



CHAPTER 7:

VALUED ENVIRONMENTAL COMPONENT: SOCIAL

Socioeconomic Baseline of the Trishuli River Basin

The study area of the Trishuli River Basin (TRB) provides ecosystem services that sustain the livelihoods of more than 313,862 people (CBS 2014) across 14 municipalities in the upstream, midstream and downstream sections. The study area is located within Province 3 (Central Development Region). In addition to climate change factors, changes from increasing in-migration, urbanization, induced vulnerabilities from natural hazards, and other anthropogenic factors are contributing to stress on the TRB.

Table 7.1 profiles demographic indicators of the 14

municipalities considered as a part of the study area.

There are certain common economic, social, and cultural features that link upstream, midstream, and downstream river reaches in the TRB. Likewise, there exist certain differences in resource utilization patterns (for example in agriculture, fishing, and other riverine-based livelihoods) and economic conditions (linked to market access, gender, inequality, and other income-related issues).

To illuminate these similarities and differences at a basin-wide level, the following sections illustrate the socioeconomic profile for the upstream, midstream, and downstream sections. Figures 7.1– 7.3 provide an overview.

Table 7.1 Demographic Indicators

Municipality	District	Total population	Population density per square kilometer	Sex ratio	Percent of Adibasi Janjati
Upstream					
Gosaikunda	Rasuwa	7,143	7	1,073	90.1
Kalika	Rasuwa	9,421	49	909	56.5
Uttargaya	Rasuwa	5,490	8	966	62.9
Aamachhodingmo	Rasuwa	8,255	79	872	97.1
Midstream					
Belkotgadhi	Nuwakot	36,982	238	961	42.8
Bidur	Nuwakot	55,725	539	864	45.9
Kispang	Nuwakot	17,979	218	855	77.4
Tarkeshwar	Nuwakot	14,345	198	814	54.2
Downstream					
Benighat Rorang	Dhading	31,475	152	990	63.9
Gajuri	Dhading	27,084	195	966	56.2
Galchi	Dhading	27,784	214	930	47.4
Siddhalek	Dhading	23,729	198	859	50.7
Gandaki	Gorkha	23,268	188	832	61.6
Ichchhyakamana	Chitwan	25,002	150	993	81.9

Source: Central Bureau of Statistics (CBS 2014). The data do not include the changed administrative structure in Nepal in effect since 2017.

Note: Sex ratio is the number of males per 100 females in a population.

Figure 7.1 Socioeconomic Profile: Upstream

The upstream study area of the TRB falls in Rasuwa District of central Nepal. Its altitude ranges from 1,000 to 7,250 meters, with some of the highest alpine mountain ranges in the country (Humagain and Shrestha 2009). This upper catchment area of the TRB is not used for irrigation or water supply. Almost 56 percent of the total area of Rasuwa belongs to Langtang National Park (LNP), an important biodiversity location in Nepal. The area under cultivation is low because of the steep hills and mountains. The Tamang people, an ancient indigenous group of Nepal, with their own richly developed traditions, local customs, rituals, and cultural practices, inhabit more than 65 percent of this area. They derive significant ecological and livelihood values from forests.

- The climate is temperate or subalpine.
- Changes in snowfall and rainfall patterns is a major water-related concern.
- Tibeto Burman communities such as the Tamang, Gurung, and Rai.
- Agriculture mostly relies on rainfed farming, thus making it vulnerable to water stress and extreme events.
- While maize remains an important crop, there is a gradual shift away from the traditional cereal-based cropping to cash-generating vegetables and organic farming.

- A majority of local communities use fuelwood for cooking, whereas electricity is mainly used for lighting.
- The government of Nepal declared Rasuwa District as an area for raising trout. However, a gradual increase in temperatures has affected cold water fish, with more intense activities in tributaries and supported by the research station in Dhunche.
- Majority of the households depend on agriculture and animal husbandry as their main source of income. Decline in crop yields is influencing adaptation strategies such as commercial herb farming and tourism as alternate sources of income, resulting in the development of tourism villages such as Syaphrubesi. Medicinal plant collection, forest and nontimber forest products, wage labor and ecotourism are some of the supplementary income sources for the residents of Rasuwa.
- The earthquake of 2015 flattened entire villages and displaced complete village populations in Rasuwa, making it one of the worst affected districts in all of Nepal. Several erstwhile VDCs reported local communities having out-migrated further downstream of the basin to settle into Internally Displaced People Camps, such as Nuwakot.
- The focus of government interventions (in addition to rehabilitation of earthquake victims) is to encourage farmers to move toward commercial livestock rearing, implement afforestation programs, and support governance, biodiversity conservation, and livelihood enhancement of communities.

Photo F7.1.1 Upstream Geography



Photo F7.1.2



Photo F7.1.3



Map F7.1.1 Upstream Study Region

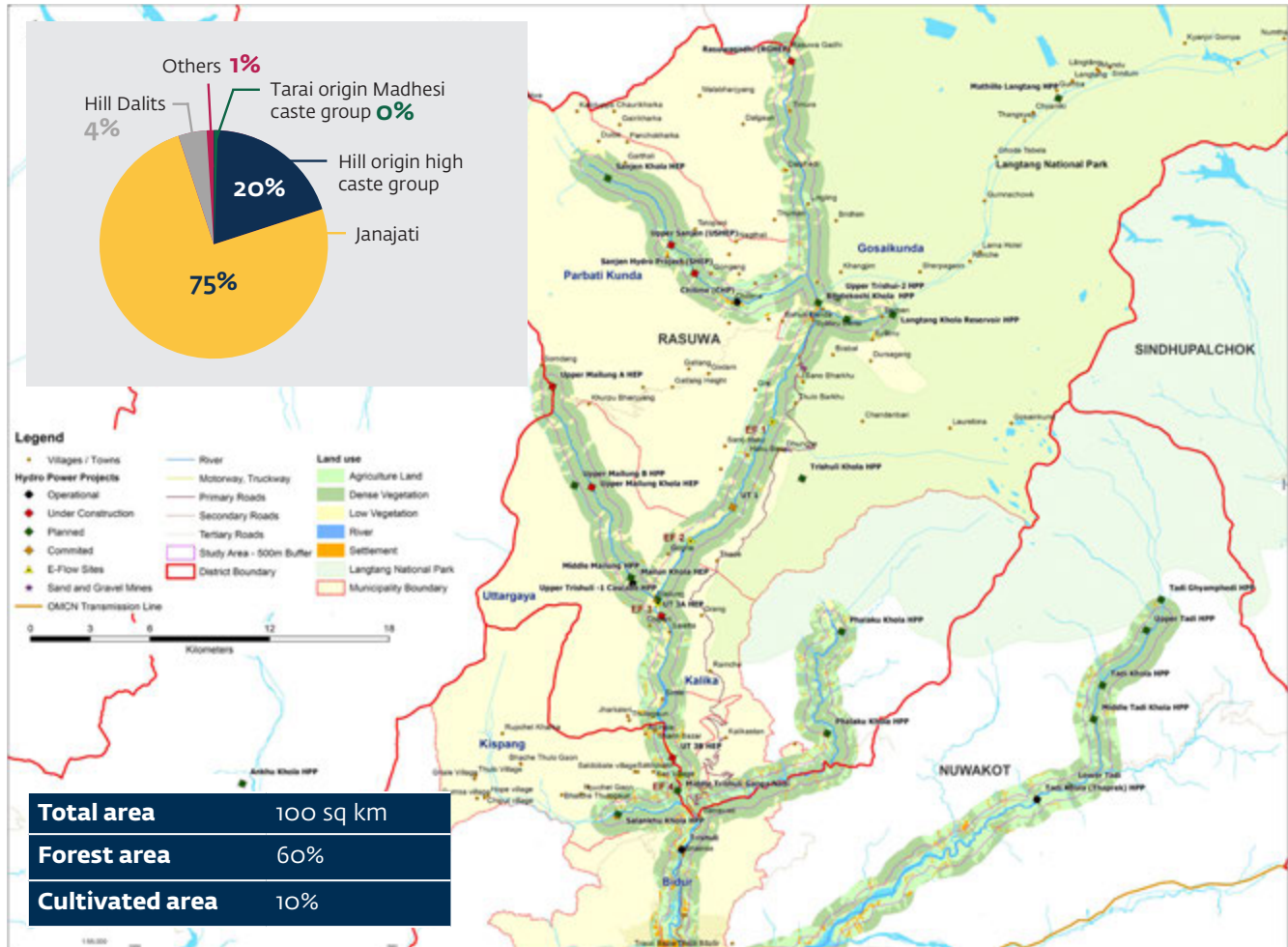


Figure 7.2 Socioeconomic Profile: Midstream

The middle part of the TRB falls in Nuwakot District of central Nepal, about 75 kilometers north of Kathmandu. Nuwakot is predominantly covered in hills and highlands with an elevation range from 457 to 5,144 meters above sea level (Gurung, Basnet, and Lamsal 2006). Fishing, agriculture, and ecotourism are some of the main occupations. Rainbow Trout farming in the hilly terraces of Nuwakot is supported by the presence of suitable land and cold-water streams, along with ready market access. The local people of Nuwakot perceive an increase in the frequency of floods and landslides in the area, caused by a combination of factors like road construction, increase in rainfall, and possibly, hydropower development along the river basin.

- The climate is subtropical to temperate.
- Water-induced landslides, drying up of springs, and droughts are major water-related concerns.
- Hill origin high caste groups dominate along with Adivasi Janjati.
- Water for irrigation is a concern among the farming community because of the variability of rainfall. The previous cropping pattern of paddy in the monsoon season and wheat in the winter season remains. However, there is a decline in productivity for the wheat crop.
- Drought-resistant crops such as drought-resistant rice are cultivated in rainfed areas and staple crops and a variety of vegetables in irrigated areas.

Photo F7.2.1 Midstream Geography



Photo F7.2.2



Photo F7.2.3



- An estimated 83 percent of households in Nuwakot (CBS 2012) have access to electricity. However, fuelwood remains a major fuel source for cooking (with increasing use of liquefied petroleum gas (LPG) in urban areas) along with lighting.
- Increased urbanization in towns such as Ratmate, Bidur, and Belkotgadhi has emerged as a key regional influence for local economic and demographic trends.
- In recent years, unreliable rainfall patterns are affecting crop yields. Nuwakot has seen migration due to increased problems in agriculture resulting from the decline in water availability and insufficient production. However, specific areas such as Battar Bazar and Bidur have seen an increase in in-migration of subsistence farmers and increase in less water-intensive crops. Farmers are negotiating with upstream users to increase their allocation of water within their water user associations (if present) and reducing canal leakages and plot drainage.
- Scarcity of drinking water is a major problem faced by these communities, with most people susceptible to low-quality water and waterborne diseases. Water problems are exacerbated by the incidence of extreme natural events like landslides as they sweep away existing drinking water pipelines.
- After the earthquake of 2015, there was an influx of people from their original villages in Nuwakot and there is social impoverishment associated with displaced populations. District Development Councils are allocating funds for disaster risk reduction and undertaking programs of protection of slopes to reduce landslides.

Source: Source: Dandekoya et al. 2017; Ministry of Forests and Soil Conservation 2015; CBS 2014; Basin-level consultations.

