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Fish Sanctuary Delineation Protocol:

Riverscape Level Aquatic Biodiversity Conservation in Nepal

Resources Himalaya Foundation
and
Central Department of Environmental Science-TU

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Contributors

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Executive summary

Increasing human pressure on natural resources degrades freshwater habitats and ecosystems. It creates a huge threat in the plethora of aquatic flora and fauna: the environment of water habitats. Considering the threats to river ecosystems, aquatic biodiversity, and to strengthen human and ecological resilience of the communities, especially in Karnali, Mahakali, and Rapti River Basins, the USAID-funded Paani program has supported its ability to manage water resources as a good example to entire Nepal. Seventy nine watersheds were studied across these River Basins, to address the critical issues of freshwater biodiversity and climate change. The program had 12 priority watersheds to resilience out of those seventy-nine. The Paani program had engaged multiple stakeholders including academia, non-governmental organizations, community-based organizations, private institutions, media groups and individual experts to fill the knowledge gaps. It had demonstrated the conservation methods and other various tools to aware the ecological crisis of freshwater habitats. The program also helped the Community Aquatic Animal Conservation Groups (CAACGs) to strengthen the local capacity for river stretch management and local governments to formulate aquatic animal and aquatic biodiversity conservation acts.

This acts indoors sustainable river stretch management, establishing a fish sanctuary as an effective tool. This effort will conserve fish and other aquatic biodiversity by preserving aquatic ecosystems and also increases fish production in water bodies to support the local livelihood. It secures designated area, where targeted fish species will be protected and grow in their natural process as other aquatic habitats. The fish sanctuary delineation protocol is a tool to establish a fish sanctuary for riverscape level aquatic biodiversity conservation in Nepal.

Published and unpublished Paani program reports such as watershed health reports, profiles, briefers, projects, and research reports are the foundation of this protocol. Besides, the reports from the government and non-government sectors, various scientific papers were reviewed to publish this report. Expert teams were consulted with numerous stakeholders, representatives of government and local bodies, observing the maps and practices of CAACGs and aquatic animal and aquatic biodiversity conservation acts/bills of local governments.

The fish sanctuary delineation protocol encloses background information on Nepal's aquatic biodiversity conservation, the status of aquatic biodiversity, and existing institutional arrangements in conservation. Introduction of the fish sanctuary, benefits and pitfalls, the process for fish sanctuary declaration, fish sanctuary approval, and management/governance structure are explained briefly in the protocol. Nature (biodiversity value, topography, ecology, and land use), wealth (infrastructure and livelihoods), and power (local institutions, ethnicity, social inclusion, and governance) are the primary fish sanctuary delineating factors, which are also used by the Paani program for prioritizing the watersheds. This report is an entry point of the fish sanctuary establishments and a guideline for identifying the river stretches potential for fish sanctuary declaration in Nepal.

Acronyms

AABCA	Aquatic Animal and Aquatic Biodiversity Conservation Act
ADB	Asian Development Bank
BCN	Bird Conservation Nepal
BES	Brief Environmental Study
CAACG	Community Aquatic Animal Conservation Group
CBS	Central Bureau of Statistics
CFPCC	Central Fisheries Promotion and Conservation Centre
DNPWC	Department of National Parks and Wildlife Conservation
DoFD	Directorate of Fisheries Development
DoFSC	Department of Forests and Soil Conservation
DPR	Department of Plant Resources
GIS	Global Information System
GoN	Government of Nepal
ICIMOD	International Centre for Integrated Mountain Development
IEE	Initial Environment Examination
IUCN	International Union for Nature Conservation
MoEST	Ministry of Environment, Science and Technology
MoFE	Ministry of Forests and Environment
NARC	Nepal Agricultural Research Council
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-government Organization
NTNC	National Trust for Nature Conservation
NP	National Park
Paani	Program for Aquatic Natural Resources Improvement
REA	Rapid Environmental Assessment
WECS	Water and Energy Commission Secretariat
USAID	United States Agency for International Development

1. Background

1.1 Wetlands and aquatic biodiversity in Nepal

Wetlands encompass freshwater ecosystems including, lakes, ponds, reservoirs, rivers, streams, groundwater, and other water bodies. These water bodies occupy more than five percent of the total area of the country (DoFD, 2012). It is divided into two broad categories: natural (lakes and ponds, riverine floodplains, swamps and marshes) and man-made (water reservoirs, ponds and deep-water paddy fields) wetlands. National Wetland Policy (2003) defined wetland as rivers, lakes, reservoirs and forests, and waterlogged lands in and around human habitation. About 48% of the wetland is occupied by a running river system, which drains 395,000 ha of land in Nepal (Table 1). Nearly half of the wetlands (45%, standing water bodies) are in the high Himalaya due to the occurrence of a large number of glaciers and glacial lakes. The rest coverage of standing water bodies shares Tarai and Siwaliks (DoFD, 2012).

