and Scenic River Legislation to the Government of Nepal. Two important documents were produced by NRCT in August 2019 setting out the details:

- Karnali River Corridor Management Framework
- Strategic Considerations for River Conservation Legislation in Nepal

Summary of Key Results

- There is a well-established myth that the Karnali River flows from Rakshas Tal on the Tibetan Plateau. The flow of the Karnali River does not come from Rakshas Tal but instead the headwaters of the Karnali River come from the meltwater of glaciers on the north side of the Himalaya in the Tibetan Autonomous Region of China. The Machakabab Spring in the Tibetan Autonomous Region, sacred to Tibetans, contributes to the flow of the Karnali along the way.
- The free-flowing Karnali river, one of the most pristine in all of Nepal, possesses an ecological diversity which can be used as a reference site for the restoration of

degraded sites in Karnali and other areas of Nepal. The Karnali River should not be seen only as a source of hydropower; the river also provides other uses of water resources and ecosystem services. The Karnali River Corridor concept has the potential to bring prosperity to the Karnali region by drawing on religious, cultural, and eco-tourism along historic trade and pilgrimage routes.

- Strategic and sustainable hydropower development is possible if the GoN does not only focus on developing large-scale hydropower projects in the Karnali Basin. They also need to focus on the development of other forms of alternative energy, such as solar and wind energy technologies, to enhance energy security and sovereignty. Doing so will provide sustainable energy without damaging the aquatic resources and recreational values found in the Karnali.
- The Karnali River Corridor Management Framework identifies and describes five sections of the Karnali River that we propose should be considered for formal classification via river conservation legislation in Nepal. Simply put, these sections of the Karnali have significant environmental, cultural, and social values equivalent to other “Wild and Scenic Rivers” in the United States and other high-value protected rivers around the world.

“Wild and Scenic” Conservation Planning of the Karnali River

We suggest that the main channel of the Karnali River remains free-flowing (if not in its entirety, then at least in certain high-value sections) to ensure that water resources and riparian lands are managed to maintain important social, cultural, and environmental values. While some sections of the river face specific pressures, our study indicates that the Karnali River itself is overall in a nearly pristine state. Therefore, we must act soon to preserve, protect, and improve riverine health, as well as the well-being of the diverse communities living along the river throughout Nepal.

The Karnali is rich in ecological, cultural, and scenic resources. In many ways, it embodies the sense of “wild and scenic” that

has guided river conservation efforts in other countries around the world. The findings of this report are based on a literature review of river conservation legislation and the rights of rivers internationally, as well as a series of consultations with Nepalese water experts and environmental advocates.

The Karnali River Corridor Management Framework describes five sections of the Karnali River that we propose should be considered for formal classification via river conservation legislation in Nepal. All of the sections have been identified using criteria including designation (wild and scenic), nature of the river section (free-flowing or not), outstanding and remarkable features (geology, wildlife, fisheries, recreation, scenic, cultural, or historic), conservation measures in place, and possible threats to the section. It also incorporates the key opportunities found in that area. The proposed sections are based on the following working definitions, which were created in the context of river conservation legislation in other countries but reviewed by legal experts in Nepal.

- **Wild River Areas** – Understood as those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially undeveloped and waters unpolluted.
- **Scenic River Areas** – Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely undeveloped, but accessible in places by roads.
- **Recreational River Areas** – Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.
- **"Free-flowing"** – As applied to any river or section of a river, means existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.



An aerial view of a tributary mixed with the main stem of the Karnali River

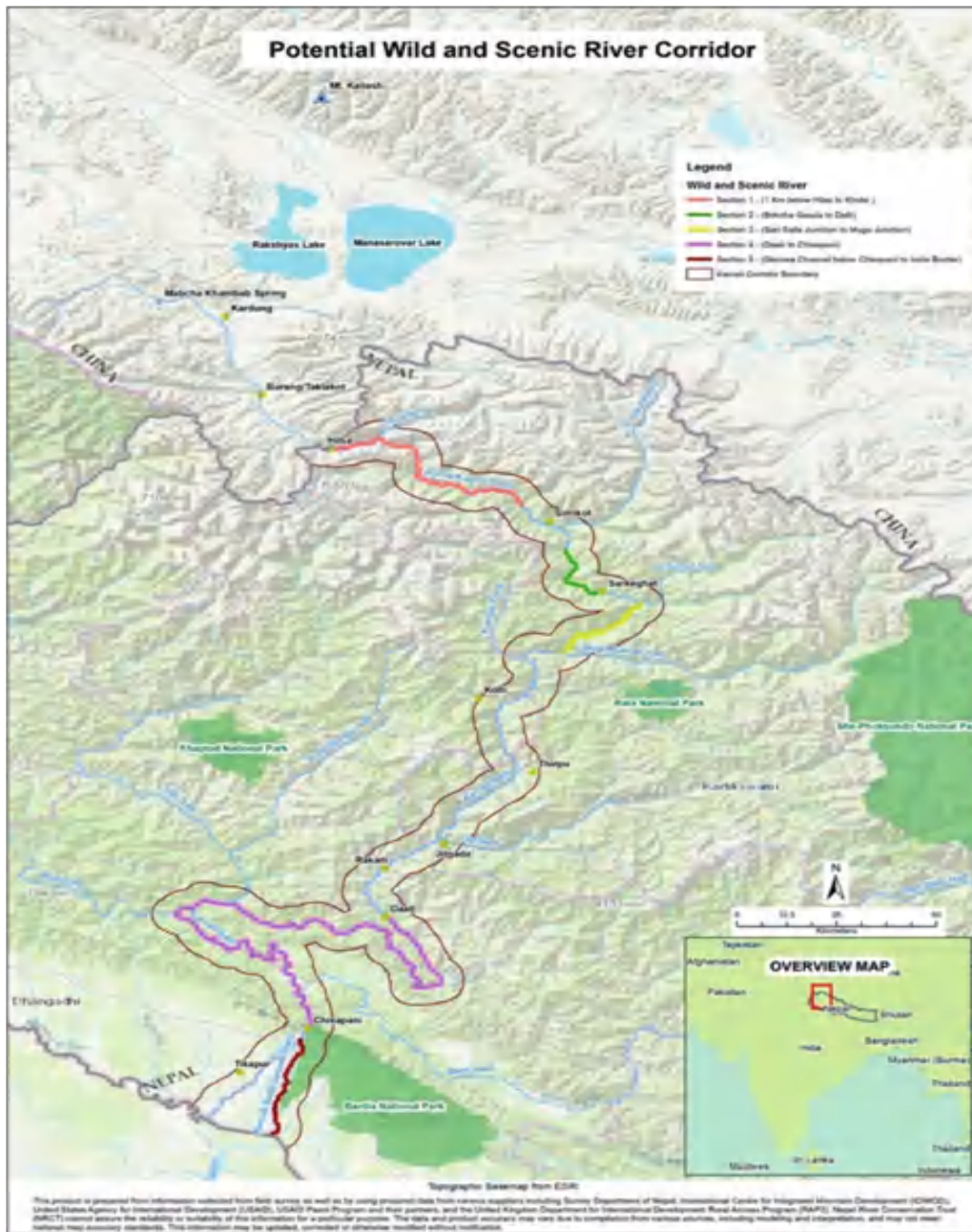


Figure: Map of Wild and Scenic Sections in Karnali River

- **Outstandingly Remarkable Value (ORVs)** – Outlined in terms of geology, wildlife, fisheries, recreation, scenic, cultural, and historical values.

Lessons Learned

- Creating river conservation legislation is only half the course. Doing so requires the creation of long-term river conservation management plans, and efforts to ensure that river conservation efforts are effectively implemented—which includes monitoring and evaluation programs designed to ensure compliance and accountability.
- Strong communications networks and connections to the media help to promote and disseminate information to wider audiences. Social media promotion is a strong tool for dissemination of news and events as well as outcomes of the expedition and project itself.
- Conversations with local government representatives who have pursued local legislative efforts in the Karnali region indicate that the time is right for innovative legislation at the local and provincial scale.
- Getting people together to talk about environmental issues in the form of stakeholder consultations, workshops, and multi-sectoral events such as the Third National River Summit is critical—so is the process of local consultation. These types of dialogue can generate complementary initiatives and seed or facilitate future environmental efforts, even if immediate outcomes and goals seem distant.

Recommendations

- River conservation legislation should be introduced at the local, provincial, and national scale. To do so, use a participatory approach in drafting legislation and planning to determine which sections of the river will be protected and what that means for the future.
- Declare a “Masheer Conservancy” fish sanctuary from Rakam to 16 km below the Thuli Gad Confluence and 10 km above the Seti Khola. This conservation area could be a world class research area for Masheer and support development of a remote (helicopter or boat-in) high-value catch and release fishing business.
- Identify and declare conservation areas for sport fishing and angling that diversifies ecotourism opportunities linked to fishing.
- The Karnali region should pursue a sustainable hydropower development model to generate more than 6,000 MW from tributaries, while leaving the main stem free-flowing for ensured conservation of freshwater biodiversity and ecosystem integrity in situ.

Next Steps

- Environment and conservation related projects must be implemented for longer periods of time—over 15 to 20 years—to achieve the necessary outcomes. Short term projects lasting five to seven years cannot capture environmental benefits.
- Identifying high-value rivers and river sections for conservation requires a strategic perspective that considers water resource management issues at the basin and national scale. Strategic and cumulative impact assessment of water and energy infrastructure is sorely needed in Nepal, especially given the density of hydropower development licenses that have already been sold and the number of planned hydropower projects distributed throughout the many watersheds of Nepal. Currently, cumulative impacts are poorly understood (both by policy makers and the public), and coordinated, strategic decision making about the management of water resources is minimal.
- River conservation advocates need to take local desires for economic development seriously—otherwise they run the risk of being perceived as “anti-development” in the current political climate. To ensure that local livelihoods are taken into consideration, river conservation advocates should work directly with local stakeholders to develop innovative and place-based livelihood opportunities, livelihood enhancement initiatives, and training programs. Therefore, river conservation advocates need to engage potential stakeholders in open dialogue about the potential impacts (positive and negative) of both hydropower development and river conservation efforts.
- Choosing the correct language is critical for legislative and policy-oriented efforts, as well as general campaigns focused on environmental awareness. To ensure that different stakeholders can understand, relate to, and even identify with river conservation goals, it is critical to workshop different terminologies and phrasings. This could be done by working with a linguist and/or conducting focus groups to determine which terms are most meaningful and appealing to differently positioned stakeholders.



Wide and braided stream of Karnali in trans-Himalaya in Humla, Nepal

Photo credit: Nabin Baral for USAID

Additional Reflections (prepared by Megh Ale)

#1. USA/Nepal Sustainable Hydro Energy Development Study and Learning Tour to the Pacific Northwest (July 2016)

#2. Managing Rivers for Nepal's Prosperity

#3. PANCHASHEEL – the “Five Principles” for Karnali Province Prosperity

Reflection #1: USA/Nepal Sustainable Hydro-Energy Development Study and Learning Tour to the Pacific Northwest (July 2016)

I must say it was an eye-opening tour for me. The lectures from the professors and instructors were excellent, the

observing the effort being made to revive the rivers in their natural state while promoting salmon fish conservation during field visits was very interesting. The visit to a Native American village to participate in a salmon ritual was a memorable event. It was incredible to see how much care and respect Native Americans have for the river and nature. I still remember one of the professors telling us that the U.S. has made many big mistakes, which made me realize that because Nepal is still raw and undeveloped, we still have a chance to save our rivers. If we do not do this now, then retrofitting can be much more costly in the future. This is what has happened in U.S.—close to 1,000 dams have been removed in an effort to bring rivers back to their natural states, costing huge sums, and there is still more to be done.

It will be wise for Nepal not to repeat the same mistakes that the US and other first world countries have made.

One of the most important things I saw during this trip was management of a trans boundary river, the Colombia River Basin, between U.S. and Canada. During the trip, we learned about how the treaty was signed between the two countries after a long negotiation, and how the benefits of the treaty have been shared between the two countries. Because the treaty expires in 2024, renegotiation is ongoing. At the same time, there are environmental activists loudly pushing to decommission and remove the dams. It seems their voices are not unheard and that negotiations may carry

on between them, the two national governments and the tribal authorities.

Nepal and India have many transboundary rivers, and many disputes exist over benefit sharing. There have not been fair deals at all on the Koshi, Gandak, and Pancheswar dams. Our country needs to renegotiate the deals with India to make sure we have a fair deal in sharing the benefits of these transboundary rivers. Nepal must study the best practices surrounding transboundary rivers across the world and apply these learnings to renegotiating with Nepal to create a win-win benefits-sharing situation.

Meeting with Karen Bennett:

It was great to meet up with Karen; she was the coordinator for USFS and our team from Nepal. I shared my dream and vision with her about Karnali and rivers of Nepal, as well as my mission to keep the Karnali river free flowing. She advised me that the river campaign needed to be backed up with more science-based evidence to make it more logical to increase its chance of success. In order to engage the politicians, policymakers, as well as the public (aka river communities), we needed more logical and science-based evidence. This is how we planned the first scientific Karnali expedition from the source in Tibet/China to the Ganges in India—1008 km of distance in 44 days, implemented with USAID Paani and other donor support. Karen helped write the proposals to international organizations, ICIMOD, airlines and other private companies. They came on board as it was for a worthwhile cause.

Meeting with George Taylor by the Boulder Creek:

After the study tour I travelled to Boulder, Colorado to meet up with some of my friends from the Waterkeeper Alliance to go out on a river rafting trip. While there, I also wanted to meet George Taylor. We met for dinner at a restaurant by the Boulder Creek. I shared my idea and vision to save the Karnali, and we discussed how this mission could go forward. I still recall that summer evening looking at the Boulder Creek, listening to the sound of the water as he told me, “look my friend, many types of environmental activism started from here and succeeded. Now we start Save the Karnali campaign from here.” I really felt good about the whole situation, and now the mission is on.

The rest is history—now we have Karnali River Basin Framework and Strategic Considerations for River Conservation Legislation in Nepal. The Third National River Summit was a great success, thanks to Paani. This really made the Karnali Province politicians and policy makers think a little differently. Most recently, the WWF (with Paani support) has been very engaging on high conservation value rivers as well as on an energy options



White water rafting expedition in Karnali

Photo credit: Nabin Baral for USAID



assessment and system scale planning for hydropower development across Nepal.

Reflection #2: Managing Rivers for Nepal's Prosperity Being Serious About Development

If we are serious about developing our country, Nepal, first of all we have to realize what our strengths and weaknesses are, and what Nepal has to offer.

Nepal has 6000 large and small rivers, which have the potential to be an asset or liability depending on how we manage them for our short and long term prosperity.

We must also look around the world and learn from others as well. For example, before oil was discovered in Dubai, the country relied on trade and transit for income. However, once oil was discovered, UAE/Dubai's economy boomed.

Not that long ago the Sheikh realised that oil is not going to last for ever and he must look for other options to sustain his country. So, he applied the wealth he had made from oil to modernize Dubai's historic trade and transit revenues by creating banking institutions and infrastructure to beautify the city; and to facilitate both industries he introduced tourism. Now the country's economy is 60 percent tourism, 20 percent trade, and 20 percent oil.

Vision Statement

I would like to put forward five things what Nepal must do which could be the recipe for Naya Nepal.

Tourism Industry: Nature, Culture and Adventure based - Which has to be recognised as low hanging fruits and it can be a quick relief for the nation as well as a long term

one, this can be the backbone of our economy. It is a low investment and high return.

Agriculture: We must understand the value of Himalayan herbs and declare Nepal as an organic country within the next 10 years. We will not be able to fulfil the demand of our neighbouring countries once we produce our organic products.

Handicraft and Cottage Industry: We are extremely rich in our handicrafts, which must be used to develop the cottage industry. We already have a good reputation in it and our products are well recognized by many countries around the world.

Trade, Transit, and Banking Institutions: Trade, transit, and banking institutions need to be developed in the country. We are members of the WTO, as are India and China. Nepal must take advantage of being in between these two economic giants. Why should not Nepal import the system like in Hong Kong or Singapore in banking and introduce free trade dry ports? The experts and policy makers must look into it.

Hydro Industry: Without a doubt, Nepal is the second richest country in the world in hydro resources. The above four points will not be complete without the support of hydropower, and this point will enlighten all the above. The priority must be the above four to take care before we go elsewhere. Implementing this cannot be compromised.

Nepal therefore cannot afford to destroy nature for the sake of hydropower dollars. Once nature is gone, all will be gone forever.

These above five have to go hand in hand simultaneously and once we bring together these five points they can be the Naya Nepal. Only if we all put them together and close the hand, this will be the Naya Nepal we all are looking for - peace, prosperity and living in harmony.

