PROCEEDINGS OF THE WORKSHOP ON

Assessing freshwater ecosystems for sustainable hydropower development in Nepal

19–22 November 2019
Dhulikhel, Nepal

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Contents

Abbreviations and acronyms

ASPT	Average Score per Taxon
EIA	Environment Impact Assessment
EMP	Environment Management Plan
EPA	Environmental Protection Act
EPR	Environmental Protection Rules
FRTC	Forest Research and Training Centre
GDP	Gross Domestic Product
GoN	Government of Nepal
ICIMOD	International Centre for Integrated Mountain Development
IFC	International Finance Corporation
IWMI	International Water Management Institute
KU	Kathmandu University
MoFE	Ministry of Forest and Environment
NESS	Nepal Environmental and Scientific Services Pvt. Ltd.
NVE	Norwegian Water Resources and Energy Directorate
PES	Payment for ecosystem services
RSC	River Stretch Co-management
WENEFC	Western Nepal E-Flows Calculator

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The Koshi Basin Initiative (KBI) is supported by the Australian Government through its Sustainable Development Investment Portfolio (SDIP) for South Asia while the Cryosphere Initiative is supported by the Norwegian Ministry of Foreign Affairs. Both initiatives are also supported by the Swiss Agency for Development and Cooperation (SDC). This workshop was also partially supported by core funds from ICIMOD contributed by the governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Switzerland and the United Kingdom.

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Executive summary

Different anthropogenic and natural disturbances have impacted the health of freshwater ecosystems throughout the Hindu Kush Himalayan (HKH) region. Hydropower development has caused a decline in the connectivity and environmental flow (e-flow) of rivers. To minimize these impacts, the Government of Nepal (GoN) recently endorsed the Hydropower Environment Impact Assessment manual. Following the launch of the manual, an in-depth training needs assessment to implement the manual was conducted. Improving the capacity of relevant stakeholders in freshwater ecosystem assessment for EIAs was highlighted as one of the focus areas of the needs assessment.

In this context, a four-day training workshop was held in Dhulikhel from 19 to 22 November 2019 to provide hands-on assessment tools and procedures to stakeholders on assessing freshwater ecosystems as part of environment impact assessments (EIAs) in the hydropower sector. This included a full day of field training. The training was organized by the International Centre for Integrated Mountain Development (ICIMOD) in collaboration with the Forest Research and Training Centre (FRTC) – Ministry of Forests and Environment (MoFE), Nepal; the Norwegian Water Resources and Energy Directorate (NVE), Norway; the International Finance Corporation (IFC); and Kathmandu University (KU). A total of 30 participants including government officials, hydropower proponents and students joined the training.

The sessions provided an overview of the national and international policies and guidelines for EIA. They also demonstrated the importance of freshwater ecosystems as well as tools to assess freshwater ecosystems as part of EIA for sustainable hydropower development. The participants visited the Panauti hydropower station and also practised applying the assessment tools at the Roshi Khola. They collected hydrological and water quality data, and used the Rapid Assessment Protocol to understand the health of the river. Through interactive discussions and use of role play as stakeholders involved in hydropower development, the Workshop highlighted that stakeholder involvement in proper technical assessment was a prerequisite for ensuring the environmental sustainability of hydropower projects. It also demonstrated that mitigation measures must be tailored and adapted to suit the requirements of the respective watercourse and should include a benefit sharing mechanism and the species that are to be protected.

The following key takeaways emerged from the discussions between the resource persons and participants at the training:

- One of the major reasons for poor hydropower development is the limited study of catchment characteristics and the limited engagement between different field experts like hydrologists and ecologists during the project design and EIA. Cumulative impact assessment and e-flow approach, which take into consideration basin characteristics and ecological functions, are not practiced in Nepal.
- The knowledge and capacity of resource persons of EIAs in Nepal is very limited relating to assessment of freshwater ecosystems. Thus, the potential impacts on freshwater ecosystems of hydropower projects is often neither well reported nor reviewed in EIAs. Freshwater ecosystem assessment includes collecting data and analysing the information on the catchment, hydrology, water quality, and biodiversity in the ecosystem. Assessment priority should be on fish species, species diversity, abundance, size, cost, human resources, and pros and cons of the method used.
- In addition to the EIA manual for hydropower, it is necessary to develop a standard protocol for freshwater ecosystem assessment to strengthen capacity to conduct such assessments for use at various levels of the government and other stakeholders in implementing the hydropower manual and thus ensuring sustainable project design.

At the end of the training, the participants said that it was very relevant for them and also noted that their knowledge on the EIA process and freshwater ecosystem assessment had increased (see pre- and post-assessment results in the Section titled 'Training evaluation'). As such, the need for developing a freshwater ecosystem assessment handbook based on a standard protocol relevant to the context was recommended. The handbook could be a guiding document for researchers, environmental professionals, students, and policy makers for conservation and management of freshwater ecosystems in Nepal.

Background

Freshwater ecosystem health can be determined by a series of factors such as water quality and quantity, connectivity to other parts of the system and landscape, habitat condition, and the diversity and richness of plant and animal species (Simonov et al., 2019). But infrastructure developments, such as dams for hydropower, have led to declines in connectivity and impacted the e-flows of rivers (Grill et al., 2019). Hydropower dams can cause decline and degradation in the habitats of many species, impact floodplain ecosystems, become barriers to fish migration routes and alter the livelihood prospects of downstream communities. Therefore, hydropower planners should strive to minimize the impact of such plants on natural ecosystems and their services through improved impact assessments and impact mitigation.

In 2018, the GoN launched the Hydropower Environmental Impact Assessment manual as a guiding document for EIAs for hydropower, in line with international good business practices in the hydropower sector. Following its launch, in order to ensure effective implementation of the manual, a workshop on training needs assessment was conducted for professionals involved with EIA in the hydropower sector. It identified keys areas in which the capacity of the users of the manual, including reviewers of EIAs, needed enhancement. The need for a specific standard methodology for baseline studies and for impact, compliance, and baseline monitoring was noted across stakeholder types, especially for aquatic ecosystems.

A four-day training was thus organized to strengthen the capacity of EIA professioanls and government representatives – from the federal and provincial levels – in conducting freshwater ecosystem assessment. It included a field visit to the Panauti Hydropower Station, Kavre, Nepal, as well as field testing of the assessment methodologies. It was organized by ICIMOD in collaboration with the Forest Research and Training Centre (FRTC) – Ministry of Forests and Environment (MoFE), the Norwegian Water Resources and Energy Directorate (NVE), the International Finance Corporation (IFC), and Kathmandu University (KU). The participants included representatives of approval authorities and relevant government ministries, EIA practitioners, hydropower consultants and investors.

Objectives

The training workshop provided assessment tools and procedures to participants to support the assessment of freshwater ecosystems as part of EIAs in the hydropower sector. The specific objectives included the following:

- Improving theoretical and practical understanding of integrated water resource management;
- Equipping participants with tools and techniques for collecting and analysing data on water quality and aquatic life; and
- Discussing upstream–downstream interlinkages and impact of hydropower on downstream ecosystems.

Day 1

Opening session

KEY MESSAGES FROM THE SPEAKERS

Laxmi Dutt Bhatta, Senior Ecosystem Analyst, ICIMOD, introduced the four-day programme and presented the training's objectives. He stated that the training will improve the knowledge and skills in freshwater ecosystem assessment of professionals engaged in EIA processes. He further stated that he hoped the training would provide a platform for identifying the information and data gaps that needed to be addressed in order for freshwater assessments to be better integrated into and contribute to sustainable hydropower development in Nepal.