Table 1.Wetland types and their estimated areas in Nepal

SN	Wetland types	Estimated area(ha)	Percentage (%)
1	Irrigated paddy fields	398,000	48.58
2	Rivers	395,000	48.21
3	Marginal swamps	12,500	1.53
4	Ponds	7277	0.89
5	Lakes	5000	0.61
6	Reservoirs	1500	0.18
	Total	819,277	100

Source: DoFD, 2012

Aquatic biodiversity includes all unique species, their habitats and interaction between them. It consists of phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals, etc. In the wetlands, about 256 species of fish (Shrestha and Thapa, 2020), 1,001 species of phytoplankton (Prasad, 2013), 121 zooplankton (Surana et al., 2005), 192 mollusks (Budha, 2012), 117 amphibians (ICIMOD and MoEST, 2012), 200 birds and many flora and fauna are dependent (Grimmet et al., 2000 cited in Baral, 2009; IUCN, 2003). All these species are inter-dependent to each other maintaining the aquatic biodiversity. Prehistorically, human beings rely on aquatic resources for food, medicines and materials. Even the recreational and commercial purposes of

livelihood and business such as fishing and tourism are the ingredients of the aquatic world. Aquatic organisms also equally depend upon the great diversity of aquatic habitats in terms of sources for food, materials, and breeding grounds. Thus, it has both economic and aesthetic value and cultural value as well, so it is human responsibility to maintain the overall environmental health and eco-system.

Aquatic conservation was incepted when the aquatic animal protection act was enacted in the 1960s. The aquatic biodiversity and their habitat in Ramsar sites were then listed and conserved since the late 1980s (Table 2). Later, Aquatic Animal and Aquatic Biodiversity Conservation Act was enacted from 2018 to 2020 by 35 local governments (Gaunpalika and Nagarpalika) in Karnali, West Rapti, and West Seti River Basins. This act defines aquatic biodiversity as the number, variety, and variability of the living organism of a river, rivulet, lake, or wetland and their interrelationships and co-existence of its diversity; living creatures, vegetation, and micro-organisms including their genetic diversity, varietal species diversity, and the ecosystem diversity.

Table 2. Ramsar sites of Nepal

SN	Sites	Eco-zone	Prov	Alt(m)	Area (ha)	Designation date	Ratification date	Fish sp.
1	Koshi Tappu	Terai, Lowland	2	90	17500	1987	2003	105
2	Ghodaghodi Lake	Terai, Lowland	7	205	2563	2003	2003	23
3	Jagadishpuri Reservoir	Terai, Lowland	4	195	225	2003	2003	18
4	Beeshazari and Associated lakes	Terai, Lowland	3	285	3200	2003	2003	25
5	Rara Lake	Himalayas	6	2990	1583	2007	2007	3
6	Phosksunda and Associated Lakes	Himalayas	6	3610	494	2007	2007	
7	Gosaikunda and Associated Lakes	Himalayas	3	4700	1030	2007	2007	
8	Gokyo and Associated Lakes	Himalayas	3	5000	7770	2007	2007	
9	Maipokhari	Mid hills	1	2100	90	2008	2008	
10	Lake Cluster of Pokhara	Mid hills	4	827	26106	2016	2016	

Source: MoFE, 2018a, Bhuju et al., 2007, Shrestha, 2017, and FRC, 2009

Likewise, the history of wildlife conservation in Nepal began with the formulation of the National Park and Wildlife Conservation Act, and the establishment of Chitwan National Park in 1973. At present, protected areas cover 23.39 percent of Nepal's total area. The protected areas resemble 12 national parks, 1 wildlife reserve, 1 hunting reserve, 6 conservation areas and 13 buffer zones (Figure 1, Annex 1). Out of these protected areas, 10 protected areas (Chitwan NP, Shuklaphanta NP, Langtang NP, Rara NP, Bardia NP, Parsa NP, Sagarmatha NP and Shey-phoksundo NP, Koshi Tappu WR, and Annapurna CA) are conducting wetland management programs (DNPWC, 2019). However, the population growth and subsequent habitat destruction are exerting massive pressure on the habitat of flora and fauna in the protected areas. As a result, species are listed under threatened and critically endangered categories (table 3).