Avoiding the Destructive Path

Power, both physical and mental, can always be destructive if not used constructively. Nepal must look at how we can use our hydropower constructively because it can be destructive as well.

When we want to build a hydro dam, we must plan for over 100 years or more, and ask ourselves, would the dam still be viable after that many years, what would be a better option for long term sustainable development? Would the hydropower industry help sustainable development? For example, Nepal may get very rich by selling the power to India. Will that money give jobs to more people in the country? The best is to go for micro hydro, small and a few medium hydro schemes where we have low cost, low maintenance and maximum benefits instead of dreaming about hydro dollars.

Most of the big streams and rivers have been registered in private companies' name, there are almost no river or stream left. Any profit on the schemes they build will go to private companies. With this process the rich will become richer and poorer will be much poorer. Our people must realise that our natural resources (Jal, Jamin and Jungle) belong to the people of this nation, not only to a handful

of rich and powerful people. In the past, there has been the perception among many politicians and policy makers thinking the bigger the dam, the bigger the investment and the bigger the commission.

Take a Bird's Eye View

Nepal needs to develop a long-term vision with a specific plan to carry on in its mission to manage the natural resources for the benefit of our people. When looking at developing hydropower the government should consider dividing Nepal into three different zones, vertically as well as horizontally.

Vertical Distribution:

Our country's topography starts from 80 meters in the south and goes all the way to over 8000 meters in the north. Most of our rivers come from above 6,000 meters

above the sea level. Therefore, our plan should be to allocate and manage these zones as follows:

Zone A: from 1,200 to 5,000 meters – Hydro Industry Zone.

Zone B: from 200 to 1,200 meters to be recognized as Recreational and Conservation Zone, or the Wild and Scenic River Zone.

Zone C: from 80 to 200 meters Irrigation Zone. Rivers will be utilized on a priority basis for irrigation of our fertile lands.

Horizontal Distribution of Our Rivers Across Nepal and their Proposed Management

- **West Nepal** – The Karnali should be declared as our Himalayan Heritage River. There are national parks in the name of the mountains and jungles, but we do not have a single national park in the name of rivers. Other tributaries of the Karnali such as Mugu Karnali, Seti, Lohare, Tila and Bheri as well as in far west the Mahakali river bordering India can be developed for hydroelectricity.
- **Middle Nepal** – From Kali Gandaki, Madi, Marshyangdi to Trisuli can be developed for hydropower but leave one of the five main tributaries of the Trishuli, the Madi, free-flowing.
- **East Nepal** – Leave one of the rivers untouched from East Nepal - the Tamor. The rest of the tributaries: Indrawati, Tama Koshi, and Arun can be developed. While building these dams, the local tourism and ecology must be carefully considered.

Data shows that Nepal has over 6,000 rivers and streams which have hydropower potential. Nepal also has got the capacity of developing 83,000 MWs of electricity. If we save the three recommended rivers (Karnali, Madi and Tamor) we may have 10,000 MWs less but we still will have 73,000 MWs remaining power, more than enough for both Nepal's needs and for export. There is no good reason not to keep all these three rivers free flowing in Nepal for our future generations.



Keeping the above in consideration, the best policy option for the Nepal government to support the flourishing of whitewater rafting/adventure tourism and hydropower industries is to ensure that no hydropower construction happens below 1200 meters on popular rafting rivers. Most river expeditions start below 1,200 meters elevation and most of our rivers come from 7,000 meters. This can be the only way to sustain both industries - adventure tourism and hydropower industries together without displacing one another.

As an example, the very recent problem we are facing is the Middle Bhot Koshi hydro project where Chilime Hydro Power Company wants to build a dam on the most popular rafting stretch. In fact, this stretch of the river is considered world class river for white water rafting and kayaking and among the Top 10 in the world. The brand name Bhotekoshi for rafting is renowned in the adventure world. It is as famous as Annapurna and Everest for trekking. The river is located in Sindhupalchok District along the Arniko Highway and the border is only three hours away from Kathmandu. The highway carries traffic of over 30,000 tourists every year. It is the only border crossing that will bring thousands of Chinese tourists in the near future. This river stretch must be protected, but this district has already built five hydro projects. The district needs to diversify and support sustainable development by supporting projects other than just hydro power.

To reiterate, we are not against hydro development, but since we have 6,000 rivers and streams which have hydro potential it is vitally important that we make broad, systematic plans that consider all development alternatives and leave a few free-flowing rivers to support adventure tourism and aquatic biodiversity.

Reflection #3: PANCHASHEEL – the “Five Principles” for Karnali Province Prosperity

1. Karnali, the Faith of Many Religions

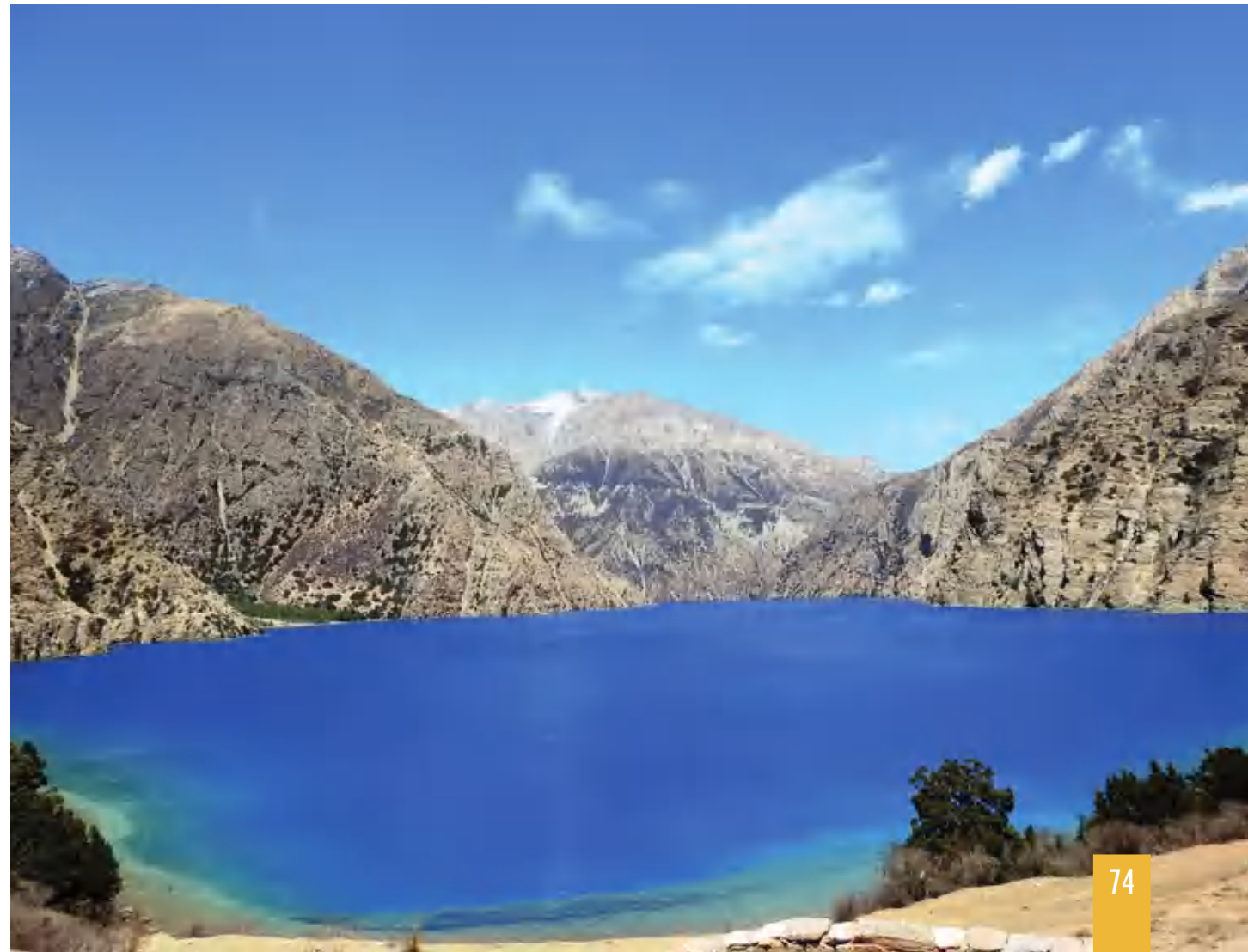
The Karnali emerges from the earth in the Mount Kailash region. A region that is sacred to Hindu, Buddhist, Sikh, Jain and Bon religions. Mount Kailash is a sacred pilgrimage site for hundreds of thousands of tourists annually. The Kailash region is the source of four life-giving rivers supporting

billions of people. From the Kailash region, the Brahmaputra flows to the east, the Indus to the north and the Ganges and Karnali rivers flow south. The Karnali flows over 1,080 kilometers through China and Nepal to India where it merges with and supplies the greatest flow of all tributary streams to the holy Ganges river.

2. Karnali as Cultural Heritage - the Root of Nepal's Civilization

An ancient trade route, bringing salt, wool and meat from Tibet to trade for rice from India, travelled along the

Karnali. The trail is witness to many varied and rich cultures. Tibetan Buddhists live along the river corridor in Kailash region and in river valleys of upper Humla in Nepal. The Khas civilization-the source of Nepal's national language, the Raute - the last nomadic people of Nepal, Chettri, Magar, Tharu and Sunwa civilizations are also found along the Karnali river corridor. The unique cultures of each of these ethnic groups is vibrant today and witnessed by their lifestyles, architecture, farming and fishing practices, religious beliefs, and cultural celebrations.



3. Karnali as an Ecological Library

The Karnali boasts great ecological diversity on land and biological diversity in its waters. The Karnali River flows through almost every ecological zone found on earth and all eight physiographic provinces of Nepal. The river supports more than 79 species of fish, including the endangered Golden Masheer and Giant Catfish and other aquatic species of global significance such as the Ganges River Dolphin and Gharial. In addition, multiple wildlife species depend on the stream flows and riverine habitats created by the Karnali. Few other rivers in the world support this biological diversity or flow through such great ecological diversity in such a short distance. The Karnali, as a free-flowing river, can serve as a reference library to help understand climatic changes under natural conditions. Protection of this resource protects global biodiversity.

4. Karnali as a Sacred River Corridor and World Heritage Site

Creating legislation that legally designates the Karnali as a Sacred River Corridor would solidify this section of the Karnali river basin as an icon of Nepal—perhaps even gaining the title of “World Heritage Site.” The Kailash - Karnali Sacred River Corridor can be developed for pilgrimage, culture, and eco-adventure tourism. It could be a place where hundreds of thousands of visitors per year can come and explore this pristine and sacred landscape. Any development within this corridor would be done in an environmentally sustainable way that protects people, their cultures, and the environment (including the river system). In addition, within the Sacred River Corridor, sections of the Karnali would be protected as “Wild and Scenic Rivers” as well as Masheer, Ganges River Dolphin and Gharial Conservation Zones. These protections would bring prominence to the area and would ensure that the outstanding natural and cultural values of the river are protected into eternity. The Karnali is the last free-flowing and most pristine river of this group, and the last free-flowing main stem river in all of Nepal. As rivers are the arteries of earth, we need to protect them to sustain our human civilization. As such, the Karnali is truly eligible as a World Heritage Site.



A long exposure shot of the sacred Karnali River

Photo credit: Nabin Baral for USAID

The Karnali River is at a crossroads. Hydropower development is planned in the lower river with four mainstem dams already licensed, though construction has not yet begun. According to the Department of Energy, Nepal has a potential to generate over 43,000 MW of economically feasible hydroelectricity. Only two percent of that is currently being produced. The way forward is strategic, sustainable hydro energy development rather than random development that has greater and much more serious negative environmental consequences. Hydropower licenses have already been issued for 6510 MW production on Karnali tributary streams. Why not consider strategically developing hydropower in smaller tributary streams first and protect the resources of the mainstem of the Karnali river?

5. Karnali as a Gateway to Prosperity

If the base of development and prosperity is tourism, organic agriculture, and local cottage industries, then the Karnali River is as good as Everest in the east, Annapurna and Dhaulagiri in the central region and Janaki temple and Lumbini in the south. We must protect this gift of nature. If the man-made Great Wall of China can generate visits from over 10 million tourists, the Karnali, as a wondrous gift of nature, can attract millions of visitors to explore this Sacred River Corridor. Karnali is already world renowned for rafting and kayaking, considered among the five best whitewater rivers in the world. If the entire corridor is branded well and environmentally sound infrastructure developed to retain the natural character of the area, the entire Karnali corridor could be known throughout the world as a jewel of Nepal.

Once the Karnali is dammed, many opportunities are gone forever. It is time to sit back and think hard before we commit another mistake. Many nations of the world (US, Australia, New Zealand, Japan, Bhutan) have now realized their error in damming their rivers and are protecting remaining free-flowing sections with laws and regulations and removing dams in critical fisheries habitat. The Karnali could be a symbol to the world of informed, proactive sustainable watershed development. True, the Karnali could be easily dammed to create electricity but it could also be utilized in its natural condition to realize an alternative future – one that brings long-term prosperity to the region and the nation and protects global biodiversity. The decisions made now could ensure a healthy, vibrant river and economy and would be an invaluable gift to future generations and a gift to the living earth.

"If we fail to manage our rivers, there will be no sustainable peace on earth". – Megh Ale

■ NABIN BARAL, PROFESSIONAL PHOTOGRAPHER

Portrait of Karnali: The last free-flowing river of Nepal

Photographer Nabin Baral travelled along the Karnali river in Nepal for 44 days to tell a story of an ancient and beautiful river under pressure. Nabin has seen the number of hydropower dams increase enormously on rivers throughout Nepal and wanted to document the last free-flowing river before it is too late.

Gandaki, Koshi, and Karnali are the three major river systems in Nepal which flow from the Himalayas. The Karnali is the only river that remains free-flowing, as all other rivers—including most of their tributaries—have been dammed for hydropower generation. Currently, 43 hydropower dams producing over 1MW are already in operation, and another 83 dams are under construction. In total there are over 350 hydropower dams which are slated for development throughout the area.

In this portfolio, I have taken the Karnali River in Nepal as a living entity and travelled along the river for 44 days to capture it before it is dammed. Karnali is an antecedent river and is older than the Himalayas. This means that its water has been cutting its path for millions of years while the Himalayas rose from the ground.

The Mapcha Khambab river of Tibet becomes Karnali in Nepal and Ghaghara in India. The trans boundary Himalayan river travels 1,100 km from its source in the Tibetan Plateau in China through the mountains of Nepal to the confluence in the Indo-Gangetic plain in India. In Nepal, Karnali travels 507 km, making it Nepal's longest river.

Due to the Karnali's trans boundary nature, the river is a lifeline for the millions of people living upstream in the Tibetan Plateau, the mountains of Nepal, and downstream in the Indo-Gangetic plain.

Rivers are like veins of our body; without them we do not exist. A free-flowing river provides food for hundreds of millions of people, delivers sediments crucial to agriculture, mitigates the impacts of floods and droughts, and supports a wealth of biodiversity and migrating aquatic life.

The Sacred Karnali Corridor has some of the most rare and beautiful gifts of nature, including the snow leopard, the royal Bengal tiger, the one horned rhino, the Golden Mahseer fish, the Ganges river dolphin, and the longfin freshwater eel. The free-flowing Karnali is living heritage of the earth; it should be protected and used in a sustainable way.

Although the Karnali still flows freely in its Nepal section, two dams in Tibet and one barrage in India disturb its flow to the north and the south. The following prophetic Cree proverb warns of the disaster that humanity faces if we do not drastically change our treatment of rivers like the Karnali. "Only when the last tree has died, and the last river been poisoned, and the last fish been caught will we realize we cannot eat money."

Editor's note:

Nabin has kindly shared 10 pictures from the 2018 Karnali Expedition organized by the Nepal River Conservation Trust (NRCT) with support from Paani and many others. In addition to these beautiful pictures that capture the landscape, he took many pictures of the people who live and work along the river. Some of these are included in the documents reporting on the Expedition. Others were part of an exhibit in Surkhet during the Third National River Summit in March 2019. Many are available at <http://nabinbaral.com/the-last-free-flowing-river-of-nepal> and <http://nabinbaral.com/the-karnali-portrait>.

NWCF/NEPAL WATER CONSERVATION FOUNDATION

■ **CHIRANJIBI BHATTARAI**
EXECUTIVE COORDINATOR

I personally came to know about USAID's Paani project in March 2017 during the Second National River Summit held in Trisuli Riverbank at Theuwater of Gorkha District, Nepal. The Summit provided me the opportunity to learn more about its activities. Since then, I have connected with the project through different events and organizations. Of those, the following aspects are worthy to mention, although Nepal Water Conservation Foundation (NWCF) was not involved institutionally except for the Third National River Summit (2019) and the IWMI-led Digo Jal Bikas survey.