Ingrid Haug, Senior Advisor at NVE, highlighted the role of NVE in the management of water resources, especially with regard to hydropower in Nepal. She said that NVE is providing technical support for hydropower development and shared some good practices in Norway that could be applicable for hydropower development in Nepal.

Eklabya Sharma, Deputy Director General, ICIMOD, stated that freshwater ecosystems are an important resource of the HKH region contributing as they do to global ecosystem services and that sustainability of hydropower depends also on how sustainably we use the freshwater ecosystems. With regard to the energy sector of the HKH region, 1.8 billion people still depend on biomass for their subsistence livelihoods. However, due to climate change throughout the HKH, glaciers are beginning to melt and freshwater sources are being lost. This might lead to decreased availability of water for industry, irrigation, hydropower, etc. Although Nepal has huge potential for hydropower, limited developments have taken place so far. Proper EIAs, good availability of freshwater in the catchment, and equitable benefit sharing mechanisms, he said, were essential for sustainable hydropower development. He thanked the co-organizers of the training for their productive partnership and hoped that it would continue beyond this training.

Subodh Sharma, Registrar, KU, thanked ICIMOD for organizing the training. He mentioned that there remains huge gaps in capacity in the area of use of tools to assess freshwater ecosystems. Informing participants that Nepal has its own assessment tools for scientific assessment of freshwater ecology, he said that capacity strengthening training should happen twice or thrice a year targeting multiple stakeholders. KU has resources, including experts in freshwater ecosystem assessment as well as data, tools and methods developed for Nepal, which can be applied in sustainable hydropower development.

Megh Nath Kafle, Director General, FRTC, welcomed all the distinguished guests and participants to the Training. He explained that the dissemination of knowledge on innovations should happen through a systems-based approach. He stated that, for the application of research in the decision-making process, there should be equal involvement of the government sector, private sector, scientific sector and academic institutions. He observed that he had found that prevailing EIA reports too often do not address the interlinkages between the ecosystem structure and its components. He said that knowledge on freshwater and its ecology is very limited and suggested broader sharing of research innovations. Summing up, he mentioned that different levels of government should be involved equally in environment assessments to ensure sustainable project design.

HIGHLIGHTS

Technical sessions

OVERVIEW OF EIA PROCESS IN NEPAL

Jwala Shrestha, Under Secretary, MoFE presented a brief history of EIA. It had been first mentioned in the Sixth Five Year Plan (1980-1985) for Nepal. Legal provisions such as the Environment Protection Act (EPA), 1997, and Environment Protection Regulation (EPR), 1997, have clearly mentioned the following: the obligation to prepare IEE/EIA reports by the proponent; prohibition on implementation of proposal without approval of the IEE/EIA reports; and penalties for non-compliance. While EIAs are approved by MoFE, IEEs are approved by the relevant ministries. In the case of both IEEs and EIAs, the ministry concerned is responsible for monitoring whereas MoFE is the authority for environmental auditing. Describing the different processes of EIA studies and EIA report

review and approval process, she mentioned that 307 EIA reports have been approved to date by MoFE. She mentioned that MoFE has taken some initiatives to facilitate the EIA process, such as making amendments to the EPR and EPA and the formulation of the Hydropower EIA Manual.

OVERVIEW OF A FRESHWATER ECOSYSTEM APPROACH IN EIA FOR HYDROPOWER

Ingrid Haug, NVE, shared the Norwegian experiences with hydropower development. She mentioned that Norway, the 7th largest hydropower producer in the world, is favoured by topography and rainfall and relies on hydropower for 96% of its energy. In the 19th century, in response to growing demand for electricity, new hydropower plants and large dams were developed rapidly. However, this had negative impacts on the natural environment and landscape of the nation with rivers and water falls drying up due to lack of e-flow and the fish populations significantly reduced. Hence, a concerted effort was made to institute environmental protections - a big turning point for the Norwegian hydropower sector from the 1960s to the 1980s. Sharing Norwegian licensing procedures, she showed that EIA is an important decision making tool in ensuring the environmental sustainability of the project, which is arrived at through a democratic process via stakeholder involvement. She also emphasized that mitigation measures must be tailored and adapted to suit the respective watercourse and species to be protected.

NATIONAL AND INTERNATIONAL GUIDELINES AND STANDARDS RELATED TO HYDROPOWER DEVELOPMENT

Salil Devkota, Managing Director, NESS presented the existing national and international guidelines and standards related to hydropower development that emphasize the protection of the environment. He stated that while ensuring human rights, environment conservation should not be neglected. Different sectoral and cross-sectoral guidelines, manuals, and standards of the GoN need compliance with in the preparation of environmental reports. He presented the monitoring indicators for different phases of hydropower development, including pre-construction, during construction, and post-construction phases.

ENVIRONMENTAL FLOWS: CONCEPTS, TOOLS, AND APPLICATIONS

Vishnu Prasad Pandey, Regional Researcher – Water & Climate, IWMI - described e-flow as the specific amount of water required for natural or environmental demand. E-flow depends on its natural flow regimes, i.e., high flow, moderate flow and low flow. E-flows should be legally and scientifically defensible and administratively feasible. Explaining the different methods and approaches to estimating e-flows, he stated the need for guidelines along with well-demonstrated examples of holistic approaches encompassing hydrology, ecology and socio-economy, for evidence-based policy and practice. Capacity strengthening and awareness raising and overcoming challenges related to implementation are important aspects in setting e-flows. Pandey also demonstrated the Western Nepal E-Flows Calculator (WENEFC) for e-flows estimation.

DISCUSSION

After each presentation, the floor was open for discussion and interactions between participants and resource persons. The participants expressed concern relating to the following: the authorities' protocols on penalties for EIA rule breakers; provision for EIA/IEE approval process where the provincial government laws are not formulated; mechanisms for auditing the EIA process; formation of review committees for approval process; and field visits for monitoring. Jwala Shrestha, MoFE, responded that while the authority to impose penalties has been clearly mentioned in the Act, the terms of facilitation and mode of punishment are being discussed and will be addressed in the new EPR. MoFE will inform upon inquiry how the EIA/IEE approval process will proceed where a provincial government law has not been formulated. She also said that the discussion on the process of auditing is ongoing at MoFE. She also said that the discussion on the process of auditing is ongoing at MoFE as well as the formation of project-specific review committees that include relevant experts. She further stated that while field visits for monitoring are rare, it will be addressed in the new EPR.

Participants also raised questions regarding strengthening of the capacities of local and provincial governments. In response, Shrestha said that the MoFE is collaborating with ICIMOD, FRTC

and IFC on capacity building and that a budget can be arranged for capacity building workshops, trainings and meetings. Participants also queried about an academic curriculum on EIA in order to increase understanding of IEEs/EIAs. Salil Devkota said that those involved in the technical side of the process are usually not involved in curriculum preparation and that there is one chapter in the Master's Course of TU on IEE and EIA under Environmental Management Tools. He, however, said that the USAID PAANI project has just started to teach environment law at Surkhet University.

