PAANI RESEARCH BRIEFER
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River Health and Biodiversity Profiling in the Karnali and West Rapti Watersheds: Implications for Basin Planning and Sustainable Water Resource Management in Western Nepal

BACKGROUND AND STUDY OBJECTIVES

Aquatic life is threatened by a wide range of human activities. Major threats include rampant changes in land use, direct discharge of sewerage, rapid urbanization, industrialization, development of hydropower and irrigation projects, and unsustainable harvest practices of aquatic life. On the one hand, these activities maximize human benefits, whereas on the other hand, they imperil aquatic habitats and biodiversity with potentially irreversible and unquantifiable costs. Thus, interventions to reverse these trends and ensure aquatic biodiversity, river health, and sustainable water supply to meet the ever-growing demand for safe drinking water, must be every nation's priority. In the Nepalese context, the lack of data on water quality and aquatic biodiversity has hindered implementation of appropriate basin plans and sustainable management of water resources. Where infrastructure is present, the impacts of these operations on aquatic ecosystems are poorly documented. Therefore, the Paani-supported Kathmandu University (KU) study aims to: 1) document aquatic biodiversity, especially benthic macroinvertebrates and fish; 2) evaluate watershed health and assess the impacts and stressors, including operation of dams in river ecosystems; and 3) generate bio-assessment champions (i.e. citizen scientists) in each prioritized watershed to implement sustainable bio-monitoring practices.

The specific objectives are:

- Develop river quality/health maps of watersheds in the Karnali River Basin (Lower Karnali-Code: 289), Churia-Siwalik (Thuligad-Code: 332), Middle Mountain (Middle Karnali-Code: 333) and High Himal (Tila watershed - Code: 30), and West Rapti River Basin (Jhimruk Khola -Code: 373).
- Prepare inventory of benthic macroinvertebrate diversity in prioritized watersheds, including pictorial keys for bio-assessment.
- Evaluate the effects of existing stressors, including hydropower and invasive species in benthic macroinvertebrate assemblages and fish diversity.
- Assess fish diversity and identify bio-indicators that proximate habitat quality and develop watershed bio-monitoring champions.
- Establish the relationship between water quality and freshwater biodiversity to identify bio-indicator species that help assess habitat quality.

The research has generated baseline data on aquatic biodiversity and stressors in each watershed that can inform policy and programs to be implemented at different scales, including local, provincial, and unions. Water managers, conservationists, government line agencies, and basin planners can use these outcomes for prioritizing development activities, conservation, and protection of biodiversity in the watersheds.

KEY FINDINGS

- Most river stretches of study watersheds fell in river quality class (RQC) 1 and 2, indicating high and good status while RQC 3 was recorded for a couple of river stretches of Thuligaad (Figure 1) and Lower Karnali Watersheds.
- Organic pollution was minimal in all the study watersheds. Hydro-morphological degradation, including riverbed excavation were found to be major stressors in most of the river stretches in Karnali Basin and Jhimruk Watershed of Rapti Basin. Tila and Middle Karnali were mostly affected by stressors related to activities and facilities.
- High seasonal variation in faunal (periphyton, benthic macroinvertebrates and fishes) diversity were documented in all study watersheds. Higher richness was recorded in the pre-monsoon season.
- A total of 79 fish species were recorded in study watersheds.
- Fish species in Tila Watershed were found to be more sensitive to river ecology while 60% of total diversity occupied in Lower Karnali and Thuligaad were more adapted to the river ecology. (Figure 2).
- Tributaries and lower stretches of Thuligaad and Middle Karnali Watersheds were identified as spawning grounds of Tor putitora (Golden Mahaseer) (Figure 3).
- The diversity of benthic macroinvertebrates and fish has remarkably declined at the immediate dam site and nearby vicinity in Jhimruk Watershed, as compared to a few kilometers upstream or downstream of the dam.
- About 50% of faunal diversity (benthic macroinvertebrates- 48% / fish -58%) were similar between rivers and wetlands (Bhagaraiya) in Lower Karnali Watershed.
- Under this grant, a pictorial field guide for rapid stream bio-assessment using macroinvertebrates as bio-indicators was developed.
- A total of 25 Citizen Scientists from 5 watersheds were capacitated in the field of bio-assessment using benthic macroinvertebrates (Figure 4). In total, 20 Citizen Scientists were selected as bio-assessment champions for the watershed.

Infrastructure may interrupt fish migration in Jhimruk Watershed

Water diversion for hydropower affected migration of keystone species (e.g. Tor spp.) especially during the dry period. Also observed that their migration was limited to monsoon season. Though diversity was indifference but a smaller fish size was observed mainly because of limited foraging ground available in upstream. That said, fish ladder works well during monsoon season but fish migration interrupted in times when water released downstream is limited.