Map 7.2.1 Midstream Study Region

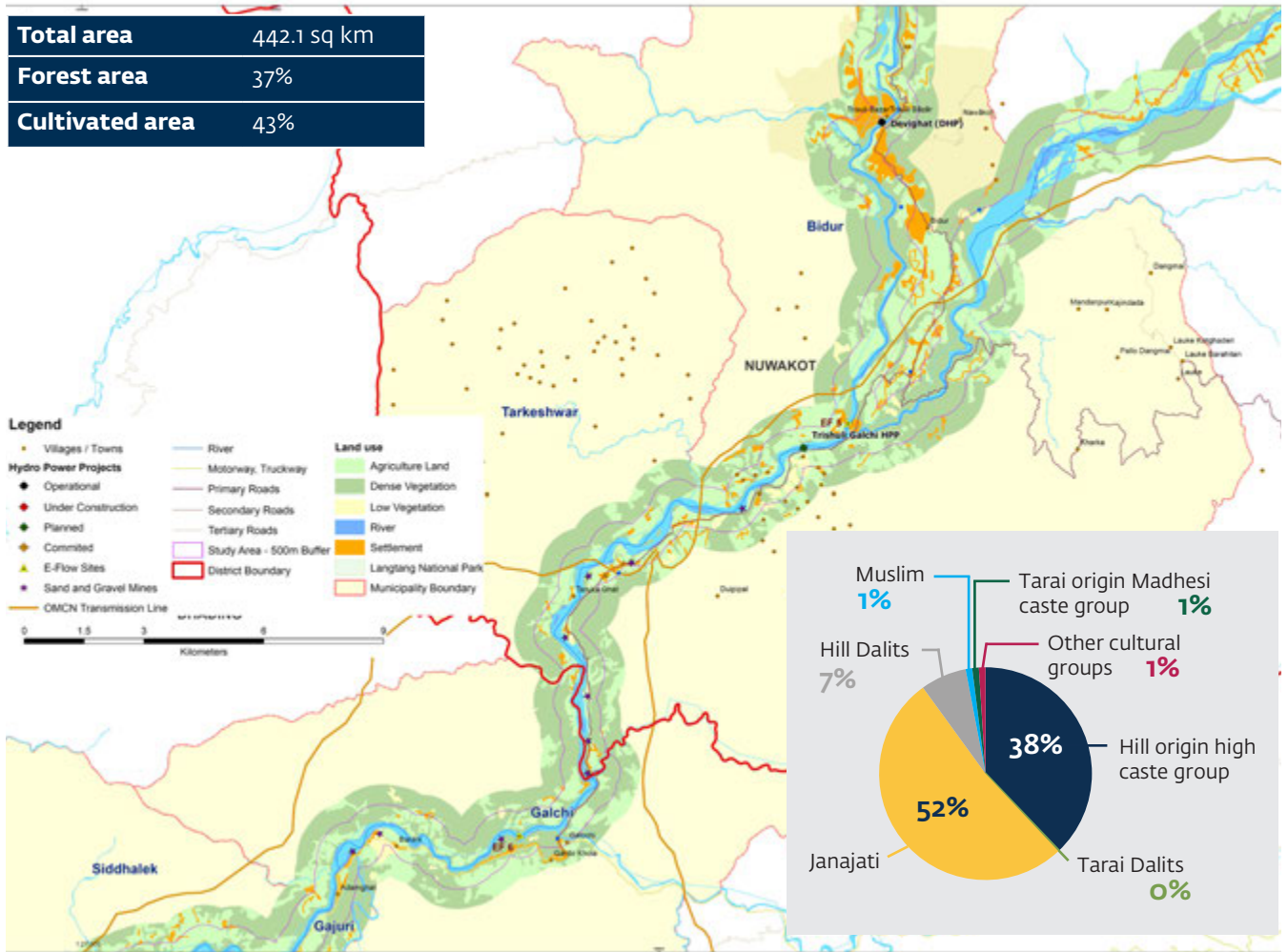


Figure 7.3 Socioeconomic Profile: Downstream

The lower part of the TRB falls in Dhading, Gorkha, and Chitwan Districts with a mild river gradient, a subtropical to temperate climatic regime, and an extreme range of elevation from 430 to 7,409 meters (Regmi 2003). The area is accessible from Kathmandu via the Prithvi Highway, which connects Pokhara and Narayangarh. Sand and gravel mining, rafting and adventure sports, and agroforestry have helped to enhance the economic conditions of poor and marginalized areas where crop farming is not a sustainable livelihood option. Fishing, mining, agriculture, sale of agro-products, and ecotourism are the prominent occupations here.

- The climate is mostly tropical.
- Hill origin high caste groups dominate along with Adivasi Janjati.
- Water for irrigation, floods, and droughts are major water-related concern.
- The areas close to the river are affected by inundation of fields and massive silt deposition during floods, which reduce the productivity of the land. Farmers are moving away from paddy cultivation.
- Drought-resistant crops such as lentils, sesame, maize, potatoes, peanut, and mustard, and drought-resistant rice are cultivated in rainfed areas.
- Decreased agricultural productivity and shifts in farming season have led to economic vulnerability and shift toward labor.

- Access to electricity and use of solar power, kerosene, or biogas for lighting is predominant along with fuelwood for cooking.
- Sand mining continues unabated along the river leading to decline in water quality, increase in floods, and riverbed subsidence as reported.
- Adaption techniques include use of pumps, small-scale water storage ponds to irrigate fields such as potatoes, and raising the height of tube wells.
- The area suffers from undeveloped infrastructure like roads and electricity, and poor-quality sewage and sanitation facilities. District statistics reveal that less than 40 percent of the population has access to clean drinking water.
- Loss of biodiversity (compounded by deforestation upstream), escalating illegal wildlife trading activities, hill slope disturbances triggering landslides, and early runoff causing flash floods are some of the environmental issues in this district.
- Government initiatives: The district government has been working on issues linked to the provision of irrigation and drinking water, flood control and erosion, construction of river bank protection structures, and water-induced disaster mitigation, and has allocated resources and implemented development plans focused on these areas.

Photo F7.3.1 Downstream Geography



Photo F7.3.2

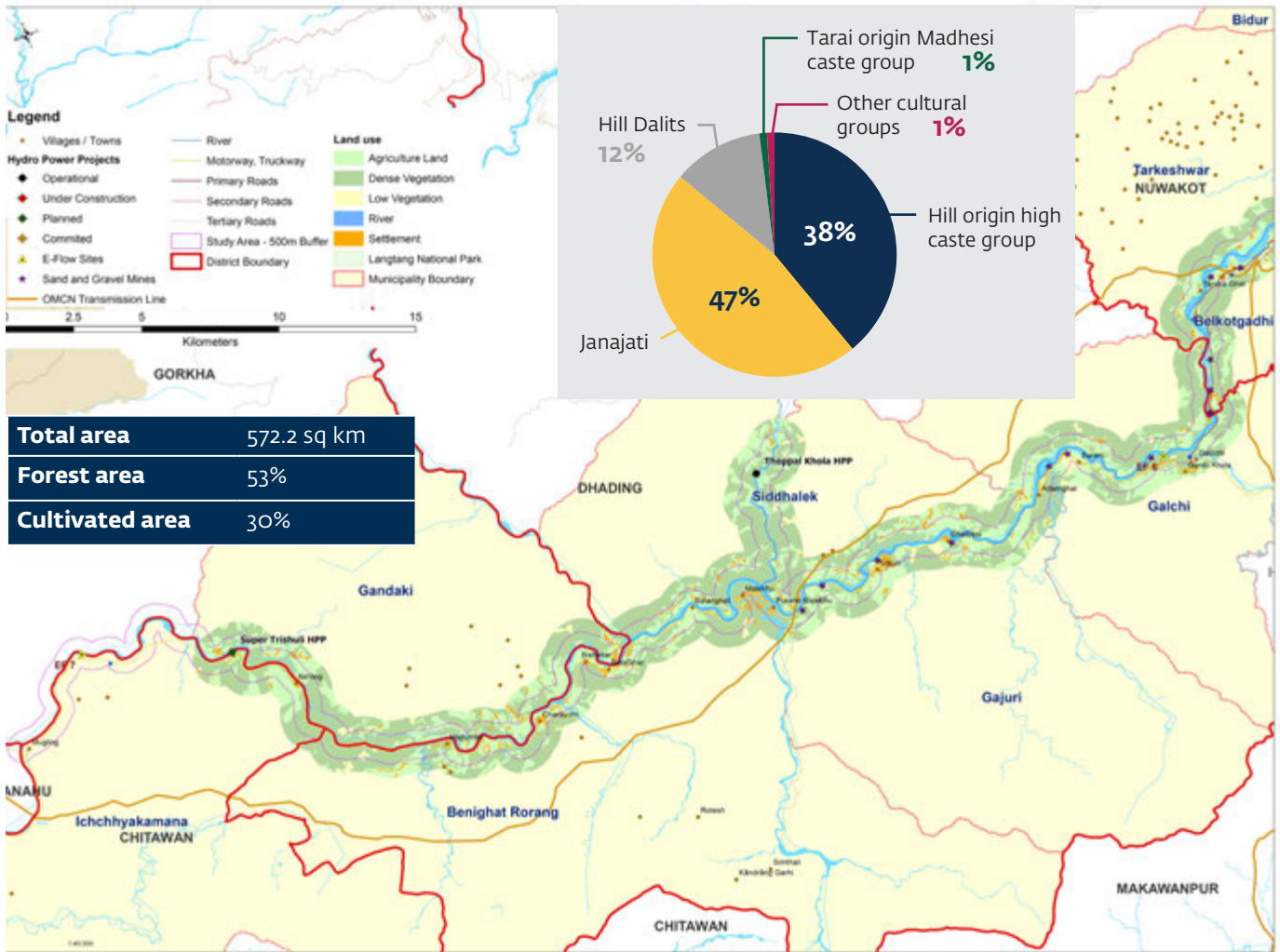


Photo F7.3.3



Source: CBS 2014; Dandekeya et al. 2017; Ministry of Forests and Soil Conservation 2015; and basin-level consultations.

Map 7.3.1 Downstream Study Region



Water Availability

Chapter 8 of this report provides an overview of water resources as a VEC and summarizes the baseline conditions on water availability and concerns across upstream, midstream, and downstream of the basin. Overall, communities indicate that the aftermath of the 2015 earthquake has seen an intensification of water shortages, which is further attenuated by the drying up of springs, damages to spring conveyance systems due to landslides, and general decline in surface water quality in the midstream and downstream sections.

Indigenous Communities

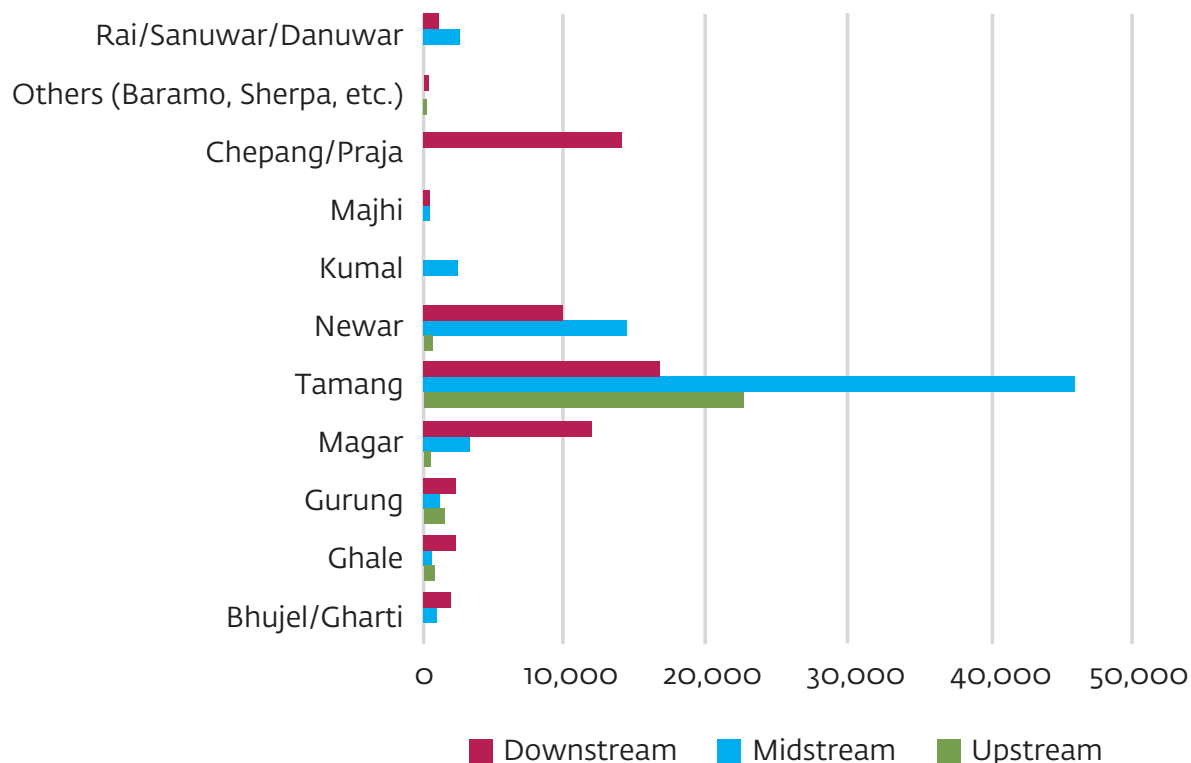
There are approximately 19 indigenous community groups (*Adivasi janjati*) across the basin. Figure 7.4 presents the comparative populations. While the absolute numbers of these communities are high in the midstream and downstream reaches, the proportion of the population gradually declines from 75.9 percent in the upstream area, 57.2 percent in the midstream area, and 55 percent in the downstream area.