Participants also posed questions to the Representative from the NVE regarding other aqua fauna besides salmon; the minimum e-flow to be maintained; and contribution of fish towards the Gross Domestic Product (GDP) of Norway. Ingrid Haug replied that as Norway does not have diverse aquatic fauna, only benthos macro invertebrates and salmon were considered in the study and that the minimum e-flow is estimated separately for each specific project. She further stated that the contribution of fish to Norway's GDP has not been calculated although salmon remains an attraction in eco-tourism.

Questions were raised by participants about the relationship between high e-flow and bird breeding, streamlining the amount of e-flow, and the unwillingness of hydropower companies to maintain e-flow. Vishnu Prasad Pandey answered that hydropower proponents are more willing to pay compensation than releasing water to maintain the e-flow. He said that as some bird species can breed only in particular flow regimes, if the species is not able to find areas with sufficient e-flow, they will be unable to breed. He further stated that though there are implementation challenges when it comes to ensuring e-flow, the government regulation states that whatever the size of the hydropower project, they have to adhere to the 10% minimum flow, which does not take into account the flow regime or the seasonality of the flow.

Day 2

Case study on aquatic biodiversity assessment/ freshwater ecosystem assessment

BARRIER EFFECT ON FISH AND OPTIONS FOR THE UPPER TRISHULI FOR THE PROTECTION OF AQUATIC SPECIES

Salil Devkota, NESS, said that an integrated study of catchment characteristics by an interdisciplinary team of field experts that includes hydrologists and ecologists is needed to assess the potential impacts of hydropower on the freshwater ecosystem. He said that there are many hydropower plants within the Trishuli River basin that hinder fish conservation, especially hydropower dams that create a barrier against fish migration. The Trishuli River is dominated by the common snow trout and *Schizothorax spp.* (asala). Hence, fish ladders should be designed based on the speed and distance covered by the fish during migration. Although fish transport and hauling methods have been adopted in the Trishuli River, in which fishes are brought from fish hatcheries and released into the river, he said that the fish ladder method has been found to be more effective than fish transport and hauling. Thus, in the Upper Trishuli I project, a fish ladder is going to be constructed to facilitate the migration of the common snow trout.

CASE STUDY OF AQUATIC BIODIVERSITY ASSESSMENT AT JHIMRUK HYDROPOWER PROJECT

Deep Narayan Shah, CDES-TU, and Ram Devi Tachamo Shah, AEC-KU, presented a study on river health mapping and stressors identification in the Jhimruk watershed. The major components covered during the study were water quality parameters, periphytons, benthic macroinvertebrates, fish, and the social survey. They also trained citizen scientists to develop bio-assessment champions for continuous monitoring of the river system. The study showed that upstream, midstream and downstream

tributaries were in very low, low or moderate stress, respectively. The study revealed that there is a large variation in the benthic macroinvertebrates composition and abundance between the upstream and downstream of the Jhimruk hydropower dam. Reophiles (stoneflies and caddisflies nymphs) were absent at sites downstream of the dam. In the case of fish, migratory species such as Tor spp. seemed affected by the operation of the dam in the river.

CASE STUDY FROM THE TOLGA POWER PLANT IN RIVER GLOMMA, NORWAY

Ingrid Haug, NVE, presented the case study of the Tolga power plant in River Glomma, Norway, where long-migrating fish populations of grayling and trout are found. Before the power plant was established, the fish could pass freely up to 360 km and it was a popular fishing spot. But, with 16 dams and 17 power plants in the main watercourse (which form barriers for fish migration) since then, fish ladders have had to be included to maintain fish migration and viable population. In addition, fishing tourism which was an important source of income in the region has also had to be maintained. Thus, EIA reports were prepared with mitigation measures to reduce impacts on fish population. After public consultation and field visits, additional assessments on a two-way fishing passage, a turbine bypass valve, and habitats of flora, birds, and mammals were conducted. The EIA Report recommended that e-flow and fish passage be maintained.

WATER ENVIRONMENTAL SURVEY AND AQUATIC LIFE STATUS: DISSEMINATION OF MONITORING PROTOCOLS AND RESULTS

Subodh Sharma, KU, mentioned that about two-thirds of the total insects live in water during their larval phase. Hence, water pollution affects food availability by interfering with the life cycle of insects as well as the food chain. Presenting a good survey practice for assessment of aquatic organisms, Sharma stated that researchers should select sample sites by themselves in order to reduce bias in the sampling procedure for collecting representative samples. He further mentioned that one should always follow the sampling protocol very carefully based on the objectives of the study. Identification of taxa with its background information, typology and results, and its interpretation by exploring the links to water quality and the ecological status of the water system are a major part of freshwater assessment.

STANDARDIZED PROTOCOLS FOR FISH SAMPLING AND MONITORING DEVELOPED FOR THE TRISHULI BASIN

In his presentation, Deep Narayan Shah, TU, showed that changes in the following can be measured: community structure (biodiversity); population size and demographics; individual biometrics (e.g., growth, fecundity, etc.); barrier permeability/fish pass efficacy; and habitat availability, distribution and accessibility. He mentioned various options for monitoring these changes such as collect cast net, seine hauls, kick hauls, fyke nets, physical/remote observation, e-DNA, anglers, etc. He also briefed participants on options for monitoring migratory performance by automated fish counters and biotelemetry. He said that monitoring the early life history stages of fish gives a rapid indication of population performance, migration routes and spawning habitat, and characteristic nursery habitat requirements. Explaining the survey methods, he mentioned that the methods were typically habitat, species, or life-stage specific. However, he said that this would require multi-methods approaches with enormous resource requirements. Furthermore, he mentioned that, when it comes to conservation and mitigation strategies for large river fishes, consideration of habitat, type of hydropower, hatcheries and harvest is essential. In Nepal, legislation is needed to require ladders and hatcheries to be build. As fish ladders have not typically been monitored till now, their effectiveness is not known. He said that among different testing and monitoring methods, consideration should be given to priority fish species, species diversity, abundance and size as well as the cost, human resources needed, and pros and cons of the method used.

PAANI'S CONTRIBUTION TO CONSERVATION OF AQUATIC BIODIVERSITY IN NEPAL: LESSONS LEARNT FROM THREE RIVER BASINS OF WESTERN NEPAL

Deepak Rijal, PAANI/USAID, stated that river conservation is very important in Nepal for sustainable hydropower, irrigation, tourism, and disaster management. But, as there is a wide knowledge gap in Karnali, Rapti and Mahakali on the impact of anthropogenic activities on river system and biodiversity, PAANI aims to fill this knowledge gap by fostering upstream-downstream linkages, engaging different stakeholders, focusing on sustainability, and ensuring linkages among livelihood, GESI and biodiversity. Presenting aquatic biodiversity in western Nepal, he listed the threats to aquatic biodiversity as well. In order to overcome these threats, USAID's PAANI programme is working to enhance collaborative aquatic resource

management using a co-management approach. He said that river stretch co-management (RSC) builds on concepts taken from other conservation management practices to designate delineated stretches of the river for implementation of targeted, comprehensive, and sustainable community conservation initiatives. This management is intended to conserve aquatic animals, enable equitable access to aquatic animals and water, reduce impacts of anthropogenic activities, sensitize local stakeholders, and ensure restoration of aquatic species.

WATER QUALITY MONITORING AND ASSESSMENT

Sunil Babu Khatri, NESS, stated that before performing water quality assessment, it was necessary to understand the standard and instrument to be used for each of the parameters. He said that instrument calibration and data validation were important parts of water quality assessment before publishing of the data. Furthermore, before defining the water quality parameters to be checked, it was important to focus on objectives and have enough background information about the sampling sites. He recommended that data quality control is ensured while handling and analysing data as, otherwise, it might yield different results. He pointed out that time frame, budget, and application of different tools also determine the accuracy of water quality monitoring and assessment.