ACTION / RECOMMENDATIONS

- Local government/ water resource planners can use the river quality maps of each watershed for water resource management and planning at watershed and basin levels. The maps propose practical mitigate measures in cases where river quality has deteriorated.
- Academic institutions should lead multi-year research activities to pick up where this study left off. While the yearlong study on biodiversity profiling has generated baseline data for the river basin, a multi- year study could provide a complete inventory of data. Similarly, one-time data availability on the impacts of human actions on river ecosystems and biodiversity merely hints at the potential consequences, whereas multi-year biodiversity data across space and time can offer a complete faunal list, detailing comprehensive consequences on aquatic biodiversity.
- Further validation and refinement is needed for the newly developed field guide on bio-assessment developed under this grant. Academic institutions should implement additional biodiversity studies in other watersheds, to enhance and upgrade the knowledge available in Nepal.

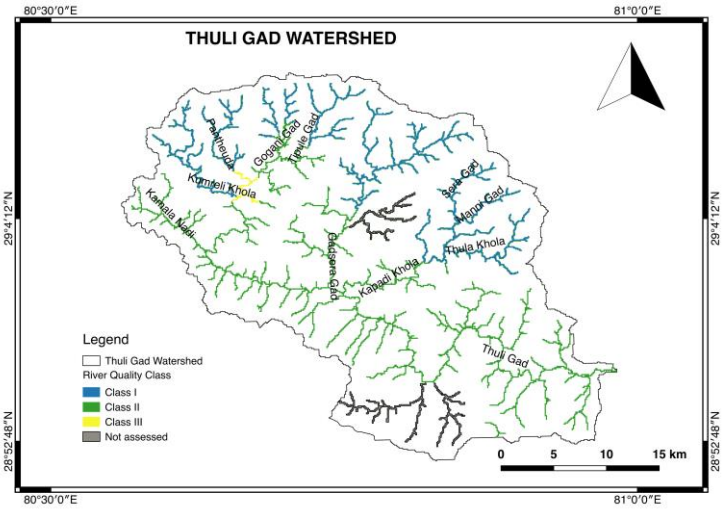

Figure 1: River quality map of Thuligaad Watershed

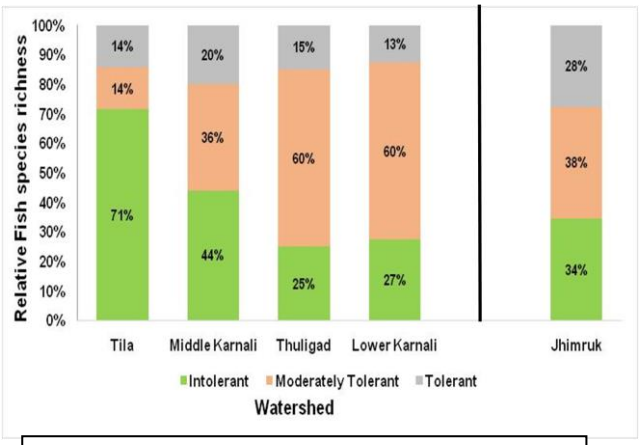

Figure 2: Composition of fish species' tolerance levels across watersheds

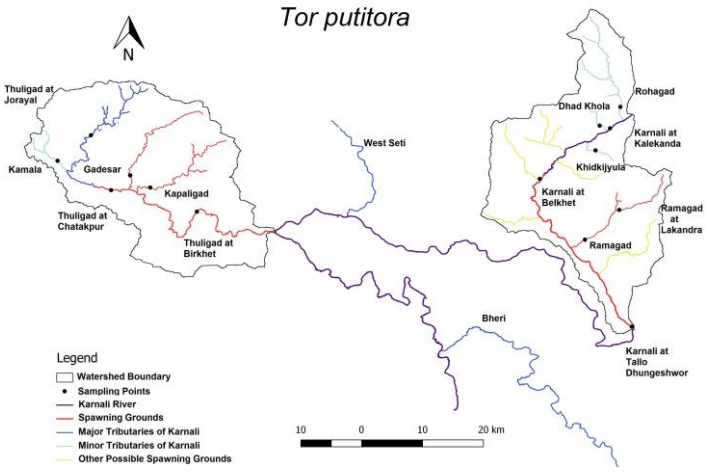

Figure 3: Mapping of spawning grounds of Golden Mahasheer in the Karnali River

Figure 4: Bio-assessment training given to Citizen Scientists in Jhimruk Watershed *(Photo credit: USAID Paani Program/Ram Devi Tachamo, Kathmandu University)*