1. River Summits

As someone who is involved in the conceptualization of river summits in Nepal and organizing the First National River Summit, I believe that the Second River Summit successfully drew the attention of activists, researchers, policymakers, and professionals on the burning issues of rivers in Nepal by bringing them together in a common forum to discuss issues and challenges. The USAID Paani project contributed financially to organize the Summit. Additionally, some of its partners and professionals took part in the Summit and shared information about the project. This event contributed to the river conservation campaign in Nepal.

The Third National River Summit held in Surkhet and on the banks of the Karnali at Rakam Karnali in March 2019 was a mega event in the river conservation campaign, involving research, policy, activist, private sector, political leadership, and local community members that discussed and debated about both the positive and negative developments linked to and impacting the rivers and river basins of Nepal. This Summit's major achievement was the Karnali Declaration that condemned haphazard development practices continuing in the guise of physical infrastructure building and called for an



Karnali River Basin outside of the Magar Homestay in Sunpur, Janu

Photo credit: Christel Bonarero for USAID

immediate end to such practices. The Declaration demanded that the rivers should receive legal recognition as living entities, and that the main stem of the Karnali River must be recognized as a free-flowing river for the sake of future generations. The private sector hydropower generators' participation amidst the program and discussions and debates on the domestic needs, export potentials, and model of hydropower development in Nepal made the Summit a multi-stakeholder dialogue on river conservation and development.

2. Water and Environment Friendly Local Governance

A recent survey of springs conducted by Nepal Water Conservation Foundation has revealed that about 74 percent of local governments in Nepal have experienced incidences of springs drying up—the only source of water for millions across the hills and mountains. The problem is further exacerbated due to the water body's pollution. Major causes are the haphazard physical development—particularly in road construction—and haphazard urbanization. The U.S.

Forest Service-led environment friendly road construction training workshops and guidelines development piloted by some local governments is a remarkable initiative. However, lessons learned from their execution and implementation are still unknown. Likewise, the aquatic biodiversity conservation law-making emanating from the local government level is a creative step to engage local actors in water and biodiversity conservation and build ownership of such programs.

3. Watershed Database and Journal Articles

Prior to Paani, scientific research related to rivers in Nepal was limited and had limited coverage. Whatever research was conducted in the past was focused mainly on hydroelectricity generation. In such a situation, Paani provided financial support to research projects helping to collect and generate scientific information, contributing to a mission that aims to create a baseline database of rivers in Nepal. Moreover, the research results published in national and international journals, online portals, and media have helped to disseminate the research findings.

4. Karnali River Corridor Management Framework

Two documents produced under the project, i.e. Karnali River Corridor Management Framework and Strategic Considerations for River Conservation Legislation in Nepal, have a long term significance where NWCF was consulted during the review. Additionally, I was involved in dissemination events. The impressive documents covered several important aspects of the Karnali River and ways to protect and conserve it. Since NWCF has been campaigning to keep the Karnali a free-flowing river, the documents provide scientific justification to recognize Karnali River as a sacred river and keep it free flowing. Moreover, these research reports can contribute greatly to initiating legal battles against unplanned hydropower development and can make the case stronger in favor of the Karnali River and biodiversity conservation.

Lessons:

- Considering the massive and haphazard physical developments contributing to the drying up of springs and water bodies, biodiversity losses, and water pollution, partnership with local governments and stakeholders can achieve faster results and build stronger ownership over the natural resources than a “top down” approach.
- The Western model of private sector involvement in natural resource conservation sector may not work in Nepal as expected considering the size of its economy and the experience and philosophy of the private sector. The attempt to apply such a model—especially in the Nepal River Basin Conservation Fund—can be a litmus test that will need careful assessment and evaluation to measure its success.

Way Forward

- Extensive research and evidence-based policy making can contribute to water/river conservation, and natural resource management. The above examples indicate as much. Therefore, comprehensive programs to promote scientific research, evidence-based policy making, and legal activism are essential. Moreover, coverage should not be limited to only some river basins, but should be



Use of heavy equipment for rural road construction in Jhimruk Watershed

Photo credit: Bhaskar Chaudhary for USAID

applied all over Nepal, and non-profit public interest groups should be mobilized and prioritized in such areas to bring tangible results and achieve sustainability.

April 28, 2021

SCOTT WILSON NEPAL

■ SHUVA SHARMA

Environment Friendly Road Construction Activities
Paani Program
Key Results, Lesson Learned and Future Priorities

1. Key Accomplishment

Problem Statement

Poorly executed rural road construction in the mountainous areas of Nepal continues to be one of the key root causes of slope instability and soil erosion in country. The direct

effects of this are the occurrences of landslides¹ and gullying, and the subsequent effect on watershed health through sediment disposal and diversion of water courses, among others. The reasons why the problems associated with rural road construction persist are complex and have been sustained over decades of malpractice in the sector. Contributing factors are diverse, ranging from environmental and engineering capacities of local government teams to political economy, governance practices, and the corruption associated with road construction processes at all levels.

SW Nepal (Scott Wilson Nepal/SWN) was assigned by the Paani program to undertake an “Environment Friendly Rural Road Construction Support Activity (EFRC)” intended to build trust among stakeholders, allow a deeper level of knowledge-sharing and best practices, and includes sustained and close engagement of local governments (LG).

Key Results and Accomplishments

¹ Road construction is attributed as the cause of nearly 40 percent of the landslides in Nepal

The following are key results and accomplishments achieved by SWN during the assignment:

- Prepared “Environment Friendly Rural Road Construction Guideline” for 15 LGs and was endorsed by the local assembly of 6 LGs. The contents of the Guidelines are designed to promote environment friendly road construction with a well-considered mix of human labor and machines applied in a planned, participatory, and transparent manner.
- Organized 6 EFRC workshops over 2 days in watershed areas that included wider participation of senior members from 15 LGs. The workshop was highly effective in bringing out issues and views on proposed EFRC guidelines and ended with an action plan and commitment to adopt EFRC approach.
- 12 Early Adopters and Champions were identified and engaged in Paani-supported EFRC workshops and study tours and were trained and mobilized for awareness raising events at community level.
- A range of IEC materials on EFRC were developed that were used for wider dissemination among LG leadership, engineering teams, user committees, civil society organizations (CSO), local contractors, and interested citizens.
- Eight LGs prioritized funds for environmentally friendly model roads in their annual programs.
- Two user groups advocated for environmentally friendly road designs, including three exchange visits between project sites to view EF roads.
- At least eight LGs in three watershed areas allocated NPR 5,81,00,000 to construct eight environmentally road projects.

Key Lessons Learned

SWN draws the following lessons from the assignment:

- The way environmental consequences of poor rural roads construction and maintenance are increasingly becoming a national and international issue. The adverse impact of these practices on aquatic biodiversity and

the sustainable access and use of freshwater resources is highly alarming and detrimental to biodiversity conservation.

- EFRC was designed to start a process, albeit to a limited extent, to address the key challenges arising from current road building practices. We noted earlier that there was a gap among LGs in understanding the underlying reasons for EFRC. The LGs needed to be encouraged to adopt, fund, and undertake EFRC approaches to minimize landslides and damage to watersheds and river health by helping to reduce erosion and sedimentation.
- The key challenges remain the capacity of LG engineering teams to communicate to LG leadership their own limited skills and capacity to apply EFRC widely, and to convince them that better roads cost more than opening tracks in the name of roads.

Impact and challenges/way forward

- The local governments are understandably ambitious and in need of substantial support to deliver infrastructure mandates. These sub-national autonomous governments are developing visions, prioritizing investments and administering them for the first time. These governments are doing so in an environment of limited experiences, inadequate expert resources and unclear legal provisions. This has clearly undermined sub-national government’s expending on infrastructures.
- Paani Program has developed an important and replicable guideline on Environment Friendly Road Construction. SWN noted that the Local Government are truly seeking supports to change the way they are building roads despite political, economic, institutional and interest-based challenges they face. The key to a sustained move towards





Community members reading Information Education and Communication (IEC) material on EFRC in Jhimruk Watershed

Photo credit: Scott Wilson for USAID

building a road that is sensitive to the environment is to institutionalize this commitment and build capacity to enable this to happen.

- SWN developed a wide range of IEC materials on EFRC and used them for wider awareness and dissemination campaign among LG leadership, UCs, CSOs, local contractor and general citizen. SWN also notes that continuous advocacy from community members and local leaders is essential to fully implement provision stated under EFRC Guideline and to ensure Environment Friendly Construction practices are in place.

2. Prospect and Priorities

Since Nepal's transformation from a unitary state to a federal republic, the provincial and local governments are exercising constitutional rights to conceptualise a coherent development vision and design periodic plans while creating desired instructional policy, structure, and resources. There is a window of opportunity to incentivise local governments to adopt inclusive and

evidence-informed planning and a strong focus on technical capacity, resilience and maintenance rather than patronage-based decision making, allowing poor quality delivery, opaque procurement, lack of maintenance etc.

Paani Program is instrumental in enhancing Nepal's ability to manage freshwater diversity, water resources management, flood risk reduction, climate change and participatory governance as well as enhance LG and community resilience. We believe the following considerations would further enhance the achievements made by the Paani Program.

Short term

- Paani EFRC team supported in technical survey and design of rural roads in Aathbish Gaunpalika of Dailekh. The team prepared a comprehensive design document including standard road geometry, balanced earthwork, drainage management and bio-engineering measures for slope protection. Immediate follow-up and site inspection is required to monitor the construction of this road as per the design documents.

- The Department of Local Infrastructure (DoLI) has issued standards for municipal road including draft guideline to develop municipal transport master plan. The EFRC guideline and municipal road standards should be made coherent with agreed road standards so that there is no ambiguity during road development process.
- The LGs should be able to develop Municipal Transport Master Plan (MTMP) that clearly administrates road project priorities, investment plans and resource allocation strategies for five years. MTMP required detailed GIS mapping, road inventory, traffic analysis and local needs, which will prioritize road projects with focus on maintenance, forecasts resources and investment needs and guides annual periodic plans and budgets.
- Institutional capacity development should be an ongoing process to capacitate engineering work force at LGs. LGs should also seek experts and specialist as needed to execute development works. In addition, focus should be given to promote private sector (promoting local entrepreneurship) for environmentally friendly road consulting services, construction, and effective transport management in LGs. The users' committees and local construction workers should be continuously orientated and trained on the EFRC approach.
- The LG should designate a committee for effective monitoring and evaluation of infrastructure projects. The infrastructure projects should be audited against construction parameters, SDG, environmental aspects and local governance. The project planning and implementation should also incorporate the learnings and findings of implemented projects.

Mid-term plan:

- The EFRC guideline should be updated regularly to address the environmental and climate change priorities, integrate technological advancement in road development, provisions to update earth and gravel roads to blacktopped roads etc.
- LGs should initiate to conduct detailed geological and vulnerability risk assessment so that the road designs incorporate risk information and are sensitive/adaptive



Dhan Kumari Chaudhary and other women in the Rawa fishing group in Middle Rapti Watershed play a key role in the conservation of aquatic animals. The group was formed with support from the USAID Paani Program

Photo credit: Sudin Bajracharya for USAID

- Local government should be able to formulate, strategize and initiate actions to tackle climate change, disasters and extreme weather events including formulation of best-suited adaptation plans, emergency response operation center, and technical resources for rescue and preparedness operation. Paani Program has contributed to building capacities of LGs to initiate these processes.

WWF

RAJESH SADA, HEAD OF FRESHWATER PROGRAMS, WWF/NEPAL

Three of the most important accomplishments of those pieces of the PANI program and the PANI project that I am familiar with:

- Nepal's community forestry work, which started back in 1970s, is considered one of the most successful community-based forest management in the world, essentially because it recognizes the usufruct of local people while managing forest resources. Similar management regimes should be initiated in the river conservation and management arena as well. The Paani project river stretch co-management model and initiation of Community-based Aquatic Animal Conservation Groups (CAACG), legally backed by local level Aquatic Animal Biodiversity Conservation Acts (AABCs) is one such vital and timely initiation towards the trajectory of community forestry, and thus can be considered as one of the very important accomplishments of the Paani project;
- Identification of high conservation value rivers (HCVRs) and river stretches in Nepal based on multiple values and services of rivers is another instrumental piece of PANI's work. It is the first effort of its kind in Nepal to clearly identify rivers and river stretches with high value, and therefore, it will support decision makers and policy makers in prioritizing the rivers and river stretches to be restored, managed, and protected while opening avenues for river conservation in the near future.

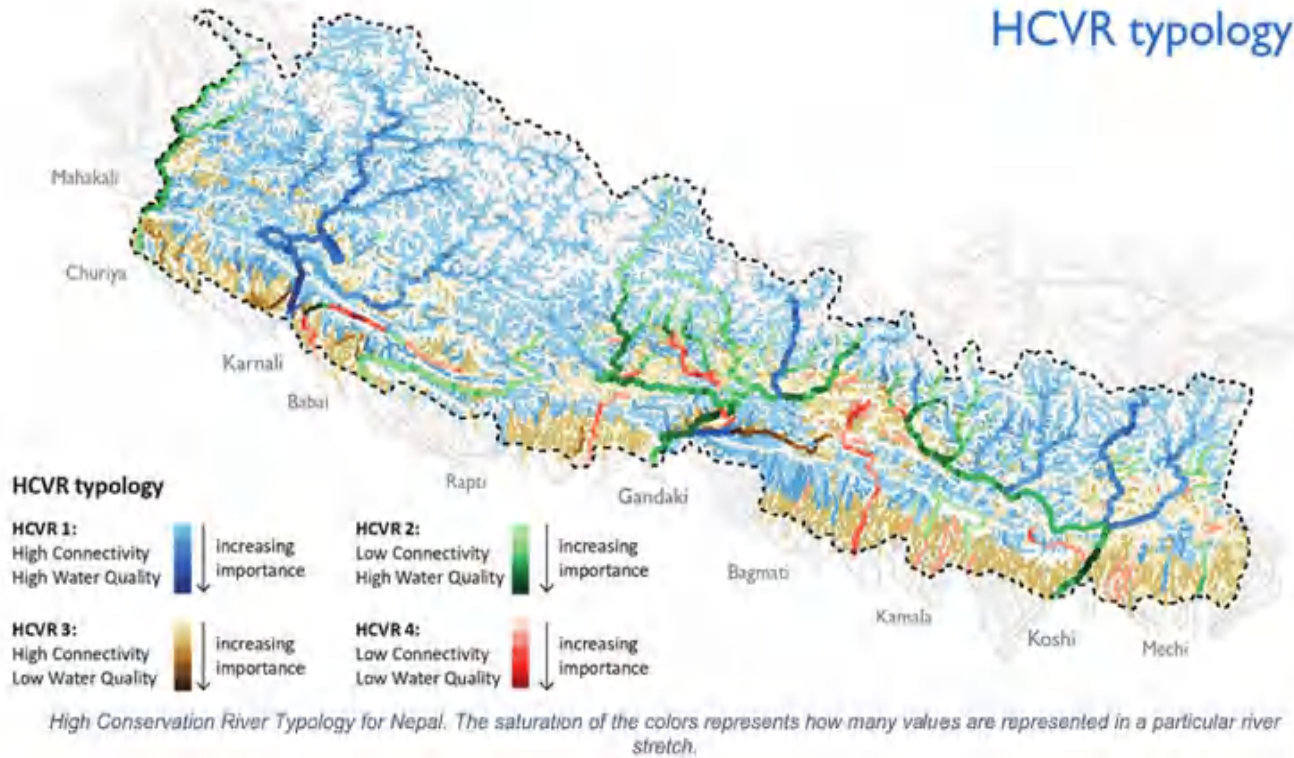
to climate events. This will reduce road failures, reduced natural drainage interruption, withstands weather events and aligns with watershed management.

- Local governments' annual budget on road projects should focus on maintenance and sustainability of infrastructure for the subsequent five years. Priorities should be given to the effective operation and management of infrastructure that delivers effective services to the citizen and promotes their livelihood and economic sustainability.
- Internalising SDGs into national programs began in 14th Year Plan starting July 2016 and budget for F.Y. 2016/17. The federal government also took initiatives for localization of SDGs and issued project selection guidelines based on SDGs targets and indicator. The annual program's budget allocations are audited against the SDGs to verify if the allocations are balanced across the SDG areas. The Paani Program significantly supports in implementation of SDG 5,6,7,8,12,13,15. Paani Program should underline its achievement in terms of SDGs targets and indicators to each LGs so that LGs can develop programs based on the works of Paani Program.