DISCUSSION

The participants had questions on the meaning of dewatering zones, provisions for the monitoring of the fish ladder after construction and the EIA approved for hydropower in the Upper Trishuli. Salil Devkota answered that the area between the tunnels to the power house where there is no water in the river system is known as the dewatering zone. He mentioned that there is continuous monitoring of the upstream and downstream sections for effectiveness of the fish ladder. In the case of the Trishuli River, the fish ladder is designed as per the characteristics of the Asla fish. The distance covered by the fish while migrating and its speed are the main components in designing the fish ladder. He stated that EIA for hydropower is project-based and that there has been no practice of cumulative impact assessment in Nepal till now. He further said that, for sustainable hydropower, assessment at basin level to know whether it meets the hydrological characteristics or not is necessary. He said that, as there were 36 hydropower projects in the Trishuli River, it was important to understand the effect of the barrier although it can be challenging.

Participants had different questions related to the case study from Norway. They wished to know about monitoring of the hydropower license, techniques to attract fish to the fish ladder or passage, fishing tourism regulation responsibilities, and investment on hydropower. They also asked about the role of NVE in EIA and the amount of e-flow to be maintained in Norway. Ingrid Haug, in response, said that one particular department under NVE is responsible for issuing and monitoring licenses. She also stated that there were no special techniques adopted till now to attract the fish though a study is ongoing in Norway and Sweden. She said that local people handled fishing tourism in the afore-mentioned river system and that both the private and government sectors were equally involved in hydropower investment. She further stated that NVE had full responsibility for EIA from the licensing process to providing expertise and recommendations to the Ministry. There was no mandatory amount of e-flow to be maintained.

The participants also raised concerns on scarcity of macro invertebrates in the downstream area of Jhimruk hydropower; habitat fragmentation due to the hydropower dam; level of water required to sustain macro invertebrates; and the change in physicochemical parameters in water upstream and downstream of the dam. Deep Narayan Shah answered that the minimal discharge of water was the main reason for the the scarcity of macro invertebrates. As the hydropower dam fragments the habitat, macro-invertebrates taxa found upstream and downstream of the dam sites were different. Flow types like rapid, riffle, and fall are the most important for species diversity. As there was a pool area immediately after the dam, human activities also increased below the dam area. Moreover, the minimum flow that had to be maintained for sustaining macro invertebrates was above 20% of the base flow in all seasons. He said that the reason that the physicochemical parameters in water was different after the dam site as compared to that of the upstream was due to the fact that there was heavier extraction of riverbed materials there. It is a fact that different species have different tolerance levels for water quality. Hence, fish should also be considered as a reference species for testing water quality.

Similarly, the participants asked about the effect of pesticides in the river system; the fecundity rate of the fish population in breeding centres; and the budget allocation for GESI by the PAANI project.

In response, Deepak Rijal stated that pesticides and fertilizers are a non-point source of pollution that cause eutrophication in water systems. In the data collected during the project in Mahakali and Karnali, he said that pesticides were found during the physico-chemical parameter test. However, he said that the use of pesticides should be minimized in commercial agriculture. He also said that it is very difficult to figure out the ratio of fecundity because it depends on habitat quality and presence of stressors. Concerning the major challenges in working on long stretch river systems, he said that this project was based on in-situ conservation and has tried to conserve biodiversity through the hatchery concept. The major gap in this research project was quantification of the fish species lost due to the barrier. He suggested that fish hotspot areas should be identified and hydropower development within such areas should be prohibited so that such areas can be utilized as eco-tourism areas. The concept of development with a multiple conservation (ex-situ and in-situ) strategy and strengthened institutional background, he said, were the challenges faced during the project. He felt that conservation and development should be balanced so that hydropower can be developed without losing important biodiversity.

Some participants asked questions regarding the water parameters that should be considered during water quality analysis, the validation of field observation with lab data, and the standard methods to be followed in hydropower project assessment. Sunil Babu Khatri, in response, said that parameters should be selected based on the purpose of the analysis. The parameter should be selected with reference to the guideline or standard, and major activities in the field that will modify the ecosystem. It is necessary to give the exact site or field description before analysing the sample in the lab. In the case of an ongoing hydropower project, the siltation and soluble and non-soluble solid tests are the most important. Similarly, for long-term hydropower projects, eutrophication, total phosphorous and dam structure (sodium, potassium) are the important parameter to be considered.

Day 3

All the participants joined the field visit that had been organized to the Panauti Hydropower on 21 November, 2019, with the objective of enabling hands-on experience in river water quality assessment and freshwater ecosystem assessment. The field visit was guided by Dr. Deep Narayan Shah and Dr. Ram Devi Tachamo Shah. Ms. Junu Maharjan and Ms. Tapasya Subedi assisted them in the field. Three groups were formed for the assessment at two sites - upstream and downstream- of the river. The highlights of the day were:

- Familiarization of participants with sampling procedures of benthic macroinvertebrates at the site;
- Learning the use of the Rapid Assessment Protocol by participants through documenting the sensory features, stressors and occurrence of benthic macroinvertebrates for the purpose of classifying the ecological river quality classes;
- Familiarisation of participants with water quality analysis including measurement of parameters like water temperature, pH, electrical conductivity, total dissolved solid, dissolved oxygen and turbidity. Similarly, hydrology parameters like river width, depth, velocity and discharge were measured. In the biological assessment, the multi-habitat sampling approach was used for the assessment of macro invertebrates.
- Documenting nine taxa of macro invertebrates in the downstream section and classifying the ecological river quality as class III (i.e., moderately polluted). In the upstream section, only seven taxa of macro invertebrates were documented and the ecological river quality was classified as class III (i.e., moderately polluted). Multiple stressors such as floodplain encroachment in the upstream and hydropower plan discharge downstream were found to be stressing the river ecosystem.

Day 4

Role play

Role play was done on the 4th day of the Training, following a case study presentation.

CASE STUDY 1

Harnessing ecosystem services for mountain development

Saldima is a beautiful country at the foot hills of the Himalayas. It has a population of about five million, with nearly 50% of the population belonging to ethnic groups (with 65 ethnic groups officially recognized by the state), and they inhabit a geographical area of nearly 38,000 km2. The country of Saldima adopted a policy to keep at least 40% of its land under forest cover. In the year 2019, 46% of the total area was under forest cover. Tourism and remittance are the major sources of income for the country.

In response to the increasing energy demand, the Government of Saldima decided to develop a new 650MW hydropower – Dotala II in one of the major rivers, Dotala. Dotala River is considered one of the key river systems in Saldima providing irrigation to millions of farmers downstream and livelihoods in fisheries for many households while remaining one of the key catchments for the drinking water supply. In Dotala River, there are already five big hydropower projects that have been planned and approved by the concerned authority. Dotala River is home to many native fish species as well as a number of herpetofauna and invertebrates. Ecologists have already warned that a big hydro dams will negatively impact aquatic biodiversity, thus impacting the livelihoods of many fishermen. The upstream of the Dotala II hydro dam is home to indigenous communities, who rely primarily on subsistence agriculture. Given its economic viability, this hydro project has already secured international investment. A preliminary environment impact assessment (EIA) has also been carried out. However, many environmental and conservation organizations as well as individuals remain opposed to the government decision to award the project. They have been lobbying at national fora against the government decision and pushing for shifting the dam. In the meantime, local communities and institutions have different opinions on the project with some supporting the idea, and the others opposing it.