Community Forests

Forests in the watershed are managed either by the government or by Community Forest User Groups (CFUGs). Local CFUGs include groups that manage religious forests (predominant in the midstream), buffer zone management committees (such as around Langtang National Park), and general Community Forests. CFUGs protect and manage these forests and also conduct development activities, in accordance with an operational management plan approved by the District Forest Office (DFO) as per the Operational Guidelines for Community Forestry Development Program, 2002. Table 7.2 summarizes the number of CFUG groups in each of the municipalities within the study area based on information provided by the Federation of Community Forestry Users Nepal.

Consultations with municipalities in the vicinity of operational and under-construction hydropower projects (HPPs) indicated that, in general, there is no major large-scale loss of land under CFUGs. Specific CFUGs that are under submergence areas may be

Figure 7.4 Comparative Population Numbers of Indigenous Communities



Source: CBS 2014.

Box 7.1 Profile of Key Indigenous Communities

Tamang community



- The Tamang are Buddhist by religion. Ghyangs (Buddhist Monasteries) are the main religious centers.
- Lakes and mountains located upstream of TRB, such as Ammachhodingmo, Gosaikunda, Bhairabkunda, Suryakunda, Saraswati kunda etc. are the major cultural sites of local communities.
- The economic life of the Tamang is mainly dependent upon agriculture and wage labor. They also keep livestock.
- Tamangs in Rasuwa have a distinct language and dialect. However, those settled in Nuwakot and Dhading are better integrated with the hill caste, hill origin communities.

Chepong community



- Chepong community is found in the midstream and downstream region of TRB.
- Similar to other Tibeto-Burman groups like Tamangs and Gurungs, their cremation practices are carried out upland.
- Chepong community used to practice shifting cultivation, and they have traditionally not owned any land in the TRB. Presently, their main livelihood is wage labor and agricultural labor.
- In the TRB, Nepali language has reportedly become more prevalent among the Chepong community instead of their own distinct dialect.

Rai community



- This community associates itself as Danuwar and Sanuwar Rai and are different from the ethnic origins of Rai found in eastern Nepal.
- No specific sacred area is in the project area. Cremation practices are linked to the river.
- As reported, the community does not have a distinct worship, cultural practice pattern and/or distinct aspects of cultural heritage.
- The livelihood activities are agriculture, labor, and livestock rearing.
- They are integrated with the mainstream community and speak Nepali.

Newar community



- Guthi is the main sociocultural as well as political organization of the Newar people in the project area with specific Guthi land in Rasuwa and in Dhading.
- The Newar people of the project area cremate the dead on the river bank, especially on the confluence of Budhi-Gandaki and its tributaries. Hindu Newar and Buddhist Newar have their own priests. Unlike other caste and ethnic groups, Guthi members are essential for funeral rites.
- Their sacred site is known as the Subrana Buddha Bihar and is not located near the Trishuli River.

Magar community



- Magar are mainly divided into three clans; Rana, Thapa, and Ale. These three clans are also sub-divided into 20 sub-clans.
- No specific sacred sites in the TRB.
- Majority of the Magar in the project area undertake cremation activities along the confluence of Budhi-Gandaki.
- Agriculture and service in the armed forces are the main livelihoods. Out-migration to Persian Gulf countries is also prevalent. Some of the Magar are involved in labor, craft, and masonry works.
- They have a distinct language that includes dialects such as Kham Magar and Kaike Magar. This community is not found upstream of the basin.

Table 7.2 Overview of Community Forest User Groups

Municipality	District	Number of CFUGs	Number of CFUG households	Area under CFUG (ha)	Proportion of the total municipality area
Upstream					
Gosaikunda	Rasuwa	8	479	243	1%
Kalika	Rasuwa	40	2,878	1,921	10%
Uttargaya	Rasuwa	32	2,434	1,370	2%
Aamachhodingmo	Rasuwa	36	2,568	1,607	15%
Midstream					
Belkotgadhi	Nuwakot	23	5,449	3,265	21%
Bidur	Nuwakot	66	8,028	4,175	40%
Kispang	Nuwakot	28	2,487	1,873	23%
Tarkeshwar	Nuwakot	45	2,385	3,184	43%
Downstream					
Benighat Rorang	Dhading	51	5,752	3,571	17%
Gajuri	Dhading	63	5,548	3,448	25%
Galchi	Dhading	69	5,577	3,959	31%
Siddhalek	Dhading	58	6,569	2,632	22%
Gandaki	Gorkha	53	5,261	1,840	15%
Ichchhyakamana	Chitwan	9	1,085	1,581	9%

Source: FECOFUN 2018.

Note: ha = hectare.

impacted by certain projects. However, these are localized impacts that need mitigation in accordance to the provisions of the Forest Act (1993). In general, access road development associated with HPPs in the upstream have enabled communities to improve their accessibility to CFUGs.

Migration Trends

The TRB has been characterized by the gradual urbanization along urban local bodies and tourist towns along the mainstem. The gradual demographic change is likely to be further enhanced due to regional infrastructure development projects such as upgrading and improving activities of the Trishuli Highway and railway corridor development within the basin as a part of the One Belt One Road project.

Table 7.3 provides in-migration data for key districts as well as the current population, indicating that out-migration has also occurred to bring about an overall decline in population growth.

Nuwakot has seen a trend of out-migration linked to a decline in crop yields and agricultural incomes as well as a decline in water availability. Communities have preferred settling in the Kathmandu Valley, specifically areas such as Shivpuri and Shankarapur. However, Nuwakot, towns such as Bidur have reported in-migration due to construction of internally displaced people camps and an increase in subsistence farmers seeking economic opportunities. Studies on the Gandaki Basin in general note that migration has enabled families to adapt, with many able to move to safer locations away from landslide- and flood-prone zones (Dandekheya et al. 2017).

Table 7.3 Demography and Migration

District	Total population in 2001	In-migration as share of district population in 2001	Total population in 2011	Growth rate
Rasuwa	44,731	6.3%	43,300	Decline by 3.1%
Nuwakot	288,478	4.29%	277,471	Decline by 3.8%
Dhading	338,658	4.12%	336,067	Decline by 0.76%
Aamachhodingmo	Rasuwa	36	2,568	1.607

Community Health

The study area of the TRB has only 2 major district hospitals, in Gosaikunda (Rasuwa) and Bidur (Nuwakot). Other health care facilities include health posts, primary and community health centers, and health assistants. The Gosaikunda District Hospital is noted to be well equipped in terms of infrastructure, resources, and technical staff. This is attributed to the general importance of the tourism industry in Rasuwa, which attracts domestic tourists and trekkers linked to religious sites, lakes, and the Langtang National Park.

Health infrastructure in downstream municipalities, such as Icchhakamana, Galchi, and Gajuri, is noted to be a major challenge, mostly due to accessibility. Table 7.4 presents available information on health care infrastructure and typical health concerns of local communities across the basin.

In general, access to health care in the basin for local communities depends upon their geographic location, available transportation facilities, and condition of roads (District Health Reports and Consultation at District Hospitals (Gosaikunda and Bidur) with health professionals and local communities, 2018). The role of traditional healers and use of CFUG areas for medicinal plants and herbs remains significant, especially in Rasuwa District (Box 7.2).

Discussions with health-care professionals in Gosaikunda and Bidur and a review of available basin-level studies indicated the following general trends in community health:

- An increase in upper respiratory tract infections

due to general exposure to dust and air emissions, mostly along the Prithvi Highway

- An improvement in the status of women and child health due to targeted interventions of sanitation initiatives by the Department of Health, an increase in the use of toilets, and presence of programs by USAID and Parivartan Nepal on water, sanitation, and health
- A general nutritional deficiency in view of the decline in productivity of staple crops, changes in cropping patterns and yields, and the consumption of packaged foods
- An increased incidence of water-borne and vector-borne diseases such as malaria, Japanese encephalitis, and kalazar linked to contamination of fresh water sources and scarcity of water during the dry season
- High blood pressure and diabetes linked to changes in consumption patterns and reportedly due to increased use of pesticides in food

There is no specific basin-level assessment of health impacts and/or implications of hydropower development, road construction, industrialization, and urbanization on the prevailing health profile of local communities within the TRB.

Religious and Cultural Sites

Rationale for Screening

The TRB has religious and mythological value to local communities, with the myths concerning the

Table 7.4 Overview of Health Infrastructure

Spatial extent	Municipality	Health care infrastructure				Health care resource: Technical staff				
		Health post	Primary health care center	District hospital	Community health care center-supported hospital	Doctor (MBBS/MD)	Nurse staff	Health assistant	ANM	Lab assistant
Upstream	Gosaikunda	6	-	1	2	6	3	17	13	3
	Parbati Kunda	4	-	-	-	-	-	6	8	-
	Kalika	2	1	-	1	3	2	6	6	1
	Uttargaya	3	-	-	-	-	-	5	6	-
	Key Concerns	The most predominant health-care risks spread across these gaunpalikas (administrative divisions) are typhoid, tuberculosis, gynaecomastia, diarrhea, orthopaedic disorders, and ovarian-related problems in females. Water-borne diseases like dysentery, cholera, and gastroenteritis, along with the typhoid and diarrhea, are extremely common in all of Rasuwa District. Communicable disease incidence has also risen, but there are limited data on attributing the same to specific aspects linked to the influx of workers or proximity to the border.								
Midstream	Kispang	5	-	-	-	-	-	6	7	-
	Bidur	6	-	1	-	8	24	4	6	3
	Belkotgadhi	6	-	-	-	-	-	6	6	-
	Tarkeshwar	5	-	-	-	-	-	5	7	-
	Key Concerns	The most prevalent health conditions across the four gaunpalikas are skin disease, typhoid, tuberculosis, gynaecomastia, and diarrhea. As in the case of upstream communities, water-borne diseases are rampant in the midstream municipalities.								
Downstream	Siddhalek	3	-	-	-	-	-	5	5	-
	Gajuri	2	1	-	-	3	2	5	6	1
	Benighat Rorang	4	-	-	-	-	-	6	7	-
	Galchi	3	-	-	-	-	-	4	7	-
	Key Concerns	Acute respiratory infection typhoid, tuberculosis, kidney stones, gynaecomastia, diarrhea, and hypertension are key concerns. Bone fracture seems to be a common problem, while the incidence of STDs, HIV, and AIDS is very low. Compared to upstream and midstream areas, there are fewer reported water-borne disease occurrences in this area, despite its being prone to floods.								

Source: District health reports and consultation at district hospitals (Gosaikunda and Bidur) with health professionals in local communities 2018.

Note: MBBS = Bachelor of Medicine, Bachelor of Surgery; MD = Doctor of Medicine. STD = sexually transmitted disease; HIV = Human Immunodeficiency Virus; AIDS = Acquired Immunodeficiency Syndrome.

Box 7.2 Role of Traditional Healers

Tibetan medicine (*Sowa Rigpa*, or “knowledge of healing”) prescribes herbal medicines, butter and oil mixtures, and needle therapy to cure diseases and ailments. The Tamang people, originally from the Tibet Autonomous Region, practice Tibetan forms of healing and medicine in districts of Rasuwa, Nuwakot, and Dhading (Gewali 2008). Folk medicine developed in Nepal from ethnic and indigenous groups’ treatment and healing processes. Several studies can be found that document ethnobotany and medicinal plants of Rasuwa and Dhading District. There is a huge diversity and number of medicinal plants in Rasuwa District, especially in the LNP area. Out of the 25–95 species of medicinal plants, several are found to be threatened by illegal trading. The hotspots for these vulnerable medicinal plants in the national park area are Cholangpati-Gosaikunda and Langtang-Kyanjin (Humagain and Shrestha 2009).

origins of the river.¹ The river flow supports cultural practices and rituals linked to religious ceremonies and cremation rites of Hindus (including certain indigenous communities). Over 66 percent of stakeholder groups consulted perceived hydropower development to affect the natural flow of water at specific religious and cultural sites that have regional significance. These sites also support livelihoods linked to ancillary activities to provide goods and services to pilgrims and tourists that visit the basin.