Long-term plan:

- Government of Nepal has recently issue National Water Resource Policy-2077, an integrated policy intending to achieve multi-dimensional, equitable and sustainable development of water resources. This policy aims to contribute to economic prosperity and social transformation by conserving, enhancing and utilizing water resources available in the country in a sustainable manner. Paani Program has expanded LG's knowledge base and capacity of on-going learning on fresh water diversity, water resource management and climate change, which will be the gateway for LGs to implement National Water Resource Policy-2077 to utilize and manage water resources in sustained manner locally.
- With the adaptation of EFRC guideline as well as continuous capacity development process, local road infrastructure delivery mechanism should properly balance between technical, managerial and intuitional factors to deliver effective services. Effective maintenance strategies and practices should be the foremost requirement to develop resilient road infrastructures.

HCVR typology



3. Support for the establishment of River Basin Conservation Foundation and Fund is equally important work, however, its sustainability and functionality must be explicitly explained.

Three of the most important things that remain to be done over the next 5 to 10 years

1. The national Convention on Biological Diversity (CBD) document, i.e., Nepal National Biodiversity Strategy and Action Plan 2014-2020 (NBSAP) had very optimistic and pragmatic targets on the conservation of wetland biodiversity, including declaring three fish sanctuaries, maintaining north-south biological connectivity in three rivers, and declaring five additional important wetlands as Ramsar sites. However, it would appear that NBSAP has not been followed much in terms of

freshwater biodiversity conservation component. So, these elements of the strategy and action plan need to be carried forward.

2. Building upon the findings of the Paani-WWF System Scale Planning (SSP) and HCVR assessments and declaring at least one or two rivers as “free-flowing” is also an important task to be done soon.
3. Promoting sustainable hydropower must be continued. E-flow assessment has to be done in entire river basins and followed up with the support required to implement the findings by engaging closely with hydropower developers and relevant government authorities.
4. Transboundary cooperation for aquatic biodiversity conservation should be initiated immediately.

5. Community based aquatic animal conservation groups need to be upscaled and aligned with the very successful trajectory of Community Forest User Groups (CFUGs) in Nepal.
6. Water governance is very weak in Nepal and hence needs to be improved. River basin stewardship has to be promoted in coming years.

JEFF OPPERMAN, GLOBAL LEAD FRESHWATER SCIENTIST, WWF;
MICHELE THIEME, FRESHWATER TEAM DEPUTY DIRECTOR, WWF-US AND GLOBAL LEAD, FREE-FLOWING RIVERS INITIATIVE

Around the world, freshwater species populations are declining rapidly. WWF’s Living Planet Index showing an 84 percent decline on average since 1970. The situation is even more dire for freshwater megafauna, like large migratory fish and river dolphins, which have seen an average decline of 88 percent.

Part of these declines is driven by the fact that freshwater species and ecosystems are often falling through the cracks—out of sight and out of mind in terms of planning, management, and decision making. For example, hydropower is a leading driver of impacts to rivers and freshwater species, yet hydropower projects are generally evaluated only at the scale of single dams. Further, this evaluation often only occurs once the project is largely moving forward, greatly limiting the ability to avoid, minimize, or mitigate impacts on rivers. It is also true that in many countries there is no “institutional home” for river and wetland conservation or the freshwater species that inhabit rivers, such that no one management agency takes responsibility for ensuring their viability.

For years, conservation organizations have emphasized the potential for better outcomes—outcomes that meet energy needs but that also are far more protective of rivers—through early and comprehensive planning that moves away from single projects and toward whole systems. However, these comprehensive and strategic system planning exercises

have rarely been funded or implemented. The Paani program supported what may be one of the best examples to date of planning at system scales—ranging from river basins to the country of Nepal—for energy development and river conservation.

The work included three major components: (1) an effort to identify high conservation value rivers of Nepal; (2) an energy options assessment for Nepal, comparing different pathways for meeting the country’s future electricity demand; and (3) a system-scale planning decision support tool that had a primary focus on the Karnali Basin, with application toward the other river basins of Nepal. Further, the project analyzed how information from these three components could inform planning and decision making.

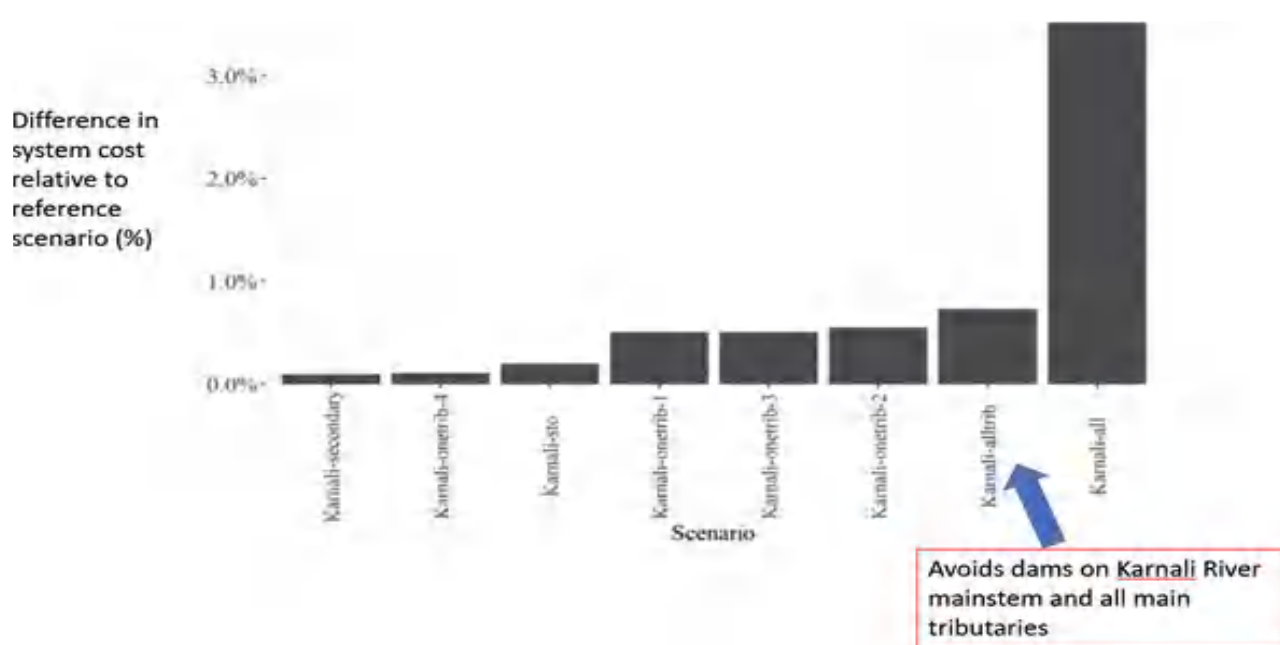
High Conservation Value Rivers

Through the Paani-WWF led work to identify high conservation value rivers of Nepal, Nepal has taken a leadership position on freshwater conservation by explicitly mapping and identifying the values that freshwater ecosystems provide to the people of Nepal. A high conservation value river (HCVR) is a clean, highly connected or free-flowing river (or stretch of river) that acts as a lifeline, maintaining ecosystem services for present and future generations, providing refuge and habitat for high levels of aquatic biodiversity, and supporting important socio-cultural values. This definition was developed by Nepali experts and refined during a series of workshops and discussions over a year and a half. The HCV Advisory Group, made up of Nepalese experts in water-related conservation values, met monthly and provided critical inputs and guidance on the development of the methods for the assessment. The values included in the assessment were biodiversity (aquatic and floodplain species), recreational (angling, rafting, trekking, protected areas), livelihood (fisheries and water provision), and socio-cultural (religious and symbolic sites). Information on these values was then combined with an assessment of freshwater status of every river reach, focusing on the status of the flow regime/free-flowing status and water quality.

The HCV assessment found that 31,300 km, or close to 62 percent, of Nepal’s rivers are classified as HCVR type 1, meaning that they have at least one conservation value and are both free-flowing and of high water quality. The Karnali River Basin stands out as the basin with the highest number of HCVR type 1 rivers, followed by the Gandaki, Koshi, Mahakali, and the West Rapti basins, which all show more HCVR type 1 rivers than other types. Of particular note, the Karnali is one of the last free-flowing rivers in Nepal, with unique values such as providing a home for critically endangered dolphin and fish species such as the Golden Mahseer and snow trout.

The results from the HCVR analysis can inform a range of decision-making processes. In addition to feeding into decisions about master planning for energy and water resource use and infrastructure (described further below), identification and

ranking of Nepal’s HCVRs can also help the country in meeting its national and international commitments. Nepal’s National Biodiversity Strategy and Action Plan (2014-2020) and National Strategic Framework for Sustainable Development (2015-2030) prioritized maintaining north-south biological connectivity in at least three rivers. The HCVR results can be instrumental in supporting the identification of these rivers and the inclusion of this information in the National Integrated River Basin Strategy and Action Plan by the Ministry of Forestry and Environment (MoFE), and associated legislation. In general, adoption of these results into planning and decision making related to river basin and water resources management at a variety of levels across the country can support Nepal’s journey of sustainable, inclusive development. Doing so would secure Nepal’s leadership position for freshwater, in addition to terrestrial, conservation, and sustainable development. This



Differences in cost for the power system of Nepal (in percent), comparing various scenarios that avoid hydropower dams in parts of the Karnali River basin to the reference scenario (the least-cost scenario selected by SWITCH). Avoiding all dams in the Karnali basin would increase system costs by three percent whereas all other scenarios, including avoiding dams on the mainstem Karnali and all of its main tributaries, would increase system costs by one percent or less.

effort is related to a larger push across the globe to ensure that freshwater commitments, including those around free-flowing rivers and river connectivity, are part of the post-2020 global biodiversity goals and targets (Tickner et al. 2020).

Energy Options Assessment

The Energy Options Assessment (EOA) component was led by researchers from the University of California, Berkeley, using a capacity expansion model called SWITCH. SWITCH allows for the comparison of different options for meeting forecasted electricity demand. The model simulates expansion of the power system in stages (2025, 2030, 2035, and 2040). SWITCH is a least-cost model, meaning it selects the combination of generation, transmission, and storage investments needed to meet demand at the lowest overall system cost. The model also allows the exploration of additional policy objectives, such as avoiding hydropower dams on certain rivers. SWITCH will then select the least-cost option that meets these policy constraints, allowing the comparison of different policy options in terms of power system cost.

Nepal currently has an installed capacity of 1,303 MW, almost all (97 percent) of which is from hydropower, and an electricity deficit which is partly met through imports from India. Large future increases in power demand are projected, with projections calling for nearly all expansion of generation to come from hydropower. Using SWITCH, we were able to compare the system costs of policies that would shift more investment toward other renewable technologies, such as wind and solar, as well as of policies that protected certain rivers. For example, policies that protected the mainstem Karnali and its major tributaries from hydropower development would increase Nepal's electricity system costs by only one percent. Avoiding dams in protected areas and on all free-flowing rivers would increase system costs by two percent and nine percent, respectively. For perspective, these estimates of increased system cost are quite small relative to the uncertainty associated with hydropower development costs: in nearby Bhutan, the cost of completed hydropower projects averaged more than a 100 percent increase compared to projected costs at the investment stage.

System-scale Planning



Rural road construction in Karnali Corridor

Photo credit: Nabin Baral for USAID

Nepal has abundant hydropower resources, only a small share of which will be needed over the coming decades—and as described above, there is great potential to guide hydropower development to places that avoid high conservation value rivers with little impact on system costs. Thus, decision makers would benefit from tools and approaches that can help them identify which hydropower projects—and combinations of projects—will provide the best mix of benefits.

System scale planning (SSP) is a quantitative, multi-criteria, and multi-project framework that can inform decision makers about the tradeoffs between different development options. The SSP process evaluates how a combination of projects performs across a range of indicators or metrics across energy, financial and economic, environmental, and social values. The SSP process does this by combining the outputs from the HCVR analysis, which indicates rivers

with high levels of biodiversity, recreation, fisheries, or other socio-cultural values together with the lowest cost electricity development options that are an output of the SWITCH power system model.

A single best solution rarely exists; most options (combinations of projects) will have advantages as well as disadvantages compared to other options. SSP supports decision-making by quantifying these inevitable tradeoffs. Thus, the SSP tool is not intended to provide a single “right” answer, but rather to make sure decision makers are fully aware of the pros and cons of different development options, and that they can understand and visualize the tradeoffs.

What next?

Collectively, these three components reveal that Nepal has globally significant rivers that provide considerable



A picturesque view of Phoksundo lake in Dolpa

Photo credit: Manoj Chaudhary for USAID

value to local communities and the country overall—and that Nepal has a great opportunity to design its future power system in a way that meets demand for low costs, with low carbon emissions, and that is consistent with protecting its high value rivers. The key is aligning decisions with that ultimate outcome. This will not be easy, because decisions are generally made at the level of individual projects, with environmental review that often does not consider system-level or cumulative impacts. As a result, it can be difficult for a country to design, and then follow, an overall strategic plan for energy development. But Nepal has a number of opportunities to begin to incorporate insights from this work into decisions. First,

there are several ongoing energy and hydropower planning processes that can deliver results and recommendations at the system scale.

Second, the results from this project can be incorporated into decisions about individual dams, including those about licensing power purchase agreements. International financial institutions can also use this information to influence which projects they prioritize. And the reality that significant conservation of rivers will have negligible impacts on system costs should make it far easier to make decisions to protect key rivers for their diverse cultural, recreation and environmental values.

Citations:

Tickner, D., J. J. Opperman, R. Abell, M. Acreman, A. H. Arthington, S. E. Bunn, S. J. Cooke, J. Dalton, W. Darwall, G. Edwards, I. Harrison, K. Hughes, T. Jones, D. Leclère, A. J. Lynch, P. Leonard, M. E. McClain, D. Muruven, J. D. Olden, S. J. Ormerod, J. Robinson, R. E. Tharme, M. Thieme, K. Tockner, M. Wright, and L. Young. 2020. Bending the curve of global freshwater biodiversity loss: an emergency recovery plan. *BioScience* 70(4): 330–342.

■ HANNAH BALETA, PARTICIPANT IN THE THIRD NATIONAL RIVER SUMMIT 2019

Introduction:

I was a technical support consultant to the Paani-WWF project: “System-scale Planning to Support Sustainable Energy Systems and Conservation of Freshwater Resources for People and Nature.” As part of this role, I presented on the project at the Third National River Summit, which was held along the banks of the Karnali River in March 2019. The presentation included an overview of the project plan which included examples such as references to recent experiences within the region such as a free-flowing rivers assessment in Myanmar and energy planning in Laos.

Looking back:

The trip to the banks of the Karnali River, supported through the Paani program, was incredibly powerful for a number of reasons.

- Poorly sited or planned hydropower development is a risk to the future sustainability of Nepal. It is very easy to make development decisions about a river sitting in a conference venue within Kathmandu. It is much harder to make the same decisions when camping along the banks of said river, watching how communities currently depend upon the river, and imagining what that could look like going forward.

- The diversity of people attending the Third National River Summit was awe-inspiring and extremely insightful. From hyper-local community members along the river to more powerful government decision makers and private sector hydropower developers, a variety of insights and inputs were heard without judgement.
- The levelling effect of having everyone in tents, sharing, eating the same food, and sitting in the same conversations was extremely powerful.

Looking forward:

I hope that the findings of the project will be taken up into decision making regarding hydropower development in Nepal. Not only because conserving free-flowing rivers like the Karnali is like protecting a “species” that is going extinct, but also because poorly sited hydropower development can also be costly financial, socially, and environmentally. The following are some highlights from the study:

- The Karnali River has one of the highest “High Conservation Value” scores in Nepal. Therefore, any future development along the river needs to take into serious consideration the loss of biodiversity and uniqueness that the river provides to Nepal. These rivers provide high biodiversity values, recreation opportunities, livelihood values, and socio-cultural services to Nepal. Hydropower development within the unique rivers such as the Karnali would deplete the rivers capacity to provide these services.
- In the Energy Options Assessment for Nepal, a series of scenarios were modelled to see the cost implications of protecting high conservation value rivers (such as the Karnali) from hydropower development. Nepal-wide conservation scenarios (including policy options such as protecting all free-flowing rivers—“FFR”—preventing development in rivers classified as HCV levels 1 or 2, and not developing selected benchmark rivers and rivers in protected areas) costs are two to ten percent higher compared to the reference scenario. This is not excessively larger than the “normal” variability of hydropower development. The lowest cost scenarios are the ones that protect Nepal’s benchmark rivers from

being interfered with (2.1 percent increase), and the one that prevents development in protected areas (1.5 percent increase).