The participants were divided into five groups with each group representing a different stakeholder as follows. Each group had to strongly present their position based on facts, data and evaluation.

- Secretary, Ministry of Energy and Power Development (The authority responsible for energy in Saldima);
- Head of the District where hydropower is proposed (who is elected to the post based on voting by the public);
- Head of a globally influential conservation NGO operating in Saldima since 1980;
- President, Indigenous and Tribal Communities' Association
- Business leader (representing the Power Investor Association)

The major points presented by each group leader in presenting their case were as follows:

SECRETARY, MINISTRY OF ENERGY AND POWER DEVELOPMENT

From the perspective of the Ministry, the positive aspects of hydropower development are: increase in energy generation that promotes industrial growth and the economy; employment opportunities; development of associated facilities; and promotion of tourism/recreation, the fisheries business and water transport. The mitigation measures that will be implemented during hydropower development would be: maintenance of e-flows downstream; provision of alternative livelihoods and skill development training; and constructing fish hatcheries and fish ponds; and arrangements for resettlement of displaced local communities and ensuring their livelihoods.

HEAD OF DISTRICT WHERE HYDROPOWER IS PROPOSED

In order to secure the benefits of hydropower development to the local communities, the Head of the District has proposed rural electrification at a cheap rate and provision of shares in the hydropower company at a nominal rate for residents of the district. The Head of the District would also prioritize development of infrastructure related to market linkage, skill development of the communities affected by the hydropower development and reasonable compensation to those

displaced for rehabilitation and resettlement. Based on the EIA, the Head of the District would emphasize monitoring and evaluation, including maintaining the e-flow and conservation of the river for multiple uses.

HEAD OF THE GLOBALLY INFLUENTIAL CONSERVATION NGO

From the NGO's perspective, the proposed hydropower site is rich in biodiversity; home to native fish with a number of herpetofauna and invertebrates; and home to sixty-five ethnic groups who are dependent on the site for their livelihoods through tourism, fishing and agriculture. The construction of the hydropower plant would reduce the forest cover; impact native fish species and their habitat; and affect native people (ILO-169, obligation) as well as impact millions of farmers downstream. Considering the country's international commitments to ILO, CITIES and CBD and the opposition to the hydropower plant from the indigenous population, it would be better to shift the dam location to another site.

PRESIDENT, INDIGENOUS AND TRIBAL COMMUNITIES' ASSOCIATION

From the perspective of the indigenous communities, they value their right to use natural resources as a first priority (ILO 169). They would also seek sustainable resettlement and require socio-economic research to assess the impact of the change from the hydropower plant. Incentives for ecosystem services should also be considered. They would like to review the resettlement plan and be involved in the decision-making process and demand free shares in the hydropower company for the indigenous communities.

BUSINESS LEADER (REPRESENTING POWER INVESTOR ASSOCIATION)

From the perspective of the investors in the hydropower plant, they would follow the regulations in EPA and EPR and adopt conservation and mitigation measures. They would like to highlight the benefits from the hydropower plant and provide assurances regarding implementation of alleviation programmes to counter adverse social and environmental impacts. They would construct schools, provide support for the construction of a health post in the district, and distribute electricity at low cost within the district. In addition, compensation would be provided to the residents in the affected area of the river catchment.

The investors also emphasized that there would be no compromise regarding aquatic biodiversity conservation (fish ladder development) and construction of sustainable hydropower. Funding will be provided for biodiversity assessment with a focus on ecotourism. They would provide 1.5% of the total profit for a conservation and research programme.

Mitigation measures such as providing employment opportunities and resettlement support to the people of the affected area will be prioritized. They would also build an ethnic museum and support livelihood diversification while providing shares in the hydropower company to area residents at a minimal cost.

CASE STUDY 2

Designing incentive mechanisms – the trade off

Hydropower development is a kind of trade-off between river ecosystem services. While hydropower may increase some provisioning services, it will decrease some regulating and/or supporting services. However, some ecosystem services that we lose would be difficult to recover, thus inevitably affecting the regulated river and riparian ecosystems. In this context, an ecological compensation or payment for ecosystem services scheme can be developed to make amends for the impact on the river system due to hydropower development. There is a need thus for an accounting system for affected rivers based on river ecosystem service alteration as hydropower services cannot ever replace the lost services.

Regulated river ecosystem service type		Lancang River	Yalung River	Min Chiang
The added	Hydroelectric generation	714	723	828
	Water supply	0.57	/	37.78
	Flood control	0.32	4.88	23.14
The lost	Biodiversity	13.90	2.47	36.26
	Fluvial transportation	188	7.85	49.12
	Soil conservation	3.01	12.39	61.35
	Environmental decontamination	0.67	4.50	11.34

Given below is the outcome of a scientific study in China (Bing Yu, 2017) with limited data presented for analysis.

The annual variation in river ecosystem service values caused by per unit installed capacity (RMB/Kw) (Bing Yu, 2017).

Based on the given data, field observation in Panauti and their own experience, participants are required to analyse the data presented and suggest a Payment for Ecosystem Services (PES) scheme. They are also required to suggest if PES can be embedded as part of an Environment Management Plan (EMP) or not.

All the groups agreed that the PES mechanism should be embedded as a part of EMP. They suggested the following points:

PES mechanism:

- Payment should be made to the MoFE (Central Government) and it should be invested in the watershed management programme. Alternatively, payment should be made to the local government, which should invest 75% on services in the affected area while setting aside 10% for monitoring;
- The ecosystem service provider upstream should sustainably use the land resources through plantations and changes in cropping patterns with introduction of agroforestry practices while the service buyer, i.e., the hydropower proponent, should adopt a benefit-sharing mechanism with the service provider;
- Proper monitoring and evaluation of the PES schemes should be conducted regularly.

PES investment:

- Payment should be invested in the basin and sub-basin levels of monitoring and for research on the impact of the hydropower project;
- Money generated from the PES schemes should be channelled towards offsetting the losses caused by the hydropower project;
- The service provider should focus on the species habitat management programme, bioengineering for soil conservation, waste water treatment mechanism, afforestation in the upstream site, flow monitoring and mobilization of experts.
- PES mechanism should focus on dewatering the area of hydropower to supply regular water to affected communities by constructing a reservoir so that water can be supplied throughout the year.

DATA ANALYSIS, FORMATTING, AND REPORTING (BASED ON CASE STUDY AND FIELD OBSERVATION)

Participants analysed the data collected during their field visit on Day 3. Based on the data collected from the different sites of Roshi Khola, nine taxa of benthic macro invertebrates in site I, i.e., before dam, and seven taxa in Site II, i.e., after water release by hydropower, were found. Participants also learned to calculate the Average Score per Taxon (ASPT), i.e., the biotic index for both sites. If ASPT lies near 10, it is then considered as good quality water; if it is a lower biotic score, it indicates degradation in water quality. Based on the physic-chemical and macro invertebrates' assessment, both the sites were categorized as river water quality class III, which means the river is moderately polluted.