Baseline Conditions

The population upstream of the TRB is predominantly Buddhist and does not practice cremation rites along the banks of the river. Cremation and burial practices of communities such as the Tamang, Gurung, and Chepang across the basin are linked to groves and forest areas in the uplands and not to the river. However, most other communities undertake cremation rites along the mainstem of the river basin. Three locations—Uttargaya and Devghat (midstream) and Devghat (downstream of the study area)—have emerged as regionally significant for pilgrims and national tourists due to the inflow of multiple tributaries that support cremation-related rites and temples of local significance. (See Photo 7.1 and Figure 7.5.)

Table 7.5 provides available baseline information on these sites.

Photo F7.1 Temple at Uttargaya



Source: ERM Photographs (February 2018)

¹ A review of tourism brochures on rafting and recreation activities in the TRB suggests that the river is named after the trident wielded by Lord Shiva of the Hindu Pantheon. Legend proclaims that Lord Shiva drove his trident into the ground at Gosaikunda to create three springs, the source of the river.

Figure 7.5 Confluence of the Trishuli River with its Tributaries Phalankhu and Salankhu Khola, which Provide Adequate Flows for Religious Ceremonies at the Designated Cremation Sites or Ghats

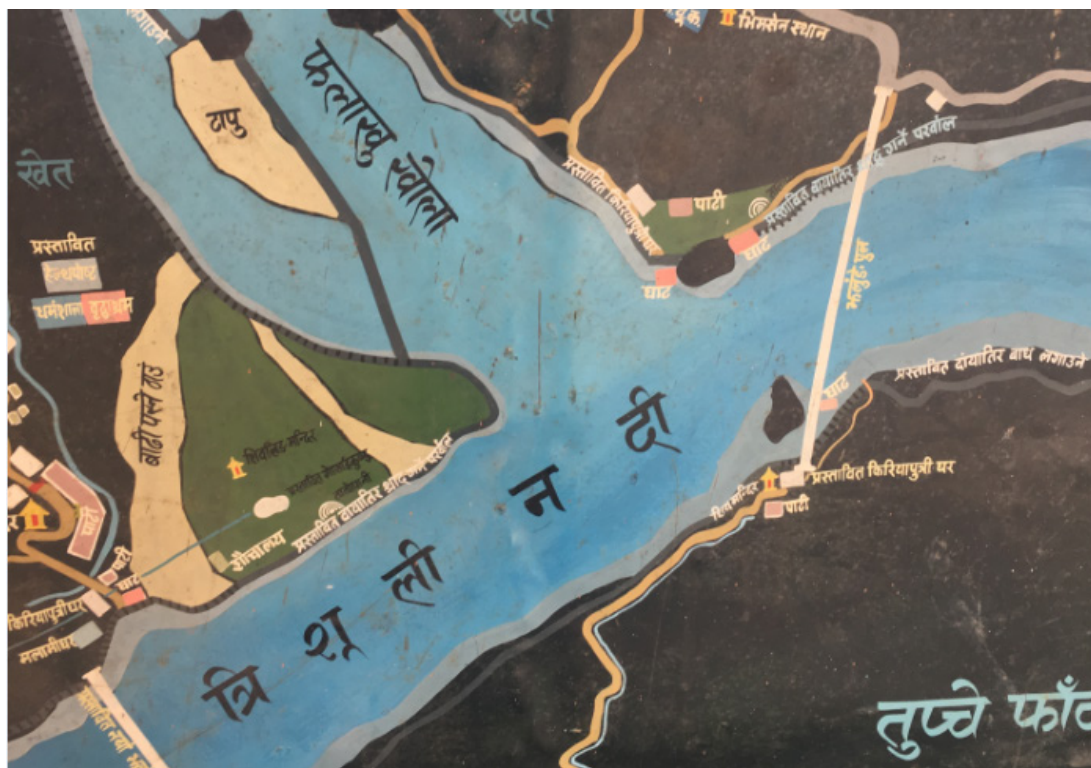


Table 7.5 Baseline Status of Religious and Cultural Sites

Cultural/religious site	Description and religious significance	Other local significance
Upstream		
Gosaikunda Lake	<ul style="list-style-type: none"> Major culturally significant tourist site located within Langtang National Park Known for specific trekking expeditions up to the lake Between 2,500 and 3,000 pilgrims and visitors annually 	Tourism is an important contributor to revenues of the Langtang National Park (annually estimated to be NPR 60 million), which in turn supports conservation activities.
Local cremation sites	A majority of the burial and cremation places of Tamang and Gurung communities are located upland and not along the river	NA
Uttargaya	<ul style="list-style-type: none"> Nationally relevant Hindu cultural site with a temple dedicated to Lord Ram, five cremation, sites and four religious ceremony platforms Three specific festivals (Gangadussehra in June, Janai Purnima in August, and a pilgrimage in December) attract devotees and tourists At least 15,000–16,000 tourists from Nepal and India visit Uttargaya each year (based on 2017 data) 	Ancillary activities to support cultural tourism around Uttargaya involve approximately 150 local people through restaurants, shops, porter services and teahouses.

Continued on the next page.

Cultural/religious site	Description and religious significance	Other local significance
Midstream		
Devghat	<ul style="list-style-type: none"> Regionally significant cremation ground at the confluence of Tadi Khola and Trishuli rivers Revered for several sacred temples and ashrams Most Hindu festivals are celebrated at this location Approximately 4,000–5,000 tourists and visitors were recorded in 2017 	Ancillary activities to support cultural tourism around Devghat involve approximately 60 local people through restaurants, shops, porter services, and teahouses.
Local cremation sites	No specific data and/or inventory of local cremation sites in this stretch of the river	NA
Downstream		
Devghat	Located 10 kilometers downstream of the Super Trishuli Project and not a part of the study area	NA
Confluence of Budhi Gandaki and Trishuli River	Important cremation site for communities that include Kumal and Newar, but this is not assessed to be regionally significant	NA

Note: NA = not applicable.

Key Stressors

Sand- and gravel-mining activities result in degradation of river banks, with river subsidence altering water quality. In addition, the lack of waste management and sewage treatment leads to accumulation of waste disposed into the Trishuli River.

Methodology

Gosaikunda was assessed to be not impacted. Potential interference with access is not relevant for this site as it is located within Langtang National Park. There may be a potential increase in the number of tourists and/or pilgrims into park due to improved local infrastructure spurred by cumulative hydropower development.

In the upstream and midstream area of the mainstem, spatial information pertaining to the cultural sites in the TRB was superimposed with the locations of HPPs considering full development (Figure 7.6). Ecosystem integrity assessment in the full development scenario was extrapolated to undertake a qualitative assessment in order to ascertain reduction in the quality and quantity of water available for rituals in Uttargaya and Devghat. It should be noted that there was limited information on the change in flow levels and/or any

specific areas of reduced flows due to the cascade of projects along the river and specific tributaries.

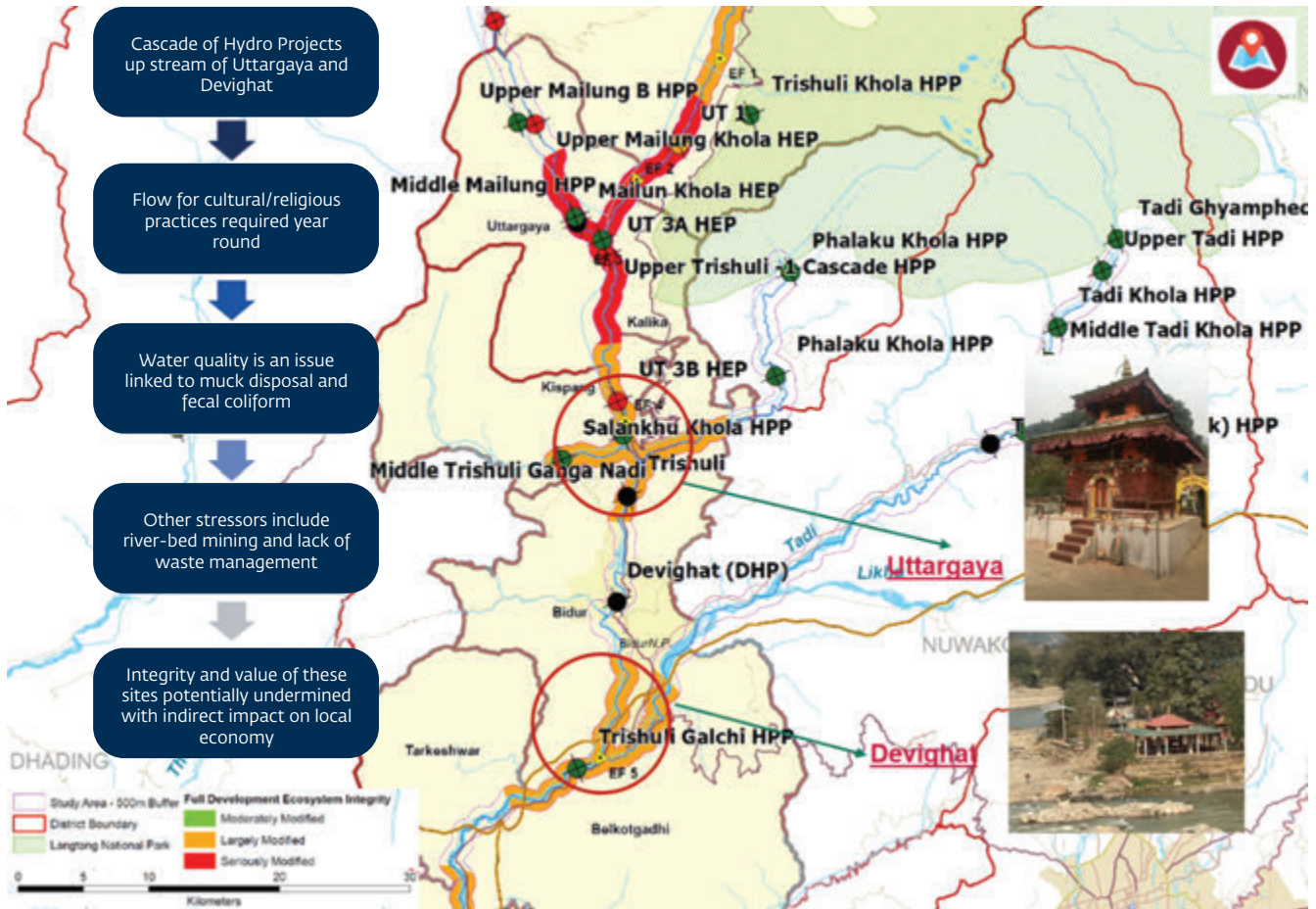
Devghat is located 10 kilometers downstream of the last HPP being considered and is thus out of the study area. Finally, the location at the confluence of Budhi Gandaki and Trishuli does not have major hydropower development immediately upstream (other than Thoppal Khola and Trishuli Galchi over 15–20 kilometers upstream), and hence there is likely to be sufficient flow to support cremation and other activities.

Significant Cumulative Impacts

Regionally significant cultural and religious sites at Uttargaya and Devghat require clean water in sufficient quantity and at least chest-high depths for local communities (and pilgrims) to perform traditional ceremonies and rituals (including weddings and cremations). These sites are located immediately downstream of a cascade of HPPs along the Trishuli, Phalankhu Khola, Salankhu Khola, and Tadi Khola.

The development of cascading HPPs in concert with sand- and gravel-mining activities in Tadi Khola and upstream of Betrawati will affect the two indicators

Figure 7.6 Cultural and Religious Sites Upstream and Midstream



being considered for impact significance: quantity and quality of water along the mainstem of Trishuli River:

- **Water Quantity:** Cascading projects will impact the quantity of water available, especially to maintain a depth to perform ceremonies. In the absence of specific data on flow and seasonality, no quantitative estimates of sufficient flows are available;
- **Water Quality:** Quality of water linked to increased fecal coliform and pollution load will further contribute toward loss of heritage resources and intangible cultural services relative to the baseline condition. Stakeholders have already indicated water quality issues from muck disposal of projects such as at UT 3A and along Mailung Khola.