- System scale planning can help Nepal undertake more detailed analysis to identify combinations of projects that have both low costs and low negative environmental or social impacts. Knowing which combinations of projects are attractive in terms of



Fisher catching a fish with a net in Karnali River

Photo credit: Nabin Beraal for USAID

costs and impacts can help the Government of Nepal to prioritize their power generation decisions. The integrated outputs of the project can support the prioritization of future hydropower investments, and the most immediate opportunity is to inform the ongoing Water and Energy Commission Secretariat (WECS) planning processes. WECS is preparing a national hydropower masterplan and associated river basin plans to revisit and prioritize all potential future hydropower projects, including those that already have licenses. In some cases, the masterplans will propose changing the location or the redesign of potential projects. The installation value and costs of all projects are estimated, which is a significant advance as there has previously not been any systematic information on comparative costs of these projects. The river basin plans also include other river-related developments, such as irrigation and flood control infrastructure, and will be subject to Strategic Environmental and Social Assessments (SESA).

- The Paani-WWF initiative benefited greatly from the interim results of this process, allowing us to work with up-to-date project data. In turn, our initiative can inform the final formulation of the masterplan and the related reports.
- Ultimately, the outputs of this project can help the Government of Nepal identify a suite of projects that have lower impact (and perhaps price) for the same energy output. These projects could then receive preferential treatment in terms of licenses, purchase power agreements and development. One of the ways these outputs can be used is that when Nepal introduces an auction or tender mechanism to select between the many projects offered by the private sector, the government will have the basis to decide which projects should be eligible in terms of location and technology. This will benefit both the people and nature of Nepal, as the financial investments in infrastructure will have lower costs and lower negative environmental and social impacts.

OTHER USAID PANI STAKEHOLDERS

■ **KAREN BENNETT** – USDA FOREST SERVICE EARTH SCIENTIST AND WATERSHED MANAGEMENT SPECIALIST (RETIRED) and NRCT

US Peace Corp and USAID Resource Conservation and Utilization Project (RCUP) 1984-1985. Soil Survey of Daraundi Watershed, Gorkha District 1984-1985. Published document includes soil descriptions and management recommendations for a wide variety of land uses.

CONNECTIONS TO PAANI

USFS International Programs

- USFS 2015 for USAID: Site visits and interviews with Nepal aquatic resource and fishery specialists – predecessor for the Paani program. Outcomes included proposals for: e-DNA assessment of Karnali River Fisheries; Green Engineering Program development, Watershed Management short-course

- Natural Resource Baseline Assessment 2015-2016: Predecessor for the Paani program for USAID
- Nepal Government high-level study tour of hydropower and fish passage in the Pacific Northwest 2016

Paani Program Grantee

- Karnali River Corridor Management Project (aka Karnali Expedition) 2017–2018: Development of grant proposals and science team leader for multi-disciplinary

assessment of environmental and social conditions in the Karnali River Corridor in coordination with Nepal River Conservation Trust. Funded by USAID, Paani, Patagonia and many others.

- Third National River Summit on the banks of the Karnali River 2019: Presented Karnali Expedition findings and introduced the concept of legislatively protected rivers by highlighting a variety of global river protection efforts.

- Advisor Paani/WWF Assessment of Rivers of High Conservation Value 2020

Nepal River Conservation Trust

- Ecotourism Center concept/design development team 2020-2021

LOOKING BACK: Most Important Contributions

USAID/USFS-Funded

Natural Resource Baseline Assessment (2015-2016)

As development progresses in Nepal, natural resource managers must be able to articulate both the sensitivity and the inherent resiliency of the landscape to understand the impact of proposed development actions to specific resources. This paper summarizes a baseline assessment of Nepal's natural resources that was developed to target the implementation of USAID's Program on Aquatic Natural Resources Initiative (PANI). Through literature searches and interviews with university, government and NGO staff, the state of key natural resources in the western two-thirds of Nepal is highlighted for specific physiographic and ecological provinces. These unique provinces result from the great environmental gradient from the Ganges plain through the High Himalaya to the Tibetan Plateau and are classified by the natural degree of surface and mass-wasting erosion, avalanche potential, stream and sediment characteristics, and aquatic habitat qualities. Stream flow is differentiated by source (i.e. glacial, snow, rain-fed systems), and forest condition and need for protection is disclosed. All of this helps the reader understand and separate inherent natural conditions from human-induced impacts. A significant GIS database was prepared and contains several newly developed layers, including physiographic zone, a hierarchy of watersheds, and fish species numbers and distribution (including migratory patterns and locations of rare, vulnerable endemic and endangered species). Various uses of and impacts to water resources, including hydropower, wetland conversion, irrigation, agriculture, and settlements are discussed, and their impact on aquatic habitats is



highlighted by sub-watershed. Finally, a prioritization of sub-watersheds is provided to bring focus to existing impacts on aquatic resources. The information helps managers protect existing high-quality areas and restore important aquatic ecosystems through participatory intervention planning, climate awareness, and monitoring.

USA/Nepal Collaborative Hydropower Learning Tour (July, 2016)

A five-day learning tour of hydropower on the Columbia and Clackamas Rivers in the United States was offered by USAID-Nepal and the USDA Forest Service in concert with multiple U.S. federal and state government agencies, Native American organizations and environmental groups for Nepali

government officials, power producers, and environmental constituents. Discussion topics ranged from an introduction to the hydropower situation in Nepal to understanding the process of hydropower planning in the USA including river basin planning strategies; feasibility studies; environmental laws; the environmental impact analysis process; licensing; dam operations; Native American cultural impacts; environmental mitigation requirements, including fish passage and the high costs of not mitigating for fish passage early-on in dam construction; and environmental flows. Interagency collaboration in hydropower dam management and the value of fisheries, water-based recreation, and river transport to the economy of the Pacific Northwest was demonstrated and the methods used to balance

environmental concerns (i.e fish and wildlife habitat) and power production were disclosed.

Learning Tour Goals:

- Raise awareness of hydropower dam planning, including environmental regulation, Environmental Impact Assessment development, and environmental safeguards
- Introduction to the roles of various U.S. Government agencies and how they work together to manage water resources.

Nepali Participants:

- Gagan Thapa, Parliamentarian, Chair of the Agriculture and Water Resources Committee

- Suman Prasad Sharma, Secretary, Ministry of Energy
- Dhana Bahadur Tamang, Secretary, Nepal Water and Energy Commission Secretariat (WECS)
- Dil Bahadur Chhetri, Section Officer, International Economic Cooperation Coordination Division, Ministry of Finance
- Mukesh Kafle, Managing Director, Nepal Electricity Authority (NEA)
- Khadga Bahadur Bisht, President, Independent Power Producers Association – Nepal (IPPAN)
- Uday Chandra Thakur, Secretary, Ministry of Forests and Soil Conservation

- Megh Ale, President, Nepal River Conservation Trust
- Shanker Khagi, USAID-Nepal

The following is a synthesis of the top seven action items that were developed by and committed to by the Nepali attendees on the last day of the study tour (July 15, 2016).

1. Establish a Hydropower Coordination Forum co-led by the Ministry of Energy and the Water and Energy Commission Secretariat with a role to create a vision for the future of hydropower development while protecting the ecological services of rivers in Nepal. Include a policy group and an interdisciplinary technical group that cuts across the silos of government and engages stakeholders.
2. Ensure that the World Bank River Basin Planning effort incorporate ecological issues and a free-flowing river element. Government messaging needs to be consistent.
3. The Environmental Impact Assessment (EIA) process needs to be improved and needs to be incorporated as a key component in design of all hydropower projects. Actions can include:
 - o Improve scientific investigations
 - o Address effects in the entire sub-watershed rather than project site specific assessments and consider cumulative environmental, social and economic effects
 - o Make sure all hydropower projects address climate change
 - o Base decisions on scientific information
 - o Engage stakeholders up front in any project planning
 - o Model EIA process using Budhi Gandaki Hydropower development project. Disclose knowledge gaps, assess effects of not building the dam as well, determine trade-offs. Monitor over time to look at the effects on aquatic species and aquatic ecosystems.
4. Present the USA/Canada Treaty on the Columbia River Basin to delegates from both India and Nepal. Include multiple government departments (like the US Federal Caucus). Ensure ecosystem function drivers are included in modernized treaties.



Members of Rawa CAACG in Middle Rapti Watershed



Nepali participants discuss hydropower dam operation practices with representatives from Portland General Electric Co.

5. Promote river conservation education to empower community decision making.
6. Establish an Institute of Hydropower and Energy at major universities.
7. Select a river system to do a comprehensive study fish and aquatic species and the effects of hydropower development.

There was much energy surrounding the compilation of these tasks and commitment to follow through on them after returning to Nepal. Unfortunately, the "learnings" from the U.S. visit and the very positive interactions among participants during the study tour could not be maintained

and capitalized on after the group returned to Nepal due to a vote of no confidence for the Nepal Prime Minister followed by a change of government. Many of the participants were assigned new roles as a new government formed. Although several members of the group pursued the concept of creating a "Hydropower Coordination Forum," the commitment of the whole group to a collaborative governmental/private sector approach to hydropower planning and development lost inertia. Paani, USAID-Nepal and the USFS followed through with promoting river conservation education and by funding an e-DNA assessment of fish species and distribution in the Karnali River.

Paani Funded:

Karnali River Expedition and the Third National River Summit

- Much of Paani's work involved gathering the baseline information needed to make management recommendations in a calculated and scientific way. The Paani program has worked with a variety of organizations to fill data gaps, making data-driven arguments for environmental conservation possible. The Karnali expedition highlighted some key opportunities for aquatic conservation, including:
 - Identification of five key sections of the Karnali River that contain remarkable and outstanding environmental, scenic, and cultural values that should be legislatively protected. Strategic Considerations for River Conservation in Nepal outlines a strategy for implementing river conservation
 - Identification of specific river sections that need to be protected to ensure survival of threatened and endangered species (mahseer, Ganges river dolphin and Gharial)
 - Promotion of wider protection for the Karnali River through establishment of the "Karnali Sacred River Corridor" as a niche for the purposes of environmental awareness, branding, and promotion of tourism.
 - Highlighted the mainstem Karnali river as a valuable resource in itself. If honored, this concept helps

to focus the conversation about hydropower development, planning, and economic initiatives that span the entire river basin. Discussions with local community members and leaders underscored the need for a balance between development and conservation.

- Analysis of the dewatering zone of the proposed Upper Karnali and Bhetan Karnali hydropower projects on the core area of Golden Mahseer rearing habitat and the loss of world class rafting opportunities to the rafting industry of Nepal.
 - The Upper Karnali Hydropower project, which everyone focuses on, is only one of several projects that would have potentially devastating effects on aquatic biodiversity and economic opportunities for the Karnali River Basin.
- The expedition promoted a balanced portfolio of energy through mini-hydro, wind, and solar, including solar pumping of the Karnali main stem river water to increase the amount and productivity of agricultural lands and medium-scale hydropower development in the upper tributary streams.
- Completed mapping of landscape stability, erodibility, and ability to capture and store moisture-ensuring low season flow contribution to the Karnali River that can be used for sustainable development planning.
- Paani, through the WWF studies, was successful in:
 - Identification of "High Conservation Value Rivers" throughout Nepal with a focus toward those that have multiple aquatic and cultural values. The current degree and source of degradation was also mapped.
 - The Energy Options Assessment established an energy portfolio for all of Nepal that includes sustainable hydropower, wind, and solar energy. The energy planning analysis clearly documents that construction of hydropower dams in the mainstem of the Karnali River are not needed, are not economically viable, and will destroy the most pristine free-flowing river that remains in all of Nepal.

- Paani, through their Nepali staff, has initiated local support for river and aquatic resource conservation. Like Nepal's successful Community Forest User Groups (CFUGs), Community-led river-stretch co-management groups, each responsible for a specific section of river, could work together to establish river management goals. The groups would represent social and ethnic diversity and be connected at local and provincial levels. Engaging locals in the management and control of their resources through establishment of these groups will ensure protection of the river corridor, water quality, and aquatic biodiversity and is important for long-term sustainability of both conservation and development efforts.
- Events like the periodic National River Summits can and do assist with coordination of the myriad of organizations working on river conservation. Through multiple presentations, open discussion, panels, and networking, the National River Summits are intended to enhance and encourage more meaningful coordination between the many different governmental sectors, NGOs and civil society working for the protection and enhancement of aquatic biodiversity throughout Nepal. These could be expanded to the greater Hindu Kush Himalaya region.

LOOKING TO THE FUTURE:

Assessment and planning need to be followed by action. Paani's long-term funding initiative (the Karnali River Basin Conservation Fund implemented by a Foundation of the same name) has great promise to begin implementation of the ideas brought to the forefront during this first five-year effort to understand and raise awareness of aquatic biodiversity in Nepal.

Priority next steps include:

- Immediately designate and enforce endangered species conservation zones as described in the Karnali River Corridor Management Framework. Utilize the designation to encourage tourism and further protection of these species.
 - Need specific information on the life histories of key species (i.e. spawning, migration, and rearing requirements of the Golden Mahseer, Ganges River Dolphin, and Gharial)
 - Establish and enforce fishing regulations that sustain viable fish populations
- Enact legislation to protect rivers throughout Nepal.
 - Use conservation biology principles of "Protecting the Best" first. It is much easier and much more cost-effective to protect a river from degradation than it is to restore degraded rivers. However, as the Paani/ WWF studies point out, there are some culturally important rivers (e.g. Bagmati) that should be restored.
 - Utilize the concept of Heritage Rivers to open discussions on river conservation and increase economic development opportunities.
- Improve the ability to prepare environmental assessments in all facets of development projects—from hydropower, to roads, to water infrastructure. Decline to implement



Photo credit: Nabin Baral for USAID

Sections of the Karnali River where remarkable and outstanding scenic values warrant legislated protection were identified during the Karnali Expedition

projects that have significant negative environmental impacts. Ensure that environmental mitigation compliance is enforced for projects that move forward.

- Reassess the licenses given for hydropower development and tie them to the Paani/WWF strategic Energy Options Assessment (EOA) and System Scale Planning (SSP) methodologies which prioritize hydropower in some of the Karnali tributary streams and encourages co-development of wind and solar energy. Add community-driven micro-hydro to the energy portfolio whenever possible.
- The cross-basin transfer of water for large-scale irrigated agriculture projects and hydropower development projects both need to be designed with careful consideration of the environmental flows needed to support in-stream organisms and adjacent riparian and wetland habitat and their associated species.
- Stop “River Training,” as it never works for the long-term. Gabions and concrete walls inhibit stream development processes and destroy riverine habitats. Instead, establish riparian corridors along the main and tributary stream channels that allow for natural river migration and create habitat for a variety of aquatic and riparian dependent species. Designate and enforce sand and gravel extraction areas away from the main river channel
- Road construction in the Karnali (and throughout Nepal) is the greatest environmental threat for long-term watershed health. It surpasses deforestation in generating and supplying long-term sediments and is more ubiquitous and persistent than localized impacts of hydropower development.
 - o Develop and enforce a high-level access master plan for entire river basins acknowledging that, in this fragile landscape, roads cannot go to every village.
 - Key into the shape, form, erosional capacity, and stream patterns across the landscape when determining road alignment. Understanding the geomorphology, or how landscapes were formed, helps planners understand where landslides have occurred in the past and, therefore, where they



Road construction alignment along major river channels adds chronic sediment to streams reducing aquatic habitat and unstable terrain threatens the longevity of the road system.

- o will occur in the future. Ensure that unstable terrain is avoided or adequately mitigated.
 - o Ensure road construction design is capable of handling large monsoon-driven runoff events. Ensure that any drainage crossing allows for passage of rocks/ boulders and debris that will move during high rainfall or snowmelt events.
 - o Plan for Disaster Risk Reduction in all development efforts. Landslides and earthquakes need to be recognized and accounted for in all planning efforts
- River conservation advocates should work directly with local stakeholders to develop innovative and place-based livelihood enhancement opportunities.
 - o Engage local citizens in design of economic opportunities that balance conservation and sustainable development – let them take the lead.
 - o Develop skills within communities throughout the Karnali corridor to provide for ecotourism opportunities throughout the basin. Many economic development opportunities exist and are outlined in



Tharu Women using traditional fishing gear "Helka" for fishing in Rapti River

the Karnali River Corridor Management Framework including establishment of: strategically located Eco-tourism training centers; a training center for rafting/kayaking guides; remote fishing camps; improved trekking infrastructure; cottage industries; and development of sustainable markets for crafts, organic agricultural and foraged products.