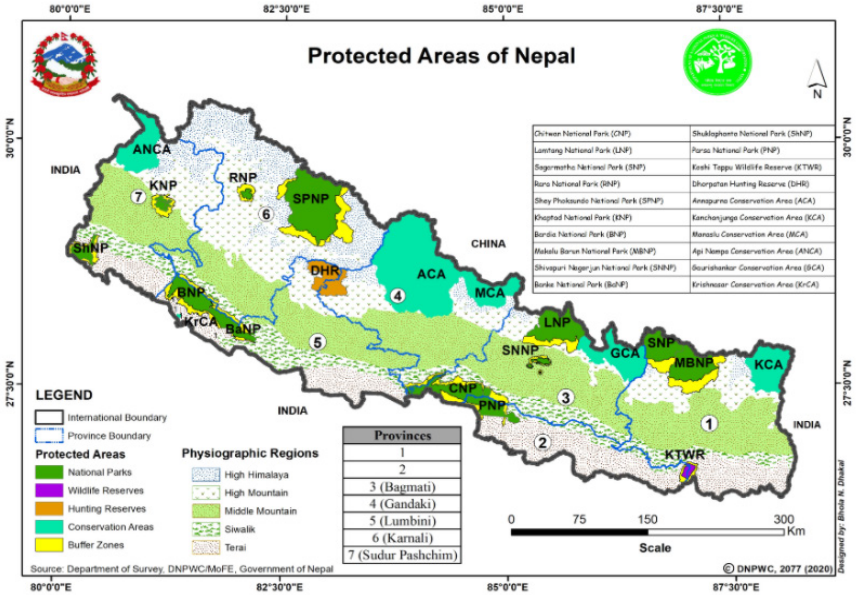

Figure 1: Map of protected areas of Nepal (Source: DNPWC)

Table 3. List of endangered flora and fauna in Nepal

Category	Plants	Mammals	Birds	Herpetofauna	Fish
Critically endangered	N/A	8	61	1	3
Endangered	2	26	38	3	1
Vulnerable	5	14	50	7	4
Near Threatened	2	7	N/A	4	13
Total	9	55	149	15	21

Source: ICIMOD and MoEST, 2007, Jnawali et al., 2011, BCN and DNPWC, 2011, Shah, 2013, and Shrestha and Thapa, 2020

After the establishment of protected areas, the conservation strategy has been remarkably successful in protecting terrestrial biodiversity. However, the aquatic biodiversity of Nepal is in shadow and paid less attention to conservation. Recently, aquatic biodiversity is in only few reservoirs and lakes, those listed in the Ramsar sites are conserved (Table 4). Although aquatic mammal species, like a dolphin (*Platanista gangetica*) being listed as protected wildlife species in schedule 1 of the National Parks and Wildlife Conservation Act, 2029 (1973), is given no specific attention for protection. Other species like Mahseer (*Tor puttitora*) are not even on the conservation priority list of Nepal, even though it is listed as 'critically endangered' on the IUCN Red List.

1.2 Methodology

The protocol was developed based on primary and secondary information. At the outset, aquatic biodiversity, water resource conservation, and management-related information was collected from authentic sources including the publications Government of Nepal, USAID Paani program, and reviewed the journal articles and research reports to understand the practices of a fish sanctuary in other places. After then, a workshop was held in Bajhang district. Field coordinators were involved in the collection of primary information in consultation with local leaders and communities at the local level. A series of consultations/meetings at local, provincial, and federal level stakeholders were conducted to collect information and validation of sanctuary delineation protocol. Finally, the protocol was also reviewed by the USAID Paani team.

1.3 Fish diversity and conservation status

The distribution of fishes in Nepal exhibits specificity for cold or warm waters. Such a pattern suggests specific adaptation and physiological preference of different species for dissolved oxygen, temperature, torrent, lentic and lotic habitats (Gurung, 2011). Indeed, Nepal is a natural laboratory to understand morphological and physiological variations in organisms in relation to altitudinal and temperature changes (Gurunget al., 2011).

The fish diversity of Nepalese water bodies comprises 230 species of freshwater fish (Rajbanshi, 2012). A review report compiled 256 species, including 16 exotic and 15 endemic fish in Nepal (Shrestha and Thapa, 2020). Among major watershed, Karnali River basin, Middle Karnali, Lower Karnali, Thuligaad, and West Seti, Mahakali, and Babai system provide habitat for 197, 68, 136, 44 and 13 species, respectively (USAID Paani, 2020). Similarly, the other three endemic species of *Schizothorax* are from Rara Lake, a Ramsar site of Mugu district. Twenty one fish species are listed in the threatened category of IUCN Red List; three are listed as critically endangered, one as endangered, four as vulnerable, and thirteen as near threatened (ADB, 2018) (table 4).