EIA REPORT QUALITY IN NEPAL: STRENGTHS AND WEAKNESSES, CHECKLISTS/FORMS, FORMATS

Salil Devkota's presentation focused on what should be considered to maintain the quality of the EIA report. He stated that, first, it is necessary to understand the sources of the risks that could be encountered during project construction such as legal/financial risk, social/environmental risk, technical/operational risk and market/political risk. Misinterpretation of data should be avoided as, otherwise, it may create difficulties during project construction. In addition, the choice of methodology and the names of equipment used for analysis should be accurately recorded in the EIA report. Furthermore, good/solid data collection with strong data interpretation is required to maintain the quality of the EIA report. Similarly, public consultation should form an integral part of the EIA process in a way that is deemed inclusive of all stakeholders. The EIA report should also include a proper analysis of the cost-benefit scenario of the project.

Closing session

The closing session was chaired by Subodh Sharma, KU. The chief guest was Lila Mani Paudyal, former Chief Secretary and Hon'ble Ambassador of Nepal to the People's Republic of China. The Chairperson and Chief Guest distributed the certificates to the participants.

Representative from the provincial and central governments stated that this training introduced them to the importance to freshwater ecosystem assessment during the EIA process. Representative from the private sector stated that the training had enhanced their EIA report writing skills and expressed hope that such trainings would be organized in the future as well. Participants also said that a standard protocol or handbook for freshwater ecosystem would be useful. They further mentioned that this training had provided them with a valuable opportunity to pick up practical tools and techniques for freshwater ecosystem assessment.

Kanchan Shrestha, Programme Coordinator – Koshi Basin Initiative, ICIMOD, pointed out that benefits of healthy freshwater ecosystems are immense and maintaining them was important for ecosystem services such as irrigation, drinking water, and tourism. Sustainable hydropower development must therefore strive to minimize impacts on the freshwater ecosystem. She expressed hope that the freshwater ecosystem assessment tools and approaches that the participants learned during this training would be useful at field level in order to improve the implementation of the EIA process. She also urged the participants and the co-organizers to work together and to engage with each other to improve freshwater ecosystem assessment practices.

Leela Mani Paudyal, in his speech, stated that there is a need for sector-specific EIA for the sustainable use, management and conservation of resources. Capacity-strengthening training with support from the different stakeholders is important for linking theoretical knowledge with practical implementation. He expressed hope that the knowledge gained during the training will be properly utilized during the EIA report review and approval process. He concluded his speech with the closing remark that "sustainable use of resources can bring sustainable prosperity".

Subodh Sharma, Registrar, KU, brought the training to a close by stating that nature does not die but, rather, rejuvenates itself. He stated that while several issues were identified during the research, priority should be given to finding solutions. Furthermore, it is necessary to conduct a cumulative impact assessment of different sectors of the river in hydropower development. He was optimistic that the training had provided participants with a basic idea on freshwater ecosystem assessment and its importance during the EIA process. He also expressed KU's interest in contributing to this area further.

Training evaluation

Pre- and post-assessment of the training was done to find out whether expectations on development of knowledge on freshwater ecosystem assessment on the part of the participant had been met or not. An evaluation form was used to elicit participant perspectives on the usefulness of the training and technical sessions. At the onset of the training, most of the participants expressed hope that the training would provide them with advance knowledge and skills as well as the requisite technical skills on freshwater ecosystem assessment for hydropower development (Figure 1). At the end of the training, the participants evaluated the relevance of the training and rated the training quality as 'extremely high' to 'high'. They found the training very relevant to their organizations and stated that their knowledge and skill had increased from this training (Figure 2). The participants recommended the formulation of a freshwater ecosystem assessment manual as it would provide consistency in methods of assessment.

References

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Simonov, E.A., Nikitina, O., & Egidarev, E.G. (2019). Freshwater ecosystems versus hydropower development: Environmental assessments and conservation measures in the transboundary Amur river basin. *Water 11*, 1570; doi:10.3390/w11081570.