- o Protect Nepali heritage as development progresses. Established trekking areas (i.e Annapurna/ Everest) tend to segregate visitors from gaining an understanding of the Nepali culture, instead catering to a somewhat sanitized and romanticized view of life in Nepal. The Karnali Sacred River Corridor offers ample opportunity for experiencing how ethnically

varied Nepali people live and work. Capitalize on religious pilgrimages from Mt. Kailash along the Karnali River through Lumbini to the Ganges (as well as pilgrimage in the opposite Ganges-to-Kailash direction) and emphasize the historic trade route to maintain a heritage connection that is key to developing niche tourism markets along the Karnali river.

- o Develop more kayaking and rafting routes, ensure that locally managed companies (rather than Kathmandu agencies) benefit from rafting tourism through food, lodging, and cultural engagement, support for local organic agriculture and the sale of locally produced crafts. Train locals to engage with rafting groups (cultural programs, introductions to flora and fauna of the area, fishing, agricultural tourism, etc.) and to be rafting and kayaking guides.
- Empower citizens to employ watershed practices that minimize water quality degradation before it becomes a significant health issue for the community.
 - o Select a community to demonstrate an integrated watershed management plan. Many places are becoming roadside eyesores with no reason for tourists to stop and especially no reason to stay for a while. Integrate best management practices to design and implement a holistic landscape that welcomes visitors and sustains an economically prosperous population.
 - Identify and train local conservation ambassadors
 - Work at the local level to provide proof of concept and scale-up as successful strategies emerge
 - o Establishing monitoring and evaluation of programs implemented by local people and giving them the power to enforce compliance is critical to the success of any program. Ensure that data is shared.
 - o Encourage citizens to perform rapid water quality assessments based on recognizable in-stream characteristics and a set of easily identified water quality indicator macroinvertebrate species. Training

would be based on the assessment protocol currently being developed by researchers at Tribhuvan and Kathmandu Universities (Ram Devi Tachamo Shah, Deep Narayan Shah and Subodh Sharma).

Ecotourism Training Center

NRCT has focused its recent efforts on establishing an Ecotourism Training Center on land donated by the Rakam Village Development Council. The goal is to create a center that models sustainable living using innovative design with local construction materials, paired with an education center that provides communities throughout the watershed and internationally with the skills to maintain a healthy land and water environment while encouraging responsible development that results in improved livelihood. The facility will have a training room with student and staff housing, tourist accommodations,

a restaurant producing traditional organic cuisine, and a market for local produced products. This will be fueled by on-site energy production and a permaculture food production system. The center will demonstrate best management practices for clean water acquisition, proper waste management, erosion control, the establishment of a riparian forests to protect stream banks and will create habitat for fish and wildlife species. Trainings will initially focus on adventure sports including rafting guiding and canyoneering, nature guiding, developing and maintaining an ecotourism and hospitality industry, and utilizing non-timber forest products. Engagement between the community, political leaders and the tourism industry at this facility will highlight the many ways in which an intact river can bring much needed commercial and economic development to the area and thereby galvanize local efforts to ensure the main stem of the Karnali remains the most pristine free-flowing river in Nepal.

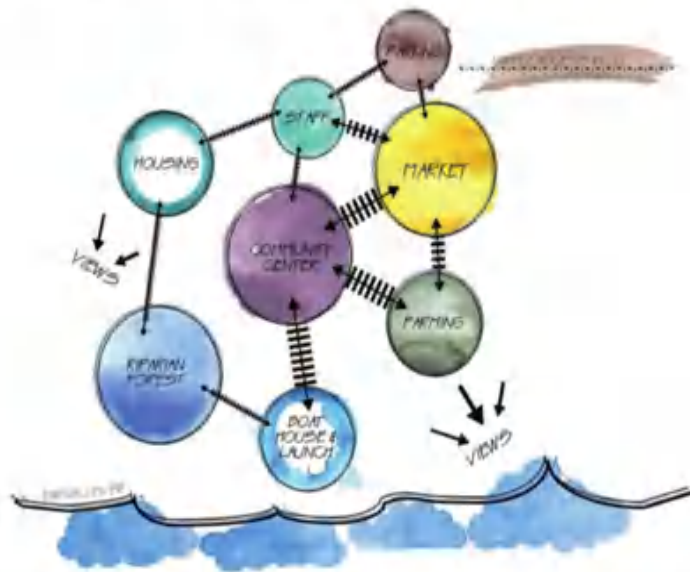
DAVID GILLETTE – ASSOCIATE PROFESSOR, UNIVERSITY OF NORTH CAROLINA, ASHEVILLE AND CMDN/NEPAL FISH BIODIVERSITY PROJECT

Through its work in the Karnali River Basin, the PANI program made important contributions to the understanding of aquatic biodiversity in high elevation rivers of the Eastern Himalaya Biodiversity Hotspot. By demonstrating the technical capacity to apply environmental DNA (e-DNA) technology for in situ monitoring of aquatic species, the Nepal Fish Biodiversity Project (NFBP) implemented by the Center for Molecular Dynamics-Nepal (CMDN) under the U.S. Forest Service (USFS) component of PANI was an important step forward in developing the in-country expertise necessary to properly assess impacts of the hydropower development slated for Himalayan rivers in the coming decades. Moving forward, it will be important to maintain momentum by training and supporting young Nepalese scientists who can expertly assess implications of such development as population and economic growth advance across this fragile ecosystem. In addition, periodic collection of aquatic biodiversity data, and publication of such data, will ensure that this knowledge base continues to grow.

Biodiversity (the variability of life on earth) is necessary for the maintenance of a sustainable human society. Preventing biodiversity loss is critical not only to ensure the continued functioning of ecosystems, but also to preserve the cultural economic characteristics of human society. Globally, rivers and streams are among the most threatened ecosystems, with rates of species loss greater than those on land. High-altitude streams are particularly vulnerable, given their sensitivity to environmental change.

Although work has accelerated in recent years, an urgent need remains for baseline data on Himalayan aquatic biodiversity. In 2010, the International Union for the Conservation of Nature (IUCN) classified almost one-third of freshwater species in the Eastern Himalayas as “data deficient,” emphasizing the need for information on species taxonomy, distribution, population trends, and threats. This deficiency was troubling, as the Eastern Himalayas Region is a biodiversity hotspot, including

Ecotourism/Community Center: Program



several “global 200 ecoregions” that harbor irreplaceable or distinctive biodiversity.

Due to its remote location in Western Nepal, the Karnali has been studied less than most Himalayan rivers. The Karnali assumes even greater importance when one considers that it remains un-impounded along its entire length, despite being slated for hydroelectric development (such as the 900 MW Upper Karnali Hydropower Project [UKHP]). It is impossible for resource managers to accurately assess the potential environmental impacts of projects such as this in the absence of baseline data on aquatic biodiversity.

The NFBP was conceived as both a “proof of concept” enterprise to evaluate feasibility of e-DNA analyses within the context of in-country infrastructure, and also as a baseline assessment of fish diversity in the Karnali in and around the proposed location of the UKHP. The eight sampling sites chosen spanned an elevation gradient from 100 meters above sea level (masl) downstream at Geruwa near Bardiya National Park up to 750 masl above the confluence with the Tila River. Coverage of a wide elevational gradient is important, because Himalayan fish species diversity is typically highest at low elevations, whereas unique endemic species often occur at higher elevations. Two of the study sites, “Downstream near Karnali” and “Upstream near Karnali”, fall within the downstream dewatered zone and the upstream impounded zone, respectively, that would result from construction of this proposed run-of-river project. Data from these sites thus represent aquatic biodiversity that would be threatened due to habitat destruction from dam construction.

Members of Rawa CAACG using traditional gear “helka” for fishing in Rapti River

My involvement in this project began with development of the study design and sampling protocols. I participated in initial site visits in March 2016 and coordinated the first round of fieldwork and sample collection in May of that year. I assisted with specimen identification both in the field and back in the lab, including help with identification of specimen photos after I returned to the United States in June 2016.

Capacity development of in-country personnel may be the most powerful legacy of this part of the PANI project. An important outcome of our initial efforts was the hiring of Dr. Deep Narayan Shah, now Assistant Professor in the Central Department of Environmental Science at Tribhuvan University and collaborator in the development of the Freshwater Centre of Excellence at TU, as PANI’s Field Coordinator. The project benefitted immensely, and continues to benefit, from Dr. Shah’s expertise in freshwater ecology of the Himalayas and his experience in coordinating fieldwork and mentoring student participants. Dr. Shah and I

collaborated closely during May 2016 fieldwork, and one of my fondest memories of that trip is seeing Dr. Shah staying up well into the night after a long day of fieldwork to teach students how to fill out their field notebooks accurately. Other participants learned how to use a backpack electrofisher and other aquatic sampling gear, how to identify common Himalayan fish species, as well as how to manage the logistics of fieldwork. In my opinion, such investment in—and development of—in-country technical capacity is crucial to the long-term sustainability of efforts to adaptively manage Nepal’s unique aquatic biodiversity in the face of accelerating environmental change.

In order to develop a passion for aquatic biodiversity, one must first understand it; in this regard I feel that one of the most significant impacts of this project was the exposure that students, project employees, and managers gained to the fishes of the Karnali. I still remember vividly pulling seine nets out of the water at Geruwa, near Bardiya National Park (Figure 1), and seeing the excitement on everyone’s faces when we realized we had a netful of Ocellated Pufferfish, *Leiodon cutcutia* (Figure 2)! Of course, the tiny pufferfish played their role to perfection, inflating themselves to look like a collection of small balloons with fins and gills (Figure 3). A similar experience took place just downstream from the proposed damsite, where electrofishing (Figure 4) yielded several different species equipped



Photo credit: Aura Creations for USAID

with ventral suckers, allowing them to maintain position in the torrential flow (Figure 5). Sadly, the habitats these fishes rely on are almost certain to be eliminated if construction of this run-of-the-river hydropower development proceeds. The section downstream of the dam, but upstream of the location where water re-enters the river after passing through the powerhouse, will be severely de-watered. I was impressed with the work ethic and dedication of the students who worked with us on this project (Figure 6), and I hope that the experiences these young scientist had learning about aquatic diversity for the first time will stick with them for the rest of their lives. Several students as well as employees of CMDN also gained knowledge of sample collection and processing to analyze e-DNA (Figure 7), and wherever our team went, we attracted a lot of attention from the nearby residents, who were always eager to learn about our project (Figure 8).

The efforts put forth by all involved to successfully carry out the fieldwork were truly impressive, and it is important to maximize the effectiveness of this work. After samples were

brought back to Kathmandu, lab-work and identification of fish specimens from field photos progressed at an impressive pace. To truly reap the full benefit of this effort, however, an important next step is to summarize the data on fish species presence and abundance for all eight sites sampled, both by traditional means (electrofishing and seining) and by analysis of environmental DNA. Such an analysis would provide important information as to the spatial pattern of fish diversity along the length of Karnali and lay out a baseline against which any potential future changes could be assessed. Although I hope this is not the case, if the proposed dam were to be constructed, these data could then be incorporated into a Before-After-Control-Impact (BACI) study design that could test for significant impacts of such a disturbance on the Karnali aquatic biodiversity.

Understanding how dam construction affects fishes in Himalayan rivers such as the Karnali is challenging, because the basic biology of many of these species is not well understood. For example, fishes in the genera *Tor*, *Nazirator*, and *Neolissochilus* (the Mahseers; Figure 9) are known to

undertake seasonal migrations to spawn. However, the timing, length, and triggers of this migration, in addition to many other life-history details, are not well-known. If a dam was constructed that disrupts seasonal migrations, it could have devastating consequences for the population. In addition to being fine food fishes, the Mahseer are also sought-after by anglers, providing a potential ecotourism revenue stream in this relatively poor region. Indeed, the Babai and Karnali Rivers both receive attention from sport anglers. Given the knowledge gap for a fish as well-known across the Indian subcontinent as the Mahseer, it is not surprising that even less is known about the dozens of other Karnali fishes. Understanding the basic biology of these species is thus a critical conservation need. Considering the strong academic program at Kathmandu University, and the emerging Freshwater Centre of Excellence at Tribhuvan University, it should be possible to encourage graduate, and even undergraduate, students to undertake theses to uncover aspects of species ecology such as spawning season and diet. Analyzing migration patterns requires more



Figure 1. Field team preparing to sample the Karnali River at Geruwa.



Figure 2. Ocellated Pufferfish (*Leiodon cutcutia*) from the Karnali River at Geruwa.



Figure 3. Inflated Ocellated Pufferfish (*Leiodon cutcutia*) from the Karnali River at Geruwa.



Figure 4. Students from Kathmandu University preparing to sample fishes with a backpack electrofisher just downstream from the proposed dam site on the Karnali, with assistance from Dr. Deep Narayan Shah (right).



Figure 5. Bottom-dwelling fishes of the genera *Garra* (top) and *Pseudecheneis* (bottom), showing ventral sucker morphology which allows them to attach to rocks and maintain position in high-flow velocity habitats.

infrastructure investment, but it can be done, as evidenced by on-going work in the neighboring Himalayan nation of Bhutan. For simpler projects, the primary investment would be in travel costs and relatively inexpensive research supplies.

A final piece that, to my knowledge, is still missing, is a quantitative assessment of the connection between local peoples and fishes of Nepalese rivers. The importance of inland fisheries, especially compared to marine fisheries, has traditionally been under-valued. However, its contribution to food security—especially that of socially, economically and nutritionally vulnerable groups of people—has been recently highlighted. The extent to which Karnali fisheries enhance food security of peoples in the region is, to the best of my knowledge, unknown. Dam construction has negatively impacted fisheries in other rivers in the region such as the Mekong, and it is likely that proposed dam construction in the Himalayas will have similar effects. Without information on the connection between local people and riverine fisheries, it is difficult to assess the impacts of hydropower development on the rural peoples of Nepal.



Figure 6. Students from Kathmandu University testing water quality just downstream from the proposed dam site on the Karnali River.



Figure 7. Student interns and employees of Centre for Molecular Dynamics Nepal (CMDN) erecting field setup to collect fish and environmental DNA samples.



Figure 8. Local residents observing data collection efforts at the Upstream Far Karnali site.



Figure 9. Juvenile Mahseer (Tor tor) collected upstream from Chisapaani.

MADHAV KARKI – EXECUTIVE DIRECTOR, CENTRE FOR GREEN ECONOMY DEVELOPMENT NEPAL

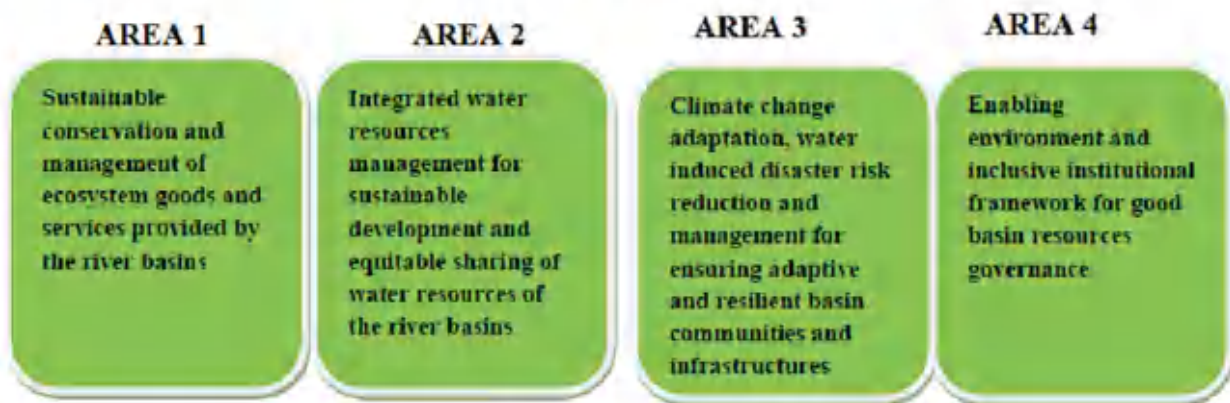
Background and Context:

Having worked in the areas of agriculture, environment, and natural resources, I have always believed that Nepal's rich forest (Hariyo Ban Nepalko Dhan, as our forefathers said), water (Paani nai Jiwan Ho) and nature (bio-diverse ecosystems where our Jaivik Bibhitata, Janwar and Jamin exist in an interconnected manner) can be managed sustainably and with built-up resiliency only by adopting an integrated, holistic, inclusive, coordinated (especially to strengthen upstream-downstream linkages), collaborative (multi-sectoral) and coherent (inter or trans-disciplinary) manner. This means Nepal's natural resources managers especially in post-federalized governance system, have to learn to work together to develop both horizontal and vertical coordination and coherence. With this conviction in mind I agreed to lead the Govt. of Nepal commissioned and WWF/Nepal funded project to develop a "National Integrated River Basin Strategy and Action Plan," whose main objective was "to prepare National Integrated River Basin Strategy and Action plan." The specific objectives among others were to identify inter-sectoral linkages and gaps and develop "Integrated River Basin Management (IRBM) strategy and action plan based on multi-stakeholder and multi-sector consultations and feedback". Implied in these objectives was to mainstream and integrate various integrated concepts including integrated watershed management, integrated water resources management, integrated conservation and development, social and gender inclusive development and strengthening upstream and downstream linkages especially in water resources management and water induced disaster risk reduction. The study also aimed to build on the 2015 Nature Conservation National Strategic Framework for Sustainable Development 2015-2030 prepared by IUCN for the National Planning Commission. This means that the Strategy and Action Plan for managing Nepal's large river basins and watersheds had to not only embrace the underlying core values of Integrated River Basin Management (IRBM) and Integrated Water Resource Management (IVRM) but also had to provide suitable institutional arrangements so that basin scale strategic decisions and interventions are made in a coordinated and coherent manner.