The integrity and value of both Uttargaya and Devighat

will be undermined in the *full development scenario* due to an impact on clean flowing water, with an indirect impact on the local economy that is dependent on revenue linked to Devighat and Uttargaya. The impact of reduced flows will be more intense during the dry season, which coincides, with some religious festivals celebrated through pilgrimages to these two locations annually. There is limited data to suggest whether reduced flows will arise from a specific project and/or due to the influence of a cascade of projects.

Consulted stakeholder groups expressed that preservation of these sites as a priority concern during cumulative impact management. A specific assessment of sufficiency of flows is required for the main stem and tributaries in order to plan controlled releases, at least during key periods during the year.

Proposed Mitigation Measures

As discussed in “Significant Cumulative Impacts (Relative to the Baseline)” above, cultural and religious activities at Uttargaya and Devighat will be affected in the full development scenario due to impacts on water quantity and quality (further exacerbated by sand mining and waste disposal into the Trishuli River).

The following mitigation measures are proposed:

Water Quantity: Undertake an assessment of the actual requirements for water flow for normal rituals as well as during specific festivals and pilgrimages through the year, especially during the dry season. This assessment will be required to confirm whether the current EFlows release (in view of all other projects upstream) is sufficient for maintaining the required depth (for ceremonies and religious activities associated with cremation, rituals, and so forth) or if additional EFlows release may be required during specific rituals;

Water Quality: Raise awareness among local communities and other stakeholder groups (including hydropower developers and sand- and gravel-mining entities) upstream about proper management of waste, and declare specific zones for disposal of muck, spoil, and other wastes.

Challenges

- Ensuring compliance regarding the implementation of proper waste management by hydropower developers and other projects
- Monitoring of EFlows release

Governance Structure and Activities for Mitigation Planning

- Form platforms and/or working groups comprising the temple management committee, hydropower developers, and local authorities to monitor, implement the actions, and make the concerned authorities more accountable (using the Environment-Friendly Local Governance Framework).
- Monitor EFlows release (responsibility of the management committees).

- Increase public acceptance of development projects in the TRB, including hydropower, for sustainability and benefit sharing.
- Develop localized policy directives to temporarily stop the mining activities at least during key festivals and pilgrimages and regionally significant rituals.

Livelihoods

Rationale for Screening

Basin-level stakeholders considered livelihoods that are dependent on the river and related ecosystem services to be the most significant valued ecosystem components to consider under the Cumulative Impact Assessment and Management (CIA). This perception was justified in view of the physical and economic displacement linked to hydropower development and inconsistent policies on land acquisition and compensation that have been implemented for projects under construction.

While physical and economic displacement is a localized impact of HPPs, the CIA has considered whether multiple projects (and their associated facilities) within the same municipality and/or tributary, along with potential loss of livelihood activities linked to the river, have led to an increase in economic vulnerability within the basin. The assessment has also tried to establish if there are certain vulnerable social groups that may not directly benefit from land acquisition but whose livelihoods may be affected by reduced flows and implications for ecosystem services.

Baseline Conditions

Fishing Livelihoods

Artisanal fishing livelihoods (capture fishing, subsistence fishing, and recreational fishing) have seen a decline in the TRB (Gurung et al. 2011). Consultations indicate that this decline is due to the reduction in fish resources, degradation of water quality and habitat, and the availability of wage labor as an income-generating activity. There is a lack of comparable temporal and spatial data on fishing as a livelihood activity across different parts of the river basin. However, in general, the following has been ascertained:

- Asla (*Schizothorax richardsonii*), Katle (*Neolissocheilus hexagonolepis*), Buduna (*Garra annandalei*), and Nakhata are the most common species of fish caught from March to May and June to August each year. Usually, the lean season for fishing across the river is December to February.
- Conventional fishing gear such as cast net, basket trap, and gill net are typically used and are thought to be less efficient than other nonconventional methods (such as electrofishing). It is understood that nonconventional methods are prohibited and are being controlled by local authorities.
- Fisherfolk have reported diminishing catches every one-to-two years, making capture fishery an incidental activity due to irregular income patterns.

However, consultations with local communities in the midstream and downstream river reaches indicated that certain indigenous communities (especially Magar, Rai, and the Chepang communities) continue to engage in fishing as an important subsistence activity. In particular:

- Limited fishing activities, even for subsistence or recreation, were reported upstream, other than for specific locations, such as Mailung Khola. Even the UT-1 Supplemental Environmental and Social Impact Assessment indicates that very few households engage in fishing as a livelihood activity. The Environmental Impact Assessment (EIA) for Rasuwagadhi and Sanjen Khola (NESS 2012a, 2014a) also suggested that other than occasional recreational fishing and as a supplementary nutrition source (fish protein is a very valuable factor for human health), there is negligible dependence upon fishing.
- In the midstream section, even though this area has seen degradation due to intense sand-mining activities and urbanization, fishing as a livelihood activity is carried out by Dalit, Magar, Rai, and certain Tamang households (assessed to be approximately 120 in all, based on consultations near under-construction HPPs).
- Downstream of the river basin, Rai, Magar, Majhi, and Chepang communities undertake fishing activities in Ichhyakamana and Gandaki municipalities above

the confluence of the Trishuli and Budhi Gandaki.

There is limited processing and/or value addition of fishing, and the fish caught are either sold to restaurants or consumed. Consultations at markets in Betrawati, Battar Bazar, Gajuri, and Dhunche indicated that, on average, each restaurant purchases approximately 2–3 kilograms of fish in the lean season and 7–12 kilograms in the peak season. Due to the irregular supply of indigenous and local varieties of fish, Rainbow Trout are purchased through small-scale aquaculture farms in Rasuwa and Nuwakot. Consultations near the under-construction Rasuwagadhi HPP indicated that fish is procured from the Kathmandu valley. Fishery Research Stations in Nuwakot and Dhunche (funded by the Nepal Agricultural Research Council) have been focusing on intensification of riverine aquaculture and capture fisheries to support livelihood activities that are less dependent on sufficient flows (Box 7.3).

Riverine Agriculture

The section “Socioeconomic Baseline of the TRB” of Chapter 7 provided an overview of types of cropping patterns upstream, midstream, and downstream of the river. The main types of agricultural areas in the basin include *bari* (upland irrigated), *khet* (riverine), *pakho* (unirrigated), and floodplain agriculture. Bari and pakho are widely practiced in the middle mountains, where land cover on steep slopes is cleared with little or no terracing, resulting in erosion and loss of top soils.

Existing EIA baselines have limited information on average income from agriculture. However, consultations indicate that income levels range from NPR 50,000–100,000 (US\$500–1,000) for the post-monsoon crop and NPR 80,000–150,000 (US\$800–1,500) for the winter crop. Communities in the midstream and downstream sections of the river practice riverine agriculture and also use the river for irrigation and/or by installation of small-capacity pumps.

Typically, agricultural land closer to the river is given to land users under three types of land tenure arrangements: *adhiya*, or sharecropping (predominant upstream and downstream); *bandhagi*, or convenience-based use, with collateral linked to loan repayment (predominant midstream); and *kut* farming, or contract farming

Box 7.3 Small-Scale Aquaculture Initiatives

The Nepal Agricultural Research Council introduced cold-water aquaculture practices on trout farming through the research station in Nuwakot. Extensive services and training were provided on feed ingredients, water quality, breeding, and fry nursing and rearing for development of a package of practices. Since then the following aquaculture initiatives have attempted to reduce river dependence for fishing livelihoods:

- Between 1998 and 2005, the Japanese International Cooperation Agency (JICA) supported three private farms with hatcheries and nurseries (two in Nuwakot and one in Rasuwa Districts) for scaling up Rainbow Trout farming to enhance livelihoods of hill communities. Three private trout breeders were developed, and about 200,000 fry were produced and distributed by the end of the project.
- In 2006, the government of Nepal declared Rasuwa and Nuwakot as trout-growing districts under the One Village, One Pond program, in which trout farming was prioritized as a way to support local farmers through cold-water resource use and local tourism.

It is understood that presently there are approximately 25–30 small-scale aquaculture farms rearing Rainbow Trout. Information in 2007 gives an indication of the intensity of the activity:

District	Number of farmers	Area (square meters)	Estimated production (kilograms)
Rasuwa	5	328	1,135
Nuwakot	22	2,351	28,543

Constraints to the commercialization of small-scale cold-water aquaculture in the area include the supply of quality feed (research stations and the small-scale farms have limited capacity to produce required feed) and lack of extension services and human resources to scale up the activity and improve the adoption of this initiative. However, rural areas along the Trishuli River have the potential for small-scale fish production of local fish species. For instance, Common Snow Trout are easy to feed with sheep food, fry are cheap to buy, and ponds will be simple to construct and will tolerate local water quality. The costs incurred for introducing exotic species such as the Brown Trout will be more expensive than the Common Snow Trout as they require special water quality and expensive ponds.

Source: Shrestha and Pant 2012.

(predominant midstream). The midstream section also has several absentee landowners who have migrated to Kathmandu, leaving local communities and land users to cultivate their land.

Trade Opportunities and Wage Labor

The gradual urbanization, upgrade of local infrastructure, and relative potential for pipeline HPPs in the TRB have spurred local enterprise and trade opportunities linked to sand and gravel mining, crusher units and quarries, construction contractors and service providers for hydropower developers, general plying of private vehicles and dumper trucks, and restaurants and grocery stores along urban areas

and tourist towns. These have resulted in wage-labor opportunities for unskilled and semi-skilled categories, especially in Bidur and the downstream area.

The building and construction sector (including local access roads) and sand and gravel mining, local quarries, and crushers are the principal source of wage labor, employing at least 5,000 local workers cumulatively. These opportunities are job specific and are not regular means of income generation. However, these opportunities have resulted in fast and accessible cash being infused into the local economy, leading to the growth and expansion of markets around Dhunche and Syaphrubeshi (upstream), Battar Bazar and Bidur (midstream), and Benighat/Kurintar (downstream).

River Rafting and Recreation

Primary consultations with local communities and the Nepal Association of Rafting Agencies (NARA) indicated that whitewater rafting as a tourism and recreational activity occurs only in the downstream area of the TRB. There are approximately 15 professional rafting agencies (associated with NARA) that operate trips and expeditions along the Trishuli River. A typical package lasts for approximately three days and includes accommodation, food, porter services, equipment, and internal transport.

Map 7.1 illustrates the route commencing in Gajuri/Melekhu and passing along Baireni/Charaudi/Fishing to end at Mugling/Devghat. This stretch has class 2 and class 3 rapids.

The peak season for rafting is from October to February, when approximately 15,000–20,000 tourists raft. June to August (monsoon season) is the lean season for this activity, due to the velocity of the river. During this season, tourists prefer to camp along the banks of the Trishuli (Mugling, Fishing, and Kurintar) as part of their trips to Chitwan National Park.