FIGURE 1 **PRE-ASSESSMENT RESULTS**

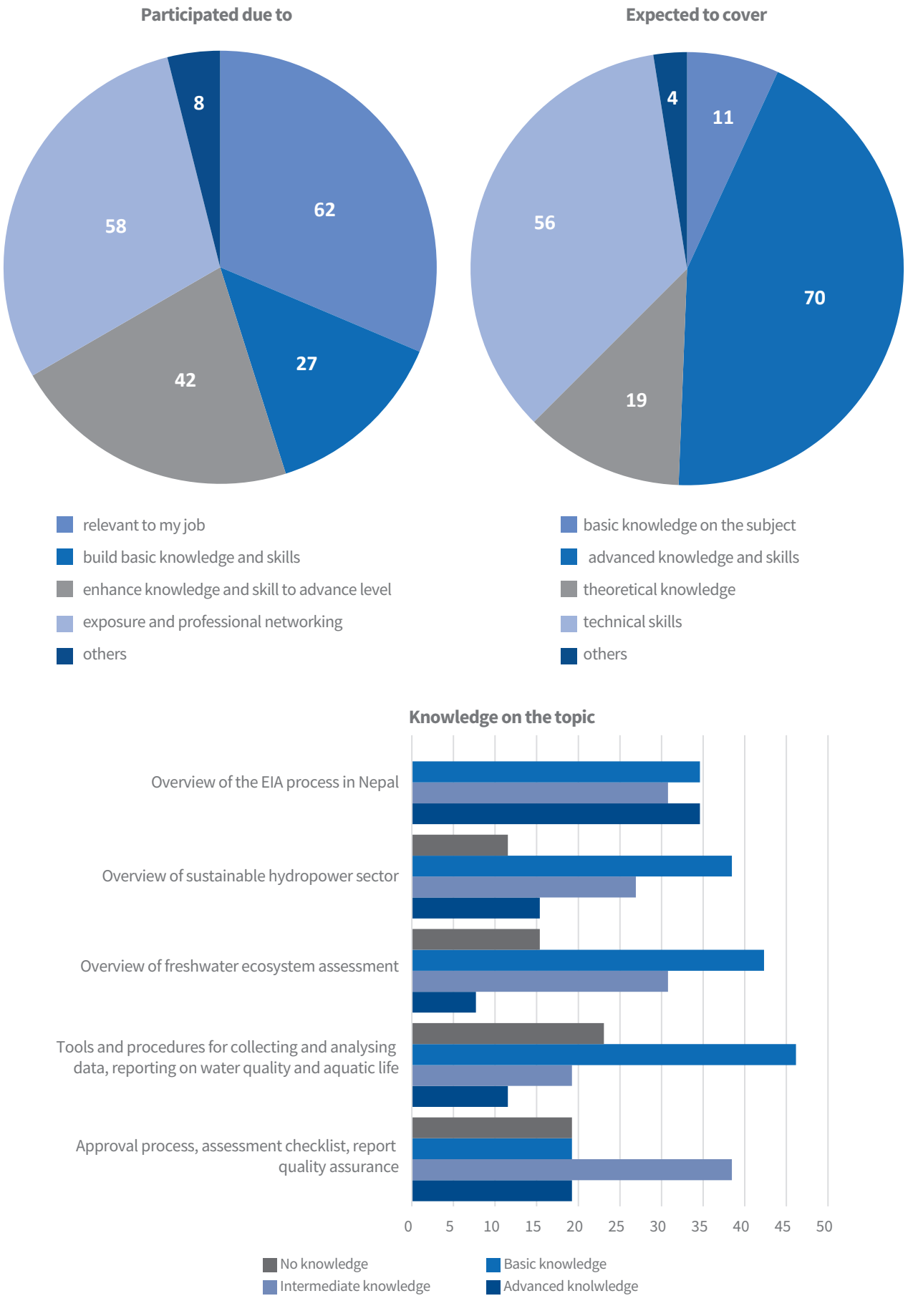
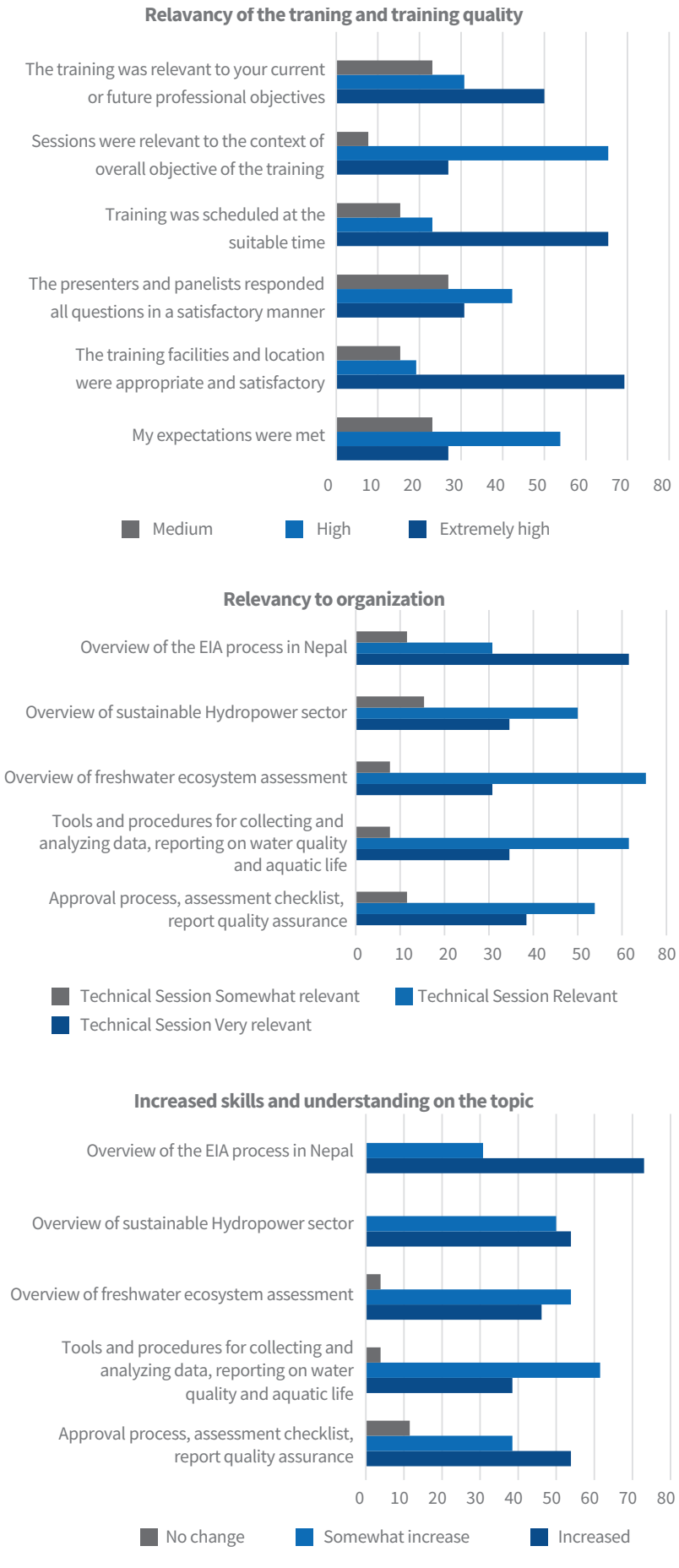


FIGURE 2 **POST-ASSESSMENT RESULTS**



Annexes

Annex I: Programme agenda

Participants will travel by bus from the FRTC in Babarmahal to Dhulikhel at 15:00 on Monday, 18 November 2019.

Day 1 (Tuesday), 19 November 2019

Time	Programme
08:00–08:30	**Registration and networking**
08:30–09:00	**Opening remarks** **Megh Nath Kafle**, Director General, FRTC, MoFE **Subodh Sharma,** Registrar, KU **NVE Representative** **Eklabya Sharma,** Deputy Director General, ICIMOD Introduction to and objectives of the technical training workshop – **Laxmi Dutt Bhatta,** ICIMOD
09:00–09:30	*Group photo and tea break*
09:30–10:45	**Overview of the EIA process in Nepal: Policies, acts, and regulations** – Jwala Shrestha, MoFE
10:45–12:15	**Creating a sustainable hydropower sector in Nepal: Social and environmental safeguards (national and international requirements)** – Salil Devkota, NESS
12:15–13:30	*Lunch break*
13:30–14:45	**Overview of the freshwater ecosystem approach in EIA for hydropower: Norwegian experiences** – **Ingrid Haug,** NVE
14:45–15:00	*Tea break*
15:00–16:30	**Environmental flows: Concepts, tools, and applications** – Vishnu Prasad Pandey, IWMI

Day 2 (Wednesday), 20 November 2019

09:00–10:15	**Case studies on aquatic biodiversity assessment/freshwater ecosystem assessment** Upper Trishuli – **Salil Devkota,** NESS Case from Norway – **Ingrid Haug,** NVE Jhimruk Hydropower Project – **Deep Narayan Shah,** TU
10:15–11:15	**Invertebrates: Assessment and protocol** – **Subodh Sharma,** KU
11:15–11:30	*Tea break*
11:30–12:45	**Standardized protocols for fish sampling and monitoring developed for the Trishuli basin: Survey for fish/fish ladder** – Deep Narayan Shah, TU

Time	Programme
12:45–13:45	*Lunch break*
13:45–15:00	**The Paani Program's contribution to conservation of aquatic biodiversity: Lessons from three river basins of western Nepal** – Deepak Rijal, PAANI
15:00–15:30	*Tea break*
15:30–17:00	**Methods**

Day 3 (Thursday), 21 November 2019

Time	Programme
08:00–17:00	**Fieldwork** Panauti Hydropower Station Rapid assessment: Upstream–downstream Biological and freshwater ecosystem assessment Water quality assessment Upstream–downstream linkages and interface

Day 4 – Friday, 22 November 2019

09:00–09:30	**Field observation – Recap and presentation**
09:30–11:15	**Case analysis and role play** (Participants will be given 1–2 cases on hydropower and freshwater assessment.) **Moderator:** Laxmi Dutt Bhatta, ICIMOD
11:15–11:30	*Tea break*
11:30–13:00	**Data analysis, formatting, and reporting (based on case study and field observation)** **Moderator:** Laxmi Dutt Bhatta, ICIMOD
13:00–14:00	*Lunch break*
14:00–15:45	**Interactive session: Approval process, assessment checklist, report quality assurance and synergy with other components** **Moderator:** Salil Devkota, NESS
15:45–16:00	*Tea break*
16:00–16:30	**Certificate distribution, closing, and feedback** – Sunita Ranabhat, ICIMOD

Annex II: Training evaluation form

Name: ……..…… Sex: Please Tick ☑, F ☐ M ☐ Country……..……

Pre Assessment Form

Expectation

Why did you choose to participate in this event?