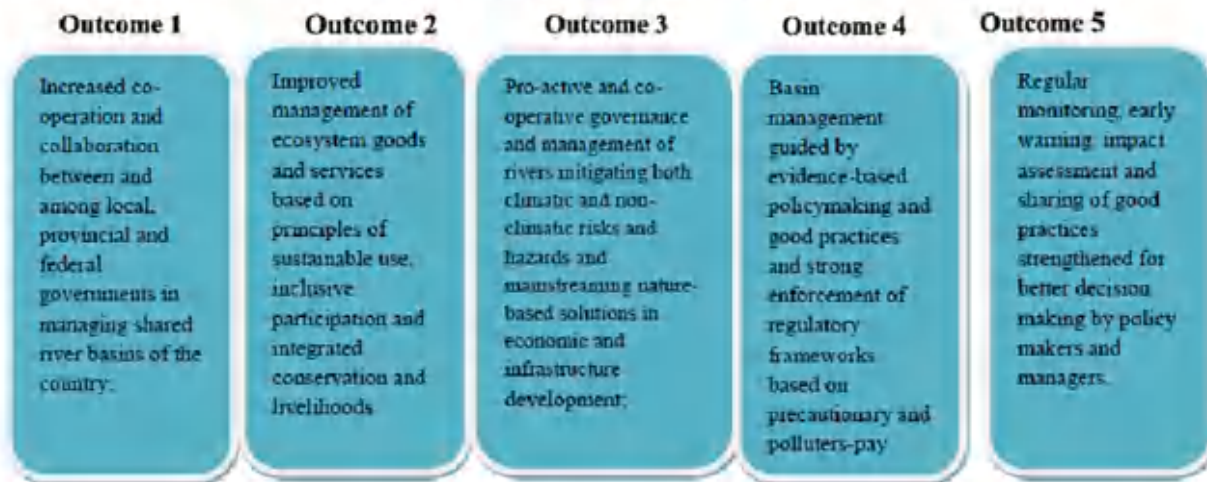
VISION FOR THE RIVER BASINS

"Thriving and healthy river basins characterized by economic prosperity, social inclusiveness, gender empowerment and environmental rejuvenation"

PRIORITY THEMATIC AREAS



STRATEGIC PLAN OUTCOMES



Collaboration with USAID/Paani Program Team:

In order to help my multi-disciplinary team to successfully undertake this challenging task, we reviewed relevant projects and programs funded by development partners in Nepal. Among a large number of studies, projects, and programs, our team found the USAID-funded Paani program covering three important river basins--Karnali, Mahakali, and Rapti—not only relevant but also science and community based. Its aim “to enhance Nepal’s ability to manage water resources for multiple uses and users” mainstreamed much needed climate change adaptation, biodiversity conservation especially of freshwater biodiversity, participatory and integrated watershed management, community forestry user group-based buffer zone management, cooperative fishery management etc. We readily embraced the Paani-employed integrated, whole-of-basin approach with activities at the watershed, river basin, and national scales, “to reduce threats to freshwater biodiversity and strengthen the resilience of targeted human and ecological communities in the Karnali, Mahakali, and Rapti river basins through improved water management through both IWRM and IVWM tools.” Paani program activities have delivered multiple biodiversity and sustainable livelihood benefits through adaptive, collaborative management and restoration of degraded freshwater habitats. My team referred to the literature on the status of aquatic wildlife species and to inform a strategic plan that focuses its work on four key prioritized areas identified based on the inputs received from the national and provincial stakeholders. The plan aims to achieve five strategic outcomes, as shown in the Figure below:

The priority areas are: A) watershed and ecosystem protection and management, B) integrated water resources management, C) climate change and disaster management, and D) institutional framework for good basin governance. These are the intervention or results areas wherein the strategic plan will provide policy and governance level guidance and exert its influence to realize the vision of “thriving and healthy river basins characterized by economic prosperity, social inclusiveness, gender empowerment, and environmental rejuvenation” in Nepal. Altogether, 26 strategies have been developed for intervention in the 4 priority areas. These



Using water mower to remove water hyacinth in Bhagraiya Lake in Bardiya

Photo credit: Pushkar Khanal for USAID

are further broken into strategic actions and targets and supported by interdisciplinary implementation mechanisms and a monitoring and evaluation framework.

Our Learning and Reflections:

The strategic plan prepared by my team has proposed four key strategic areas for interventions at the basin or large watershed scale: A) watershed and ecosystem protection and management, B) integrated water resources management, C) climate change and disaster management,

and D) institutional framework for good basin governance. Among these the result area (A) has been developed using the data, information and knowledge as well as good learning generated by the Paani program. Our team has profusely referred the following two reports:

- USAID/NCRT. Strategic Considerations for River Conservation Legislation In Nepal. August 2019. Nepal River Conservation Trust (NRCT). USAID.
- USAID. PAANI पानी परियोजना Nepal-Assessment of Aquatic Resource Based Livelihoods, Practices and

Ecotourism Development in Selected Watersheds Across PAANI Target River Basins. 2018. USAID.

We have enriched our report with latest information on the distribution and status of flagship aquatic (fish) species (e.g. Golden Mahseer) that face high risk from illegal unregulated and unmonitored fishing. We have also referred to the Paani project about the need to declare some sections/tributaries of Karnali River to protect the Golden Mahseer which Paani program funded researchers found widespread in Lower Karnali, Middle Karnali and Thuli Gad water bodies.

Overall, it was a great pleasure working with the Paani and USAID team on framing our strategic directions and policy relevant messages in the report. I strongly feel that the Paani program has created ample success stories such as fisheries cooperatives and watershed user groups in different thematic and cross-cutting areas of river basin management. The information generated by Paani has been already helped the Government of Nepal to make its latest National Water Resources Policy, 2020 (Rashtriya Jalshrot Niti, 2077) more integrated, cross-sectoral and multi-stakeholder. For example, out of the 11 policy strategies contained in the National Water Policy at least 4 strategies very clearly reflect the recommendations coming out of the Paani program:

- Strategy 1 says water use and management will be done on the basis of river basin master plan
- Strategy 2 is based on IWRM principles and multipurpose use concept
- Strategy 5 says that more studies and research will be supported and knowledge documentation done, and
- Strategy 10 calls for prevention and reduction of risk on the environmental, social and cultural value of water while using and managing river water.

I therefore, strongly recommend to USAID to continue supporting similar projects especially focused on successfully translating the new Water Policy (at least in Karnali, Mahakali and Rapti basins) so that the other basins such as Koshi, Gandaki and Narayani can learn from this river basin's success in achieving the multi-stakeholder and multiple uses based IWRM, IWM and IRBM together. In the meantime, the Ministry of Forest and Environment (MoFE) in consultation with NPC is also planning to develop Integrated Management of Large Watersheds in Nepal to fill in the policy gap in watershed management in the post federalized governance of Watershed-based Ecosystem Services. I am sure this planned policy will also benefit from the data and information generated by the Paani program. I feel that the momentum generated by Paani should not be allowed to slow down as the Government resources have been diverted to fight Covid19 battle. As such, five years of the Paani program is "too little" but is not "too late" to save high conservation value rivers of Nepal, especially in the Karnali and Mahakali basins.

■ STEVE LOCKETT – EXECUTIVE DIRECTOR, MAHSEER TRUST

Paani and the future of work started on fisheries and aquatic biodiversity in Western Nepal

Introduction

Mahseer Trust are a UK-based NGO, registered under the Charity Commission, with a remit to advance the scientific knowledge and wider community education and awareness about mahseers (fish of the genera *Tor*, *Neolissochilus*, *Naziritor*, and *Parator*, with most focus being on the so-called true mahseers of genus *Tor*) and their natural habitat. The distribution range of mahseers is from parts of Afghanistan in the West through the whole Indian subcontinent, Yunnan province of China in the North, through the whole of Southeast Asia as far south as Java, Indonesia, and east as far as Vietnam on the mainland and the whole of Borneo. In the wild, mahseers live in well-oxygenated rivers and streams, usually in the lower reaches (for *Tor*), then migrate to higher altitudes and smaller, gravel-bedded tributaries and streams for spawning.

For more information about mahseer, please visit www.mahseertrust.org

An invitation to give the keynote presentation during the biodiversity session of the Third National River Summit on the banks of the Karnali River in Rakam Karnali in March 2019, was my introduction to the Paani project. It played an important role in creating connections within Nepal between Mahseer Trust and various other agencies.

My presentation was well received and sparked many fresh conversations about how Mahseer Trust can partner with various agencies and individuals working on related areas of river biodiversity and habitat. Most useful for future research needs was

meeting Adarsh Sherchan of the Centre for Molecular Dynamics - Nepal (CMDN), who invited me to meet with Executive Director Dibesh Karmacharya at the facility to discuss aligning genetic sequencing protocols across the mahseer range. Another fortunate introduction was with Dr. Ram Devi Tachamo Shah, a macroinvertebrate expert and the Director of the Aquatic Ecology Centre (AEC) at Kathmandu University. Through Dr. Ram Devi's work as guest lecturer at Naaya Aayam Multi-Disciplinary Institute, Bhouda, Kathmandu, I was invited to give a presentation on the importance of mahseer within overall freshwater ecosystem health and implications for future study opportunities.

Most of the questions, both raised during the presentation at the National River Summit and in questions afterwards, were about the current status of valid species in Nepal. In my presentation I noted that *Tor tor* and *Tor mosal* were not currently correctly identified, which leaves them extremely vulnerable to being missed in the drive to conserve biodiversity and at threat from increased introductions of *Tor putitora*, the Golden Mahseer. Stocking of the Golden Mahseer not only threatens populations of other mahseer, it may also harm natural fish stock ratios, which could have disastrous implications for riverine community fishing needs and fish assemblages.

Dr. Deep Narayan Shah of Tribhuvan University later presented on a project to map fish species' use of river habitat. He offered that silver mahseer do migrate into tributaries. The one he has studied the most is *Thuligaad*. This could be a prime spot for future research into spawning habitat of this species, and perhaps a priority

conservation zone if, as Arun Rana (Himalayan Anglers) suggested, angler catches suggest numbers of silver mahseer are falling much faster than Golden Mahseer.

Immediately following the biodiversity session, I had the opportunity to discuss collaboration with Megh Ale of Nepal River Conservation Trust (NRCT) on future Mahseer Trust scoping or research projects. Many local angling and rafting operators also came forward to discuss the importance of ecotourism in creating models of better river resource use and providing alternate income streams for local communities.

Among other useful connections was the one made with WWF-Nepal, who were considering a telemetry project to study migration of Golden Mahseer (*Tor putitora*). Sharing accommodation with Shawahiq Siddiqui of Indian Environmental Law Association while in Rakam Karnali proved to be especially fruitful for our work in India.

We continue to expand our own operations in Nepal to allow for knowledge-sharing across regional and international borders with specific focus on how actions in Nepal can impact aquatic biodiversity in India and vice versa. Access to new partners thanks to the platform offered by the Paani project has been vital to our ability to coordinate transboundary dialogues.

Overview of Paani

Prior to attending the Third National River Summit, I was under the impression that many in Nepal work on freshwater biota or habitat in isolation. There is a clear need for those working on freshwater ecosystems to coordinate efforts to achieve better results. The local and national government politicians and those representing multi-national and international funding agencies and development projects are a formidable force, and only the most meticulous, concentrated actions will be able to withstand the development agenda and represent the requirements of aquatic life and associated human communities.

My experience of Paani, both at the River Summit and afterwards, showed that there are concerted projects addressing local needs through training, local discussion

groups, and advocacy at higher levels. Consulting with as many interested parties as possible, across all disciplines with influence upon freshwater habitat, must remain as a priority, both within Nepal and wider across the region.

Watershed level study, using local expertise where available and appropriate, or bringing in outside knowledge to improve local expertise, has been one of the most important elements of the Paani project that I can see. These studies will require constant updating, especially if larger, intrusive developments like dam building or substrate extraction are allowed to continue.

Beyond Paani – What Needs to Come Next

At Mahseer Trust, we are excited to hear about the development of a Freshwater Centre of Excellence at Tribhuvan University. This should ensure that lessons learned during the time of the Paani project are continued, and a whole cohort of young students have a solid base upon which to build.

There are elements of the previous five years' activities that still need to be completed. For instance, the Aquatic Animals Biodiversity Conservation Act should be adopted countrywide, as the reports prepared while compiling the background data make very troubling reading not only for fish of various species, but also important predators like river otters.

Similarly, work to understand and protect vulnerable water resources have to continue and even be improved. The connections between water use and ecosystem health have ramifications for those living alongside rivers, hill streams, and springs. Increased pressure on groundwater and the climate change implications for and from agriculture only add to the pressure upon fresh water sources. While this is often seen as isolated from biodiversity, there are intrinsic links which must be studied and understood at all levels, from local communities right up to national government. Such a hierarchical connection often requires the oversight of a major project like Paani if it is to truly transcend local, societal or even cultural obstacles.

We have to hope that future programs continue with the holistic view that was offered to water resource management under Paani. The five-year project funding from USAID has made large strides but should only be seen as the start of what could be an important, ongoing set of activities, and should be a constantly reviewed with extended dialogue among current and future partners.

Images (all by Steve Lockett-Mahseer Trust except as indicated otherwise below)



Steve Lockett meeting with Dibesh Karmacharya and team at CMD-N to discuss protocols for identifying mahseers through genetic sequencing.



Steve lecturing on the importance of mahseer and freshwater ecosystem health to Environmental Science undergraduates at NAMI (Naaya Aayam Multi-Disciplinary Institute) in Jorpati/Kathmandu.



NAMI undergraduates with Steve Lockett and Dr Ram Devi Tachamo Shah following a presentation on the importance of mahseer and freshwater ecosystem health.



Arun Rana with a silver mahseer from Babai River (photo by Arun Rana)

■ **DAVID MOLDEN – DIRECTOR GENERAL, ICIMOD INTERNATIONAL CENTRE FOR INTEGRATED MOUNTAIN DEVELOPMENT 2011-2020**

A unique and impactful event during my time at ICIMOD (2011 to 2020) was the Second National River Summit organized on the banks of the Trisuli river in 2017. Being right next to the river brought all of us in touch with the issues being discussed. The participants, many of whom do not regularly attend Kathmandu conferences, brought in different perspectives to the discussion. There were also key policy makers in attendance, so a range of people and voices were heard. With the lovely sound of the river in the background, I made a presentation arguing that with planning it is possible to keep stretches or branches of Nepal rivers pristine, and yet still keep other sections to provide hydropower and other services so that development and conservation can be balanced. This was not only a pleasant experience, but a great way to connect people with nature, and people to people.





Photo credit: Tek Gharti Magar for USAID

■ ARUN RANA – HIMALAYAN ANGLERS

My link to the Paani program was in the capacity of an angler, with an interest in saving the legendary gamefishes of the Himalayan waters, especially the Golden Mahseer (*Tor putitora*). Sadly, Nepal's drive for biodiversity conservation has focused exclusively on terrestrial species since the advent of modern conservation, which started with the promulgation of the National Parks and Wildlife Conservation Act of 1973. Very few conservationists in Nepal have even heard of the Aquatic Animal Conservation Act, which was promulgated four years earlier in 1969. This law, which recognizes aquatic biodiversity and proposes measures to

protect them, has sat on the shelf for half a century. Since its establishment 50 years ago, the Department of National Parks and Wildlife Conservation, which has the mandate for biodiversity conservation in Nepal, has failed to establish a protected area dedicated to aquatic biodiversity, nor has it ever established a unit responsible for freshwater biodiversity conservation.