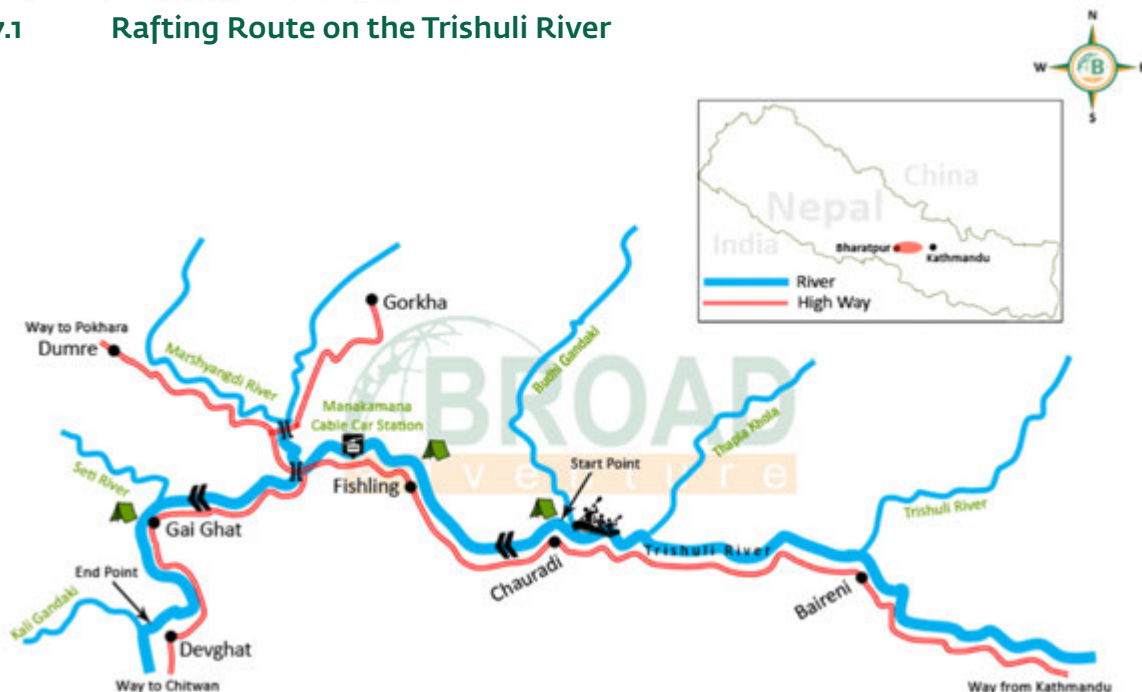
Rafting agencies reported that each agency generates

approximately NPR 3,000,000–4,000,000 (US\$30,000–40,000) per month during the peak season and approximately NPR 5,000,000–8,000,000 (US\$5,000–8,000) per month during the lean season. Overall, there are a total of 300 staff members and workers employed by these rafting agencies, most of whom are guides, porters, and cooks from the local area. These earn approximately NPR 150,000–400,000 (US\$1,500–4,000) during the year across the two seasons.

Land-Acquisition Practices

A study by USAID (2014) of HPPs in Nepal suggested that while procurement of land is undertaken under the provisions of the Land Acquisition Act of 1977, there are no consistent approaches for the participation of local communities, the development of context-specific entitlements (especially for informal rights holders and loss of access to natural resources), and no grievance redressal. These issues are dealt with on a project-by-project basis, which has led to inconsistency in land-acquisition practices. Table 7.6 captures information as obtained from EIA reports on land footprint, impacts, and details on compensation packages as reported.

Map 7.1 Rafting Route on the Trishuli River



Source: Mountain Hiking & Trekking 2019.

Table 7.6 Land-Acquisition Impacts

Indicator	Upstream of TRB						Mid-stream	Down-stream
	Rasu-wagadhi	Sanjen Khola	UT-1	UT3A	UT3B	Upper Tadi Khola	Trishuli Galchi	Super Trishuli
Capacity (MW)	111	42	216	60	37	11	75	100
Status	Under construction	Under construction	Committed/ access road under construction	Under construction	Under construction	Planned	Planned	Planned
Total land footprint (ha)	39.22	20.2	107.79	34.8	34.21	4.5	72.67	79.18
Private land (ha)	7.6 (20%)	2.7 (13%)	5 (5%)	13.3 (40%)	3.84 (11%)	0.7 (20%)	1.74 (2%)	10.74 (14%)
CFUG land (ha)	0	10.1	78.6	1.41	1.5	0	1.4	3.6
Number of villages impacted	6	1	8	5	2	1	7	5
Number of households impacted	92	13	154	42	52	29	20	25
Physically impacted households	0	2 (15%)	28 (18%)	12 (28%)	4 (8%)	2 (8%)	0	20%
Total compensation package as per EIA report	US \$1,635,209	US \$507,830	Not Available	US \$2,084,825	US \$1,700,000	US \$219,580	US \$2,200,000	US \$2,850,000
Other support and benefits	Ten percent maximum equity shares; priority employment; support to rural roads and health posts	No specific information on shares	Livelihood restoration; upgrading community infrastructure; foot trails; free electrification; 10% maximum equity shares	No specific information on shares	No specific information on shares	No specific information on shares	No specific information on shares	No specific information on shares; community infrastructure development; priority employment

Note: ha = hectares; CFUG = Community Forest User Group.

Land-acquisition practices of UT 3A and UT-1 have been reported in the public domain, providing information on the land classification process and the rates determined by the compensation fixation committees. Consultations in municipalities and villages around under-construction HPPs indicated that a share-purchase mechanism was likely to be put in place wherein any member of the local community

who is residing permanently in the districts of the project area, at the date on which the construction activities for the project commence, would be eligible to purchase shares.

Table 7.7 captures stakeholder feedback and insights on land acquisition across different sections of the basin.

Table 7.7 Stakeholder Perceptions on Land Acquisition

Municipality	Perception on nature and intensity of impacts	Views on compensation and mitigation
Upstream		
Gosaikunda	Generally, grazing and pasture land is not adequately compensated.	<ul style="list-style-type: none"> NPR 8–10 lakhs/ropani (US\$8,000–10,000/ropani) is offered as compensation, which is significantly more than the government rate. Generally, physically displaced households are moving to Bidur and Kathmandu. Compensation is being used for construction of buildings, purchasing vehicles, and purchasing land.
District Forest Officer	Impact on CFUG land is felt differently by among user groups.	<ul style="list-style-type: none"> There is a lack of transparent criteria for actual compensation paid, and it is usually based on negotiations.
Kalika		<ul style="list-style-type: none"> Impacts such as valuation of land affected by transmission infrastructure has not been included in the compensation. There is a suggestion that local communities be a part of the compensation committee.
Uttargaya		<ul style="list-style-type: none"> Municipality leaders perceive that sufficient compensation is being provided by proponents of UT 3A and 3B and that households are investing the compensation in land and assets such as trucks as well as using it to repay loans.
Midstream		
Bidur	Land procured by HPPs is not being used and is kept barren; One area of crop land is being converted into grazing land.	
Downstream		
Galchi	Land procurement is yet to commence for the downstream projects,	<ul style="list-style-type: none"> There is an expectation to compensate local communities engaged in sand mining in case this activity is impacted by the HPP. Communities indicated that in-kind compensation should be offered.
Kispang		<ul style="list-style-type: none"> There is a perception in the community that hydropower developers are making false commitments on supporting infrastructure and employment generation.

Source: Stakeholder Consultations in May and July 2018.

Overall, stakeholder feedback indicates the following:

- The revised land-acquisition policy is yet to be enforced by developers and the Nepal Electricity Authority (NEA), resulting in certain categories of impacted entities (land users, informal rights holders, and groups affected by natural-resource based livelihoods) not being considered.
- Compensation rates for land are reported to be above the market price. However, there is lack of

transparency in the compensation fixation criterion. For instance, the asset compensation principle for trees is being inconsistently applied.

- While land prices and land value have generally increased, the transmission line alignments have led to depreciation of land value along the right of way.
- There are limited tracking mechanisms to assess productive use of compensation. However, there is

an increasing trend toward consumptive use and out-migration. Farmers that prefer to buy land have to move upward, away from productive land closer to riverine areas.

- There is an overall change in the livelihood profile for specific communities that is not considered under the compensation package, and there is limited monitoring data to further assess the intensity and implications of this change, in terms of increased economic vulnerabilities.

Key Stressors

Natural hazards (such as droughts and floods), landslides, and the aftermath of the earthquake increase the vulnerability of local communities whose livelihoods are linked to the Trishuli River and to the ecosystem services that the basin provides. Similarly, land-acquisition activities linked to road widening, regional developments and projects, and major transmission infrastructure development may lead to cumulative impacts on households already affected by one or more HPPs.

Methodology

Livelihood Activities

The livelihood activities described in “Baseline Conditions” in Chapter 7 have been bifurcated into the aspects and indicators presented in Table 7.8. Stakeholder consultations and impact assessment Chapters of EIA reports have been used to assess relevance for consideration into the CIA as summarized subsequently. Significant Interactions indicating potential cumulative impacts are highlighted in green.

Summary of DRIFT Assessment

The DRIFT assessment has indicated the following key conclusions used to analyze fishing livelihoods with respect to full development of 36 HPPs:

Findings for Indicator Fish Species:

- The population of Snow Trout will deteriorate relative to the existing scenario due to the impact

of additional barriers created by dams, which will stop seasonal migration and access to spawning grounds.

- The Golden Mahseer requires flowing water for breeding. While this fish will survive in the mainstem of the Trishuli River, the reservoir with fine sediments in the bed will not provide a preferred habitat for this fish, and it will not be able to breed in the reservoirs.
- Indigenous species such as Baduna and Nakhata will sustain their population in the free low sections of the river with relatively low levels of flow release. However, they are not suited for reservoirs or lake environments.

Findings for Fish Integrity: Fish integrity will vary from critically modified in the upstream to seriously modified in the midstream. The downstream section is ascertained to be moderately modified (Figure 7.7).

Overall Findings: The overarching findings indicate that full development will affect aquatic ecology across fish integrity, ecosystem integrity, and its implications for the population of indicator fish species. All of the indicator fish species will be significantly impacted by the reservoirs and low flow section created by the HPPs. The indigenous Garra and Glyptothorax species will be practically eliminated in the upstream sections and in specific sections midstream as they cannot survive in lake environments and need cobble beds for feeding and shelter. The migratory Snow Trout and Mahseer also need a flowing river environment for survival and growth. However, the reservoirs are likely to sustain the populations of these species.

Land-Acquisition Impacts

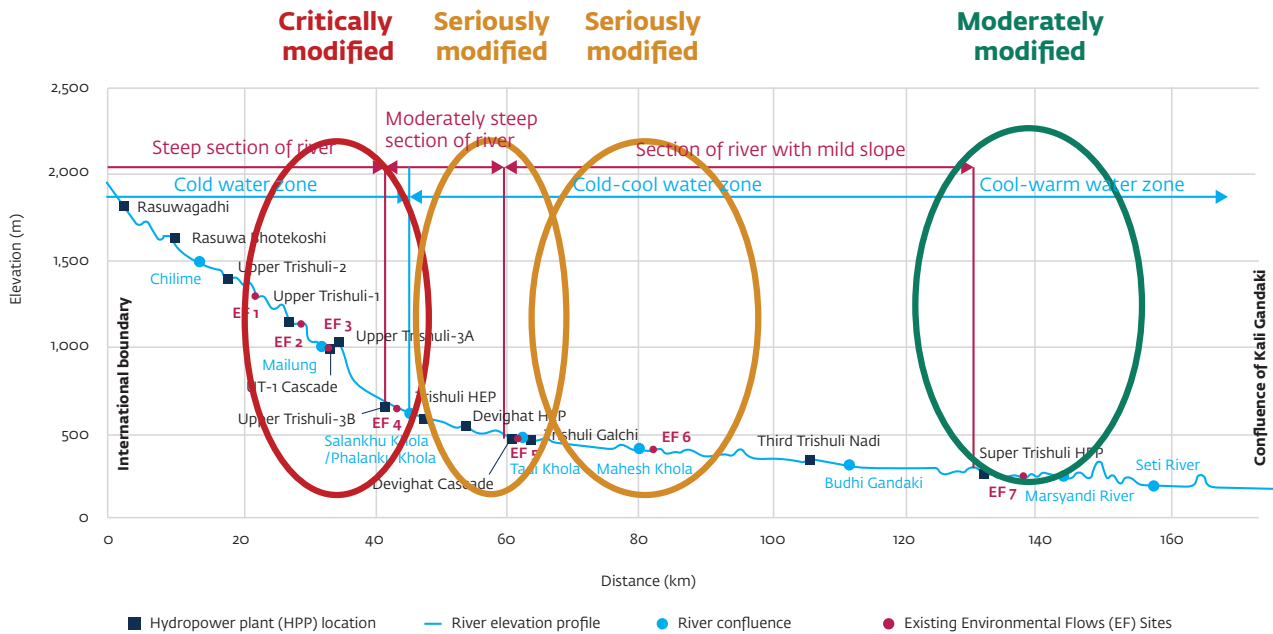
To ascertain cumulative implications of land acquisition, available data from specific projects, along with stakeholder perceptions in municipalities where land procurement and construction is undertaken; have been analyzed to derive quantitative indicators of impact significance.