☐ This training is relevant to my job

☐ To build basic knowledge and skills on the subject

☐ To enhance my knowledge and skills to advanced level

☐ Exposure and professional networking

☐ If others, please specify

What do you expect to cover in this training/workshop?

☐ I want to have basic knowledge on the subject

☐ I want advanced knowledge and skills on the subject

☐ I want theoretical knowledge to be covered

☐ I want more technical skills to be covered

☐ If others, please specify

Was this event properly communicated to you in time? Yes ☐ No ☐

If, No, what was your expectation? .....

.....

A. Science Knowledge

(Participants: Please Tick ☐ your response

Knowledge statements	Advanced Knowledge (1)	Intermediate Knowledge (2)	Basic Knowledge (3)	No Knowledge (4)
1. Overview of the EIA process in Nepal	☐	☐	☐	☐
2. Overview of sustainable hydropower sector	☐	☐	☐	☐
3. Overview of freshwater ecosystem assessment	☐	☐	☐	☐
4. Tools and procedures for collecting and analysing data, reporting on water quality and aquatic life	☐	☐	☐	☐
5. Approval process, assessment checklist, report quality assurance	☐	☐	☐	☐

Thank you for your participation in this training. We hope that you found it useful for you and your organization. Your participation in assessing this training would be a great contribution for effective design and management of similar events, follow ups and overall evaluation of capacity building efforts in future. Please respond as appropriate.

Post-Training Assessment Form

Name: ……..…… Sex: Please Tick ☑, F ☐ M ☐ Country ……..……

Please provide your response:

Relevancy of the training and training quality

Rating Scale: 1 – Extremely High; 2 – High; 3 – Medium; 4 – low; 5 – Not At All

	1	2	3	4	5	Please specify your response
1. The training was relevant to your current or future professional objectives	☐	☐	☐	☐	☐	
2. Sessions were relevant to the context of the overall objective of the training	☐	☐	☐	☐	☐	
3. Training was scheduled at a convenient time	☐	☐	☐	☐	☐	
5. The presenters and panelists responded to all questions in a satisfactory manner	☐	☐	☐	☐	☐	
6. The training facilities and location were appropriate and satisfactory	☐	☐	☐	☐	☐	
7. My expectations were met	☐	☐	☐	☐	☐	
8. Others (specify)	☐	☐	☐	☐	☐	

B. Technical Sessions

B.1 Science Knowledge

Participants: Please Tick ☑ your response

Sessions relevant to my organization	Very Relevant (1)	Relevant (2)	Somewhat Relevant (3)	Not relevant (4)
1. Overview of the EIA process in Nepal	☐	☐	☐	☐
2. Overview of the sustainable hydropower sector	☐	☐	☐	☐
3. Overview of freshwater ecosystem assessment	☐	☐	☐	☐
4. Tools and procedures for collecting and analysing data, reporting on water quality and aquatic life	☐	☐	☐	☐
5. Approval process, assessment checklist, report quality assurance	☐	☐	☐	☐

B.2 Self-Assessment			
Increased skills and understanding on the topics	**Increased knowledge and skills**	**Some increase in knowledge and skills**	**No change in knowledge and skills**
1. Overview of the EIA process in Nepal	☐	☐	☐
2. Overview of sustainable hydropower sector	☐	☐	☐
3. Overview of freshwater ecosystem assessment	☐	☐	☐
4. Tools and procedures for collecting and analysing data, reporting on water quality and aquatic life	☐	☐	☐
5. Approval process, assessment checklist, report quality assurance	☐	☐	☐

Additional Remarks

C. Feedback to the organizer

1. In what ways could this training have been improved to better suit your needs?

2. Would you recommend attending such trainings in the future? Yes ☐ No ☐

3. Other comments (please add an additional page(s) if necessary)

Annex III: Participants' list

SN	Name	Organization
Opening session		
1	Megh Nath Kafle	FRTC
2	Eklabya Sharma	ICIMOD
Resource persons		
1	Salil Devkota	Nepal Environmental and Scientific Services Pvt. Ltd.
2	Ingrid Haug	Norwegian Water Resources and Energy Directorate
3	Vishnu Prasad Pandey	International Water Management Institute
4	Subodh Sharma	Kathmndu University
5	Deep Narayan Shah	Tribhuvan University
6	Ram Devi Tachamo	Kathmndu University
7	Deepak Rijal	The USAID's PAANI Programme
8	Sunil Babu Khatri	Nepal Environmental and Scientific Services Pvt. Ltd.
9	Jwala Shrestha	Ministry of Forest and Environment, Kathmandu
10	Jens Aabel	Norwegian Water Resources and Energy Directorate
Participants		
1	Nirmal Chaudhary	Ministry of Industry, Tourism, Forests and Environment, Province 5
2	Sanjeev Subedi	Ministry of Industry, Tourism, Forests and Environment, Province 3
3	Debendra Bhandari	Ministry of Industry, Tourism, Forests and Environment, Province 1
4	Khagendra Raj Baral	Ministry of Industry, Tourism, Forests and Environment, Gandaki Province
5	Gagan Sharma	Ministry of Industry, Tourism, Forests and Environment, Sudur Paschim Province
6	Chandra Shekhar Badu	Ministry of Industry, Tourism, Forests and Environment, Sudur Paschim Province
7	Niraj Shrestha	Ministry of Industry, Tourism, Forests and Environment, Karnali Province
8	Reena Chaudhary	Department of Environment, Kathmandu
9	Bishnu Prasad Thapaliya	Department of National Parks and Wildlife Reserves, Kathmandu
10	Prakash Sigdel	Office of the Investment Board, Nepal
11	Jaya Ram Prajapati	Department of Electricity Development, Kathmandu
12	Raju Gyawali	Nepal Electricity Authority, Environment and Social Studies Department, Kharipati, Bhaktapur
13	Birat Kumar Lamsal	Department of Forest and Soil Conservation, Kathmandu
14	Subash Sharma	Ministry of Forest and Environment, Kathmandu
15	Manita Karki	Ministry of Forest and Environment, Kathmandu
16	Raj Bahadur Bist	Ministry of Energy, Water Resources and Irrigation
17	Prakash Lamichhane	Forest Research and Training Centre, Kathmandu

SN	Name	Organization
18	Binda Joshi	Forest Research and Training Centre, Kathmandu
19	Sagun Parajuli	Hydro Consult Pvt. Ltd
20	Arbindra Shrestha	Sanima Hydropower
21	Shankar Pyakurel	Trishuli Hydropower Company Limited
22	Chitra Singh	Institute of Forestry, Tribhuvan University
23	Tika Regmi	Central Department of Environmental Science, Tribhuvan University
24	Sachin Gurung	Kathmndu University
25	Shrija Tuladhar	Kathmndu University
26	Prakitsha Koirala	Kathmndu University
27	Sunita Shrestha	Central Department of Environmental Science, Tribhuvan University
28	Aditya Pal	Central Department of Environmental Science, Tribhuvan University
29	Laxmi Dutt Bhatta	International Centre for Integrated Mountain Development
30	Kanchan Shrestha	International Centre for Integrated Mountain Development
31	Govinda Shrestha	International Centre for Integrated Mountain Development
32	Sunita Ranabhat	International Centre for Integrated Mountain Development
33	Renuka Poudel	International Centre for Integrated Mountain Development
34	Chimi Seldon	International Centre for Integrated Mountain Development
35	Jitendra Raj Bajracharya	International Centre for Integrated Mountain Development

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