The fate of our rivers and the fish that swim in them—some 250 species recognized until now with new species being discovered in every survey—the future of the Himalayan fish is bleak. The vast majority of Nepal's policymakers and development planners see a river as

simply a resource to exploit to generate hydroelectricity and irrigate agricultural land. Water resources planning has so far failed to consider a system-wide approach where multiple uses of water, including space for the aquatic life that resides beneath its surface, are factored into water resources prioritization. There are dams planned on every river in Nepal. The vast majority of Nepalis who find themselves in the transition from traditional village life to an urban life see the river as a sewer line that is there to wash away their domestic waste. And those profiting from the ever-growing construction industry see the river as a never-ending source of sand and gravel.

Rara National Parks provides habitation to seasonal migratory birds

With the departure of the British from India, the craze for angling also disappeared, and with media focus on charismatic terrestrial species in the last fifty years, the world's focus on conservation diverted exclusively towards terrestrial species and ecosystems. As I fish around Nepal, moving from one depleted river to another, I have started to wonder if it is only the local fishermen and anglers like myself who fully comprehended the scale of desecration of the legendary gamefishes of the Himalayan waters, and undoubtedly with these apex species, other lifeforms below water across the Himalayas. No one cares what is happening to the fish in the Himalayan rivers.

It was really heartening therefore, to come across the Paani program, where conservationists were finally recognizing the life below water, and they actually began to reach out to anglers like myself! In the following years, I provided my experiences and represented Nepal's angling community in various meetings and workshops, hoping to raise awareness on legendary fish like the Golden Mahseer (*Tor putitora*) which has seen a recent resurgence of interest among western anglers. The Karnali River was once the fishing haven for great anglers like the Maharaja of Bhopal, but lack of conservation efforts amidst a growing population has taken its toll on the Golden Mahseer population in this basin. The efforts made by PAANI to map this river from source to its end in the Ganga, and to raise awareness on fish conservation among the locally elected representatives is commendable. It has taken over half a century to ensure that large mammals are effectively protected. It will no doubt take time for the fish in our rivers to get a similar attention as that received by the Royal Bengal Tiger and the One-horned Rhinoceros. But I believe Paani has sown the seeds towards this, and as an angler and conservationist obsessed with the fishes of the Himalayan waters, I could not be happier. But a seed sown must be nurtured to ensure it grows into a strong tree, and so a follow-on project building on the successes of the Paani program is imperative to keep the momentum going. From an angling perspective, which I believe is the answer to promote fish conservation, I see the need to further build awareness among the local representatives so that they can protect critical habitat for fish to successfully spawn. Once fish numbers increase, sports fishing tourism will become feasible, and with this, a sustainable way to generate income from the river for the local economy. The Karnali has fantastic wildernesses and waters remaining to develop into a lucrative sports fishing industry. But the fish must swim in its waters like they used to during the times of the Maharaja of Bhopal and Jim Corbett, who writes of his angling pursuit in the epic *Maneaters of Kumaon*. Then, once again, the Karnali can regain its reputation as one of the best Golden Mahseer fishing destinations in the Himalayas, and Rudyard Kipling's words can again come alive: "There he stood the Mahseer off the Poonch beside whom the Tarpon is a Herring and he who catches him can say he is a fisherman".



18.7 kg Golden Mahseer caught and released by Arnaud Cauchois in the West Seti River in 2015. Photo by Juha Rouhikoski



Aryaman Karki 17 kg Golden Mahseer in the West Seti. Photo by Arun Karki

Documentation Produced by the IWMI/Digo Jal Bikas Project

SN	KNOWLEDGE PRODUCT	TYPE
	Sustainable, Just and Productive Water Resources Development in Western Nepal Under Current and Future Conditions	Main Report
	Sustainable, Just and Productive Water Resources Development in Western Nepal Under Current and Future Conditions	Annexes

Documentation Produced by the U.S. FOREST SERVICE/USAID-NEPAL PAPA

SN	KNOWLEDGE PRODUCT	TYPE
1	DEC Version Nepal WRM FWB Assessment Report 2014	Assessment Reports
2	Natural Resource Baseline Assessment	Assessment Reports
3	June 2018 NFBP Update Report	Collaboration with CMDN
4	February 2018 Final Fish Report	Collaboration with CMDN
5	USAID Evaluation Report	Monitoring and Evaluation Report
6	USA Sustainable Hydropower Collaborative Learning Agenda	Sustainable Hydropower Series
7	Presenter Bios	Sustainable Hydropower Series
8	Participants' Bios	Sustainable Hydropower Series
9	Hydropower Study Tour Synthesis	Sustainable Hydropower Series
10	Columbia River Study Tour: Study Tour Cable	Sustainable Hydropower Series
11	Columbia River Study Tour: IPPAN Biodiversity Workshop Agenda	Sustainable Hydropower Series
12	Columbia River Study Tour: Hydropower Workshop Agenda	Sustainable Hydropower Series
23	Presentation: IPPAN - Hydropower Sector of Nepal	Sustainable Hydropower Series
14	Presentation: Treaty 1010 for Nepalese Ministers	Sustainable Hydropower Series
15	Watershed Management Training Report 2018	Watershed Management Seminar
16	Watershed Management Workshop Agenda 2018	Watershed Management Seminar
17	Watershed Management Training 2018	Watershed Management Seminar
18	Seminar Best Practices Presentation	Watershed Management Seminar

SN	KNOWLEDGE PRODUCT	TYPE
19	Presentation: USFS Watershed Management Seminar, Day 1	Watershed Management Seminar
20	Presentation: USFS Watershed Management Seminar, Day 2	Watershed Management Seminar
21	Presentation: Overview of Integrated Watershed Management in Nepal	Watershed Management Seminar
22	Presentation: Multi-Stakeholder Engagement Best Practices	Watershed Management Seminar
23	Presentation: Watershed Basics	Watershed Management Seminar
24	Presentation: Watershed Condition Assessment	Watershed Management Seminar
25	Presentation: Prevention versus Restoration	Watershed Management Seminar
26	Presentation: Low-Volume Roads Engineering Best Management Practices Field Guide	Watershed Management Seminar
27	Presentation: Community Engagement	Watershed Management Seminar
28	Presentation: Water Quality	Watershed Management Seminar
29	Presentation: Understanding Media and its Role for Better Watershed Management in Nepal	Watershed Management Seminar
30	Presentation: Water Harvesting Principles	Watershed Management Seminar
21	Presentation: WOCAN Module	Watershed Management Seminar
22	Low Volume Roads Engineering: Best Management Practices Workshop (Gorkha)	Low Volume Roads Training
	Low-Volume Roads Engineering Best Practices (Gorkha)	Low Volume Roads Training
	Low Volume Roads Engineering: Best Management Practices Workshop (Nepalgunj)	Low Volume Roads Training
	Low-Volume Roads Engineering Best Practices (Nepalgunj)	Low Volume Roads Training
	Low Volume Roads Engineering: Best Management Practices Workshop (Surkhet)	Low Volume Roads Training
	Low-Volume Roads Engineering Best Practices (Surkhet)	Low Volume Roads Training
	USAID Short-Term USFS Detail for USFS/Implementing Partner Technical Assistance in Rural Road Engineering Policy and Curriculum Development Support Concept Note	Low Volume Roads Training

SN	KNOWLEDGE PRODUCT	TYPE
	Development of a “Low-Volume Roads Best Practices” Course for Senior Level University Forestry and Engineering Students	Low Volume Roads Training
	Presentation: Green Engineering—Low Volume Roads Engineering	Low Volume Roads Training
	Long-Term Detail: USAID Outbrief	Low Volume Roads Training
	Long-Term Detail: Green Roads Reconstruction Pilot Concept Note	Low Volume Roads Training
	Presentation: Rural Road Development in Nepal	Low Volume Roads Training
	Presentation: Road Issues Discussion	Low Volume Roads Training
	Presentation: Low-Volume Roads Engineering Best Management Practices	Low Volume Roads Training
	Presentation: Environmental Analysis Process	Low Volume Roads Training
	Presentation: EIA Process Used in Nepal	Low Volume Roads Training
	Presentation: Low-Volume Road Engineering Location, Design, and Costs	Low Volume Roads Training
	Presentation: Geological Setting and Its Consequences in Road Construction in Nepal	Low Volume Roads Training
	Presentation: The Power of Water	Low Volume Roads Training
	Presentation: Roads and Aquatic Diversity	Low Volume Roads Training
	Presentation: Hydrology Methods	Low Volume Roads Training
	Presentation: Drainage Design Tools	Low Volume Roads Training
	Presentation: Road Surface Drainage	Low Volume Roads Training
	Presentation: Wet Area Crossings, Subsurface Drainage, and Underdrains	Low Volume Roads Training
	Presentation: Natural Drainage Crossings	Low Volume Roads Training
	Presentation: Causeways (Low-Water Crossing, Fords) and Bridges	Low Volume Roads Training
	Presentation: Stability of Roadway Cuts, Fills and Slopes	Low Volume Roads Training
	Presentation: Stability of Roadway Cuts and Fills (Methods of Road Stabilization)	Low Volume Roads Training
	Presentation: Roadway Materials	Low Volume Roads Training
	Presentation: Erosion Control	Low Volume Roads Training
	Presentation: Gully Stabilization	Low Volume Roads Training

SN	KNOWLEDGE PRODUCT	TYPE
	Presentation: Discussion on Availability of Native Seed and Plant for Slope Stability Purposes (Bio-engineering) in Nepal	Low Volume Roads Training
	Road Location and Drainage Exercises	Low Volume Roads Training

Documentation Produced by the USAID Paani Project

SN	KNOWLEDGE PRODUCT	TYPE
	Bilingual Civil Society Guide for Healthy Rivers (English and Nepali)	Advocacy Tools
	SHD advocacy products: 1. National Sustainable Hydropower Advocacy Strategy 2. Advocacy Training Manuals for healthy rivers 3. SHD advocacy training materials	Advocacy Tools
	Rara National Park Leaflet	Communications material
	Course on Fish Passage Design. (The course includes case studies on different hydropower projects)	Couse design
	New Integrated Water Resources Management, Low Volume Road Engineering, Applied Hydrology, and Environmental and Social Impact Assessment course curricula	Couse design
	Capture Fisheries Guideline	Guideline
	Pictorial Guide on Spring Source Mapping	Infographic
	EFRC IEC Materials (posters, brochure and flip chart and tutorial video)	Knowledge product
	Climate Smart Vegetable Farming Manual	Manual
	Integrated Fish Farming Manual	Manual
	Inventory of Fish Species from Three Different River Basins	Paani Fishery Product
	Poster Monograph: Karnali Endemic and Threatened Fish Species	Paani Fishery Product
	Poster Monograph: Karnali Iconic Fish Species	Paani Fishery Product

SN	KNOWLEDGE PRODUCT	TYPE
	Stock Taking Report on the Impacts of Non-native Fish Species on Native Fish Species (Invasive Species Report)	Paani Fishery Product
	NEFEJ Paani Television Episodes	Paani Media Product
	Flood Hazard Map Watershed Posters for dissemination in four watersheds	Posters
	Briefer: Fisheries Market and Conservation Governance Model	Primary Research
	Briefer: Protocol/Requirements for Declaration of Fish Sanctuary	Primary Research
	Field Guide on Bio-assessment and Micro-invertebrates for Citizen Scientists	Primary Research
	Poster on Mapping of Spring Sources for Five Watersheds	Primary Research
	Poster: Assessment of Wetland Biodiversity and Their Relationship with Habitat Quality (FAN)	Primary Research
	Poster: Bio Assessment using Macro-invertebrates (foldable pocket map format)	Primary Research
	Poster: Recommendation for Basin Level Plan Based on Karnali Basin Expedition and Paani Learning Discussions at Basin Level	Primary Research
	River Stretch Co-management Process Documentation	Primary Research
	An Assessment Report on High Conservation Value Rivers of Nepal	Priority Study Report
	Aquaculture Feasibility Study (First Phase)	Priority Study Report
	Aquaculture Feasibility Study (Second Phase)	Priority Study Report
	Aquatic Animal Conservation Bill of Jorayal Rural Municipality (English)	Priority Study Report
	Assessment and Conservation Status of Aquatic Biodiversity in Lower Karnali and Mahakali River Basins	Priority Study Report
	Assessment of Nature-based Tourism in the Karnali Basin	Priority Study Report

SN	KNOWLEDGE PRODUCT	TYPE
	Birds of Rara Updated Checklist	Priority Study Report
	Business Case for Capture Fisheries, Aquaculture and Fisheries-based Ecotourism	Priority Study Report
	Catch Assessment Survey	Priority Study Report
	Catch Survey Manual	Priority Study Report
	Commercial Aquaculture and Small Aqua Culture Survey Reports	Priority Study Report
	Comparative Study on the Impact of Hydropower Construction on Freshwater Biodiversity Using e-DNA Sequencing (CMDN reports).	Priority Study Report
	Energy Options Assessment Report for Nepal	Priority Study Report
	Environment Friendly Road Construction Guidelines	Priority Study Report
	Fish Value Chain Study Report	Priority Study Report
	Fishery Conservation Framework and Market Development Strategy	Priority Study Report
	Fishery Livelihood and Market Survey	Priority Study Report
	Flood Hazard Mapping Report	Priority Study Report
	Impacts of Gravel Mining on Aquatic Species in Lower Karnali and Lower Mahakali Watersheds	Priority Study Report
	Inventory of Fish Biodiversity and Associated Threats in the Karnali, Mahakali, Rapti River Basins	Priority Study Report
	Karnali River Corridor Management Framework	Priority Study Report
	Management of Invasive Aquatic Plants and Animals in Nepal	Priority Study Report
	Policy Brief for Conservation of Wetland Biodiversity	Priority Study Report

SN	KNOWLEDGE PRODUCT	TYPE
	Political Economy Analysis to Identify Champions for Freshwater Policy Change and Conservation of Aquatic Biodiversity Report	Priority Study Report
	Rara Ramsar Site Management Plan	Priority Study Report
	Sediment Transport Report	Priority Study Report
	Strategic Consideration for River Conservation Legislation in Nepal	Priority Study Report
	System-scale Planning for the Karnali River	Priority Study Report
	System-scale Planning Integration Policy Brief and Executive Summary	Priority Study Report
	NESS checklist tool: 1. Environmental compliance monitoring and social safeguards checklist for hydropower projects 2. debrief compendium and framework for interdisciplinary monitoring and orientation to province (Karnali) level planners and decision maker	Priority Study Report/ Advocacy tools
	Strategic Consideration for River Conservation Legislation in Nepal (Summary)	Report Summary
	A Multi-Disciplinary Assessment of Biodiversity and Socio-Economic Status of the Karnali River of Nepal (CMDN)	Research Briefer
	Increasing Adaptive Capacity of Communities in Upper Rangun-Khola Sub-watershed through Improved Water Resources Management (RDC)	Research Briefer
	Mapping and Assessing Pollution Stresses on Spring Sources in Five Watersheds of Mid and Far-Western Nepal	Research Briefer
	Political Economy Analysis to Identify Champions for Freshwater Policy Change and Conservation of Aquatic Biodiversity	Research Briefer
	Preparation of sub-watershed management plans engaging key stakeholders (CREEEW)	Research Briefer
	River Health and Biodiversity Profiling in the Karnali and West Rapti Watersheds: (KU)	Research Briefer

SN	KNOWLEDGE PRODUCT	TYPE
	Strategic consideration for river conservation legislation in Nepal	Research Briefer
	Assessment of Spring Water Quality in the Rural Watersheds of Western Nepal	Scientific Journal Publication
	Extent and Distribution Wetland Biodiversity in Protected and Non-protected Lakes in Far-western Nepal	Scientific Journal Publication
	Mapping and Measurement of Water Discharge from Spring Sources of Western Nepal	Scientific Journal Publication
	Status of Freshwater Biodiversity and Habitat Condition in Ramaroshan Wetland Complex of Achham District, Nepal	Scientific Journal Publication
	Status of Mahseer (Tor spp.) in the Karnali River Basin, Nepal: Diversity, Habitats, and Aspects of Bionomics	Scientific Journal Publication
	Structure of Benthic Macro Invertebrate Communities in the Rivers of Western Himalaya	Scientific Journal Publication
	Water Crises in a Water-rich Country: Case Studies from Rural Watersheds of Nepal's Mid-hills	Scientific Journal Publication
	Fishery Conservation Framework for Nepal	Technical Briefer
	Second and Third National River Summit Reports	Technical Report/ Commission studies
	Ornithology Training Manual	Training Material
	Watershed Briefers	Watershed Study
	Watershed Health Profiles (12 Paani Watersheds)	Watershed Study
	Watershed Health Reports (12 Paani Watersheds)	Watershed Study
	Watershed Posters	Watershed Study
	Watershed Prioritization Report	Watershed Study



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