Table 7.8 Cumulative Implications on Livelihood Activities

Activity	Indicators and relevance		
	Upstream	Midstream	Downstream
River-based livelihoods			
Fishing	<p>There is culturally significant activity for the Tamang community as well as for the Baramu community.</p> <p>Fishing is a complementary source of household income, especially linked to engagement of the community in net making using traditional techniques.</p>	<p>Fishing is an important livelihood activity for Majhi, Kumal, and Magar communities as well as certain Hill Dalits. Communities living in internally displaced people (IDP) camps along the river also undertake fishing, mostly along tributaries. However, consultations indicated that the dependence on fishing for income generation has decreased due to degraded habitat and a decline in fishing resources and a gradual shift toward wage labor.</p>	<p>This is an important livelihood activity for Majhi, Kumal, and Magar communities as well as certain Hill Dalits. Communities continue to engage in fishing. The recreational activities linked to rafting in the downstream stretch support ancillary facilities such as restaurants, which are markets for peak season fishing.</p>
Sand mining	<p>Negligible sand and gravel mining are carried out due to the river gradient. However, in view of multiple HPPs coming up in Rasuwa, there can be an increase in this activity due to improved access to the river.</p>	<p>Ninety sand mining and processing plants and smaller centers are located near Betravati and Ratamate and along Tadi Khola. These centers (phirphire) together engage at least 950–1,200 local persons for wage labor, including those from communities living in IDP camps in Bidur.</p>	<p>There are at least 12 legal sand-mining and processing plants along with 28 smaller centers. At least 800–900 local persons are engaged.</p>
Riverine agriculture	<p>Communities mostly undertake upland cultivation due to difficulties in accessing the river bank.</p>	<p>There are some riverine terraces and some intensity of flood plain agriculture.</p>	<p>Limited riverine agriculture is practiced, as these areas have experienced intense floods.</p>
Ecosystem services linked to Trishuli River			
Use of river water for drinking and agriculture	<p>Not relevant: drinking water comes from springs, and no riverine agriculture is practiced.</p>	<p>People depend mostly piped water supply and springs. There is no use of the river for irrigation, as water channels/ conveyance pipelines from kholas up to water mills are the prevalent irrigation technique.</p>	<p>River water is used for irrigation through pumping and lift irrigation schemes.</p>
River transport	<p>Not relevant: the river has a steep gradient.</p>	<p>Not relevant: local infrastructure projects connect municipalities across the river.</p>	<p>The river flow has a high velocity in the downstream section due to the combined inflow from upstream and the tributaries, making water transport a treacherous activity.</p>
Rafting and recreational use of the river	<p>Not relevant: there is none in this area.</p>	<p>Rafting activities start from somewhere in the lower end of this each.</p>	<p>Rafting is a key economic and tourism activity in this stretch and provides local employment.</p>

Note: Significant Interactions indicating potential cumulative impacts are highlighted in green.

Figure 7.7 Fish Integrity Assessment



Implications upstream:

- Fish populations will decline for the full development scenario.
- Impacts on Langtang Khola and Chilime Khola will be marginal due to limited breeding and spawning grounds.
- Fish populations will drop significantly due to the UT-1, UT-3A, UT-3B cascade.
- Fish will be trapped between the dams and will not be able to access favorable feeding and breeding areas.
- Contribution from Mailung Khola to population of fish in the main Trishuli River will decline further.

Implications midstream:

- Fish populations will decline due to the addition of Middle Trishuli Ganga Nadi after the cascades of Uttargaya and Devighat.
- The overall ecosystem integrity is also seriously modified.

Implications downstream:

- Full development scenario will not have a significant incremental impact on the population of fish and overall ecosystem integrity will remain the moderately modified at these sites.

Qualitative Intensity Mapping

Based on the assessment of interaction between livelihood activities and land-acquisition impacts, qualitative intensity mapping was undertaken for the upstream, midstream, and downstream river reaches based on available information. Findings on fish integrity based on running the DRIFT model for the full development scenario were superimposed on the locations of HPPs, settlements, and land use.

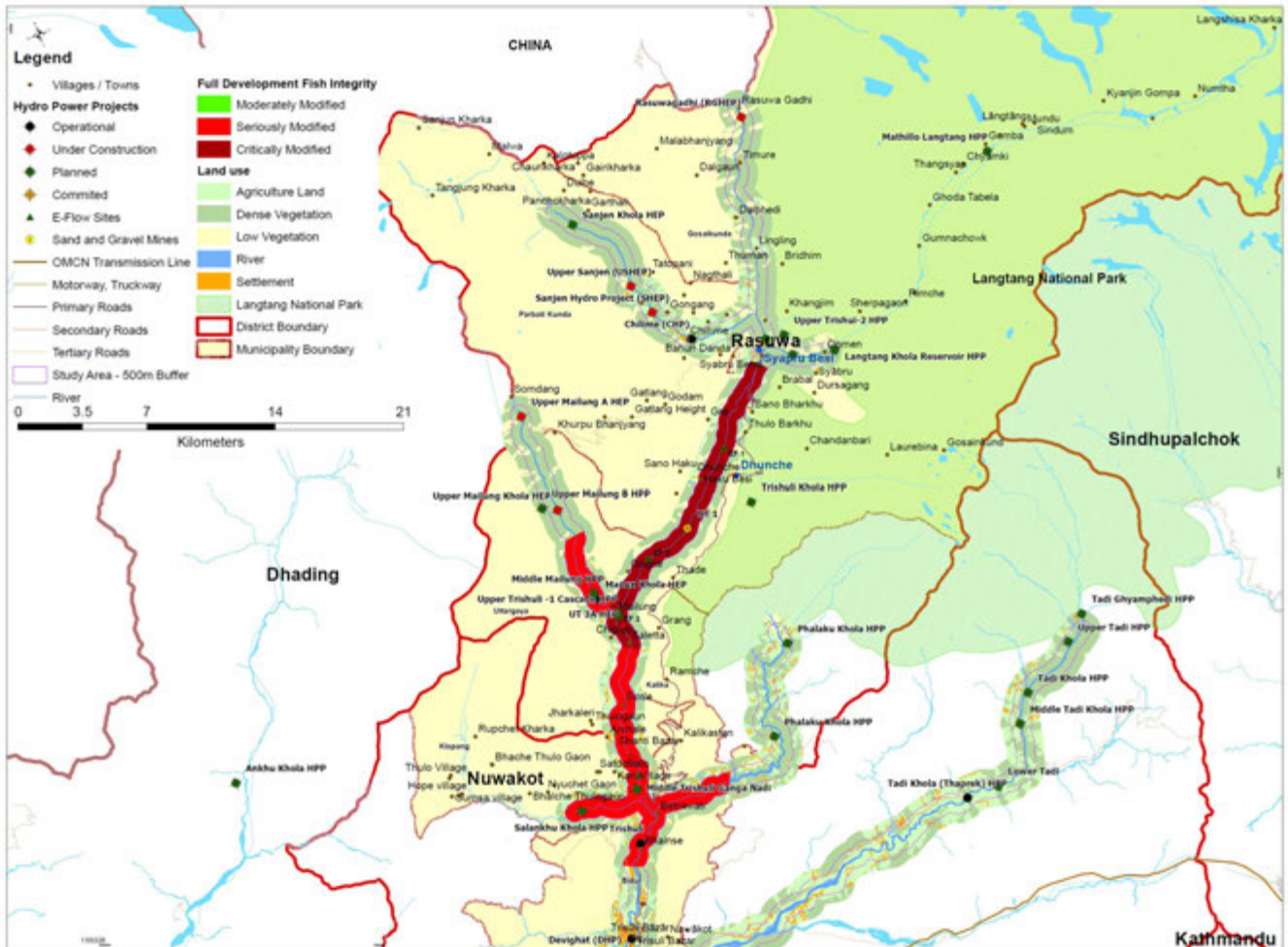
Significant Cumulative Impacts (Relative to the Baseline)

Table 7.9 summarizes the significance of impacts linked to river-based livelihoods, ecosystem services, and cumulative land-acquisition implications for each reach within the TRB.

Table 7.9 Cumulative Impacts on Livelihoods

Aspect for qualitative assessment	Study area for social VECs		
	Upstream (Map 7.2)	Midstream (Map 7.3)	Downstream (Map 7.4)
Number of projects in full development scenario	Thirty projects aggregating to 1,285 megawatts (MW)	Four projects aggregating to 100 MW.	Two projects aggregating to 161 MW
River-based livelihoods	Seriously to critically modified fish integrity implies impacts on fishing livelihoods in spite of access to the river due to access roads of HPPs.	Fish integrity is likely to be seriously modified, which will result in impacts to fishing-based livelihoods of specific communities. There will also be localized implications to riverine agriculture.	Fish integrity is likely to be moderately affected, which may result in an increase in fishing pressures from communities upstream.
Ecosystem services-based livelihoods	Increase in sand mining due to improved access to the river	Existing intensity of sand mining likely to increase further.	Implication on rafting as a recreation activity if there is variability in flow and water quality upstream
Land-acquisition impacts	650 hectares of land requirement and potential acquisition may entail significant economic and physical displacement, mostly of indigenous Tamang communities.	Land-based livelihoods may not be significantly affected, but land owners may need to move upland, away from productive areas along the bank that will be within the land footprint and/or diversion reaches.	Land-acquisition impacts will be localized to the Super Trishuli HPP and will not be cumulatively significant.
Extrapolation of fish integrity in the full development scenario	The DRIFT Model Assessment indicates that fish integrity between Chilime and Kalika will be seriously to critically affected, indicating a general decline in any possibility of fishing-based livelihoods even though access to the river will have improved. There is likely to be an increase in sand-mining activities, which may involve local communities for wage labor opportunities. Land-acquisition impacts are likely to be significant in view of the 30 HPPs that will come up in the full development scenario, necessitating at least 640 hectares of land (using an average of 0.5 hectares per MW).	Livelihood impacts are assessed to be minor with respect to economic displacement due to land procurement and/or implications for riverine agriculture. However, vulnerability of certain communities (Rai, Magar, and Dalit) that are dependent on fishing may increase.	Livelihood impacts are assessed to be minor. Rafting activities and associated tourism-based labor requirements may be cumulatively affected only in there is variable flow and water quality declines.
Overall significance	Livelihood impacts linked to economic displacement will be significant in view of multiple projects.	Minor impact significance to livelihoods is expected overall, but specific communities such as Rai, Magar, and Dalit may be impacted due to loss of livelihoods linked to fishing.	Minor impact significance to livelihoods is expected overall, other than for local communities that support rafting and tourism activities. There will be localized impact linked to Super Trishuli.

Map 7.2 Intensity of Livelihood Implications vis-à-vis Fish Integrity: Upstream



Source: OMCN = Office of Millennium Challenge Nepal

Proposed Mitigation

Fish Based Livelihoods

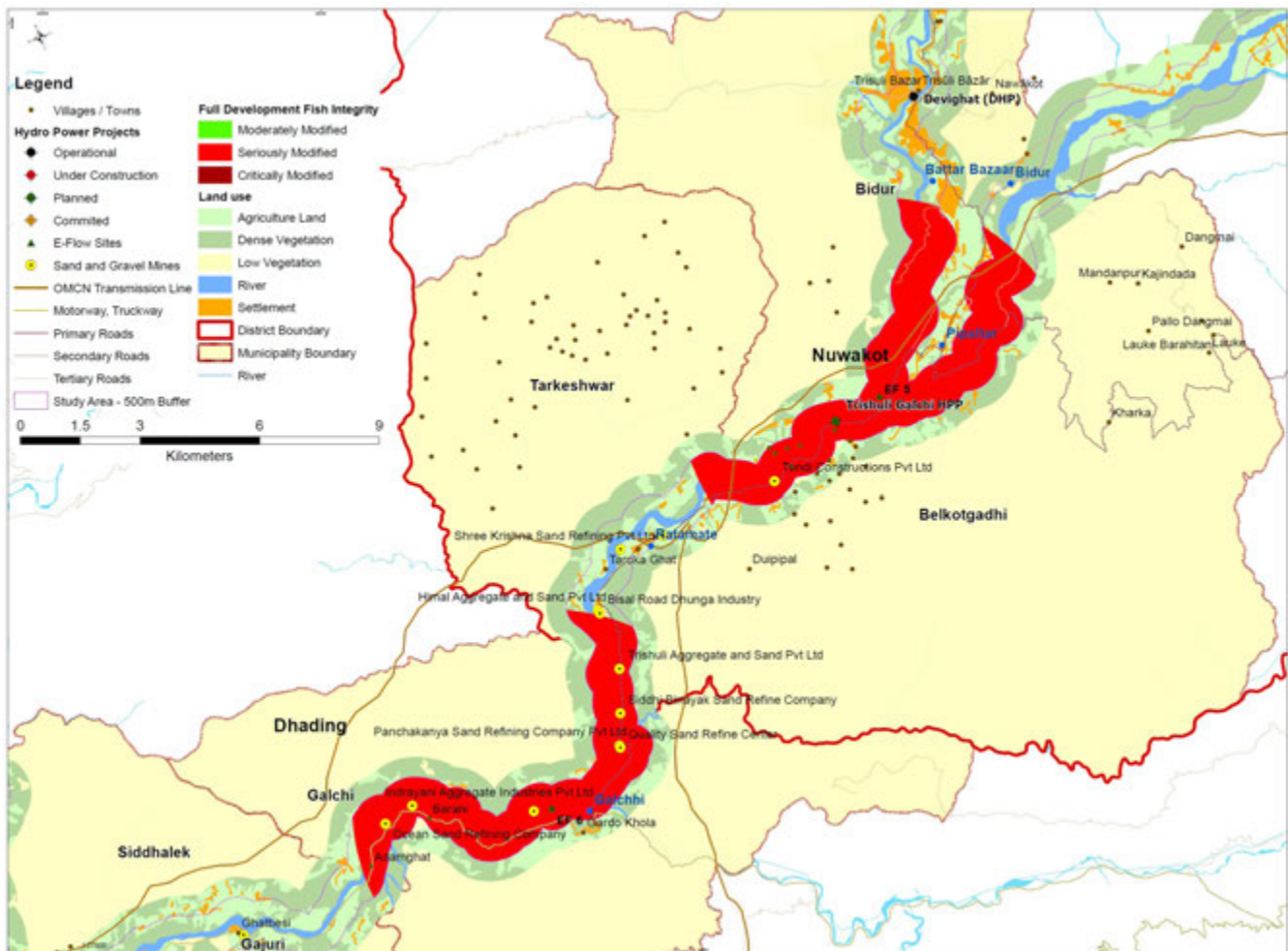
Fishing activity is predicted to decline (is already declining), and fishing communities are already looking at alternate options (including petty labor and out-migration). Local Rainbow Trout farming and fish ponds in the Terai region (Janakpur and Macha) have emerged as the major supplier of fish. There is a relatively small number of potentially affected households (especially in the upstream and midstream reach) around which to adopt a basin-level strategy to enhance fishing livelihoods (while also focusing

on not increasing fishing pressures). Overall, local municipalities will need to work with hydropower developers to implement the following:

- Granting reservoir area fishing rights and licenses based on district allocations
- Adopting sustainable fishing techniques under programs that have already seen success in the area, such as One Village, One Pond project (funded by JICA)
- Implementing cold-water aquaculture schemes focused on specific communities, such as the Majhi and the Magar

Map 7.3

Livelihood Implications vis-à-vis Fish Integrity: Midstream



Source: OMCN = Office of Millennium Challenge Nepal

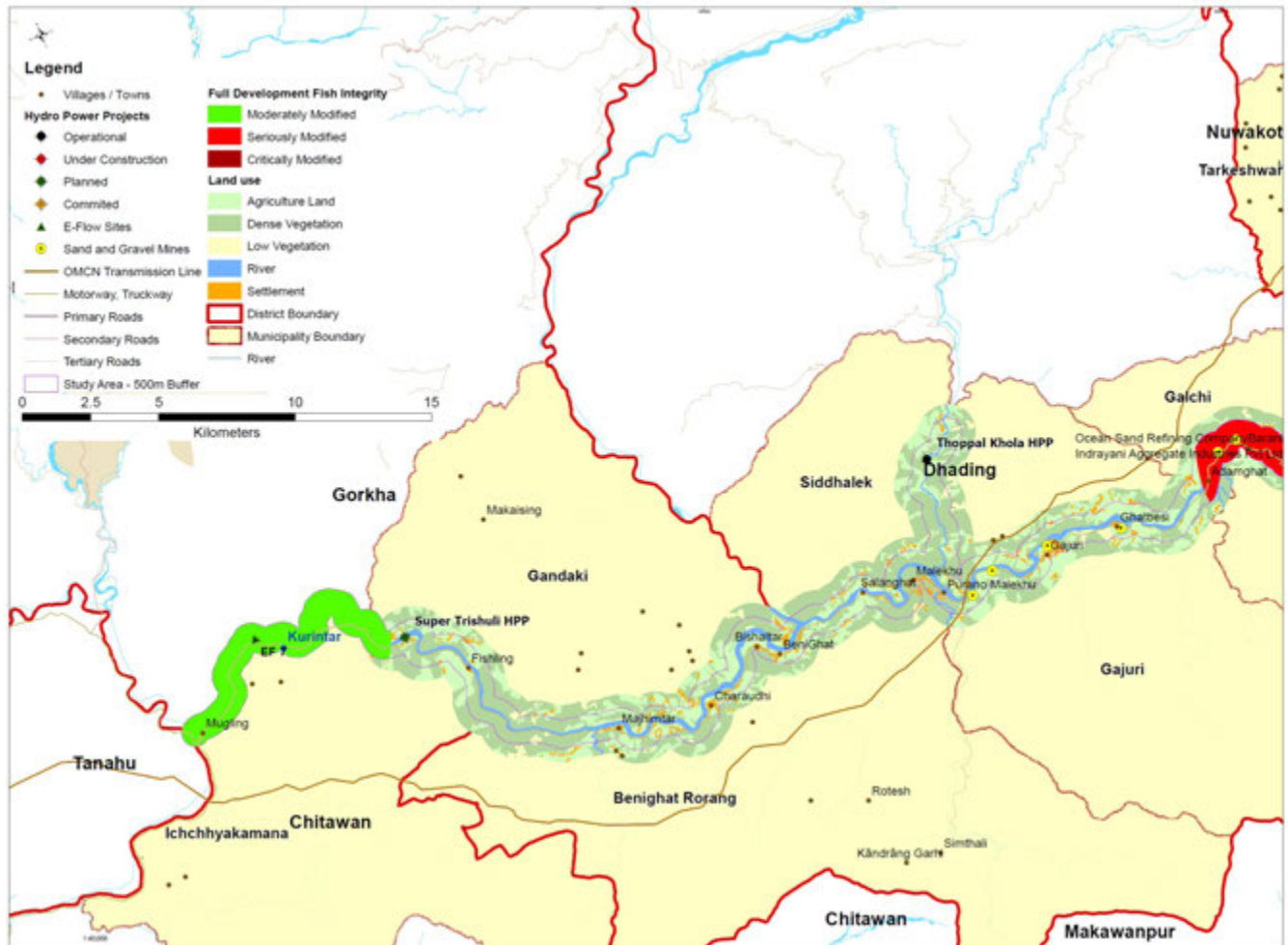
Other River-based Livelihoods

There will be an overall loss of productive riverine area in the midstream reach (and in select locations upstream) that cannot be replaced. Agricultural intensification schemes can be implemented to make upland areas more productive (through irrigation) so that the impact on overall productivity in the basin is mitigated.

Recommendations for Land-Procurement Strategy

Local municipalities and communities need to be made aware of the Land Acquisition, Resettlement and Rehabilitation Policy for Infrastructure Development Projects, 2015. Hydropower developers should agree to implement certain principles on compensation, consideration of existing economic vulnerabilities, and livelihood restoration.

Map 7.4 Livelihood Implications vis-à-vis Fish Integrity: Downstream



Source: OMCN = Office of Millennium Challenge Nepal

Cumulative Implications for Basin-Level Development

Project development of the 7 HPPs under construction and the other 23 projects under planning (mostly midstream and upstream of the basin) is likely to entail 7–10 years of intense construction activity. This timeline will also coincide with regional developments such as the OBOR linkage, increase in access-road construction, and gradual urbanization in the midstream.

During this timeline, the intensity of the following social impacts (see Table 7.10) are likely to amplify, at an overall basin-level, especially upstream in Rasuwa District:

- In-migration into the TRB
- Local economic and demographic changes
- Pressure on local resources linked to CFUGs, drinking water facilities, health infrastructure, and so forth
- Community health and safety impacts

Benefit-sharing mechanisms to be put in place by NEA and other hydropower developers may encourage an additional influx into the area; reportedly, entities deemed to be residing on land to be developed at the start of construction are eligible for purchase of equity shares.

While the mitigation of adverse impacts and the enhancement of beneficial impacts is to some extent covered by EMPs of HPPs, there is a need to demarcate zones of intense hydropower development upstream, midstream, and downstream.

Each of these zones can adopt a localized, cumulative-impact management framework involving hydropower developers, their contractors, and local municipalities in monitoring and addressing such cumulative concerns. The cumulative-impact management framework can adapt useful indicators from the Hydropower Sustainability ESG Gap Analysis Tool (IHA 2018).

Table 7.10 Basin-Level Intensity of Social Impacts

Theme	Impacts	Remarks on basin-level intensity	Challenges in mitigation and enhancement
In-migration	An influx of migrant workers and others seeking economic opportunity around construction areas will lead to in-migration and localized changes in the demographic profile.	While in-migration may entail adverse effects on health, encroachment into forests, social conflicts, and cultural values of indigenous communities; there is an opportunity of overall economic development due to the influx of additional capital, demand for local goods and services, opportunity for petty trade, and so forth.	<ul style="list-style-type: none"> • There is limited monitoring of village- and municipality-level of demographic and economic changes linked to temporary and/or short- to medium-term in-migration that may have already occurred in Rasuwa and Nuwakot Districts. • Further to decentralization, local governance units are yet to put in place any specific zonal plans on housing, waste management, business development, and social welfare that takes into account the effects of in-migration.
Community health and safety	<ul style="list-style-type: none"> • There is potential for an increase in vector-borne diseases, communicable diseases, and localized nuisance impacts due to dust, noise, and air emissions. • Further reduction in water quality and availability due to waste management practices, blasting, and tunneling activities will increase vulnerability of the local community. 	In view of the number of projects in Rasuwa District and in the upper reaches of the midstream section in Nuwakot, these areas are particularly vulnerable to adverse community health and safety impacts.	<ul style="list-style-type: none"> • There is a lack of community-health impact focused baseline data to monitor trends and outbreak of any diseases and/or conditions. • There is likewise a lack of expansion plans to improve health care access in and around specific areas that have cascading HPPs.

Continued on the next page.

Theme	Impacts	Remarks on basin-level intensity	Challenges in mitigation and enhancement
Employment generation	The coinciding timelines of the construction phase will entail labor requirement for unskilled and semiskilled categories of workers. Estimates suggest that the requirement for laborers within the 7–10 year construction period can range from 5,000–10,000. However, this employment is short term and nonpermanent in nature, as the operations phase of HPPs will not entail a retention of these numbers.	Even short-term employment generation will result in skill development (due to the specific nature of skills required for construction of HPPs) and an overall increase in the wage levels.	<ul style="list-style-type: none"> • There is a general lack of government and/or private institutions that can provide skill development training despite the increasing employability potential of the local communities. • The focus of project developers (and their contractors) on minimizing costs and a lack of effective regulation for hiring practices provide developers with economic disincentives to hire local employment or, when they do, pay more than standard local wages.
Local infrastructure	Cumulative regional development of hydropower and ancillary facilities is likely to bring about overall physical infrastructure development with respect to roads, telecommunication, and accessibility to remote areas and access to electricity.	As planning of local infrastructure is being done by municipalities, there is limited attention to holistic infrastructure, access, and linkage plans across the basin.	<ul style="list-style-type: none"> • Lack of transparency and inadequate monitoring at the government level is leading to misuse of allocated funds for infrastructure development, either from the provincial/ federal levels and/or through taxation of HPPs.