Table 4. Nepalesefish species in IUCN Red List

Scientific Name	Common name	Nepali name	IUCN Red List Status
Glyptothorax kashmirensis	Catfish	NA	Critically endangered
Schizothoraichthys nepalensis	Snow Trout	Tikhe Asla	Critically endangered
Schizothoraichthys raraensis	Rara Snow Trout	Asla	Critically endangered
Tor putitora	Golden Mahseer	Sahar	Endangered
Physoschistura elongata	Dwarf Loach	Suiree	Vulnerable
Puntius chelynoides	Dark Mahseer	Halundae	Vulnerable
Schistura prashadi	Creek Loach	Gadela	Vulnerable
Schizothorax ric hardsonii	Snow Trout	BuchheAsala	Vulnerable
Ailia coila	Gangetic Ailia	Patsi	Near threatened
Bagarius bagarius	Goonch	Gounch	Near threatened
Bagarius yarrelli	Goonch	Gounch	Near threatened

Balitora brucei	Gray's Stone Loach	Patthartata	Near threatened
Chitala chitala	Feather back	Chittal	Near threatened
Ctenops nobilis	Frail Gourami	NA	Near threatened
Garra rupicula	Sucker	Buduna	Near threatened
Labeo pangusia	Pangusia Labeo	Thed	Near threatened
Neolissochilus hexagonolepis	Copper Mahseer	Katle	Near threatened
Ompok bimaculatus	Butter Catfish	Nauni	Near threatened
Ompok pabda	Pabda Catfish	NA	Near threatened
Tor tor	Red-finned Mahseer	Ratar/Sahar	Near threatened
Wallago attu	Whiskered Catfish	Buhari	Near threatened

1.2.1 Factors shaping fish diversity

Freshwater fish are one of the most ignored faunas for conservation, which results in an alarming population decline in the past few decades in Nepal (Shrestha et al., 2009). Hydropower dams cease movement on seasonal migration and negatively impact fish and other species (Fette et al., 2006). The run of river schemes of hydropower production predominantly affects migratory as well as non-migratory fish species (Bilotta et al., 2016). More than 100 hydropower dams have been mounted, with around 100 in the pipeline, in different rivers and rivulets of Nepal (ADB, 2018) (Figure 2). The construction of dams for hydropower and irrigation, and other human activities, such as extraction of river aggregates (sand and gravel) from river beds, industrial and municipal waste discharge, destructive fishing practices, and over-exploitation of aquatic resources, etc., are affecting fish species in Nepal (ADB, 2018). In addition, the decline in fish production from Nepalese rivers is associated with poor knowledge, priority, investment, and deteriorating water quantity and quality (Shrestha, 2011). Some of the major challenges imposing threats to fish conservation are included in table 5.

Figure 2: Location of hydropower construction in the rivers/rivulets (Data source-Department of Survey, 2020)

Table 5. List of major anthropogenic and natural threats to native fish of Nepal

Factors	Effects		Overall rating
	Adverse	Positive	
(A) Anthropogenic (such as damming, change in eco physiological state)	Fish requiring migration, high transparency, high dissolved oxygen and flowing water may decline	Fish adaptable to low oxygen, low transparency and stagnant water may flourish	In general, native fish diversity should decline.
i. Eutrophication	Fish community shift, decline in fish requiring clean water.	Supportive to fish species adaptable to survive in eutrophic waters	In general fish diversity should decline with those thriving well in clean water
ii. Unconventional fishing	Fish diversity decline and lost		Should decline the overall aquatic diversity
iii. Introduction	May compete with native species, as a result there should be advantages to competent fish	May provide additional fish species for Cultivation	Depend on the type of the introduced fish. In general there should be competition with native Fish
(B) Natural i. Climate change	Several warm water fish perform better in deeper mountains due to increase in water temperature and eutrophication	Cold water fish zone may recede towards more higher altitude, and many of the earlier zone will be unsuitable for cultivation	In general, should negatively impact to native fish population due to drought and flood, warming up and Cooling

Source: Gurung, 2012

1.2.2 Responses on fish conservation

In Nepal, only a few government organizations, universities, and research institutions are focused on fish taxonomy and conservation studies. At present, Tribhuvan University introduces courses related to fish taxonomy, biological and socio-economic aspects of capture fishery. Kathmandu University also has a limited fish-related curriculum of environmental science subjects. Agriculture and Forestry University (AFU) has courses on natural water fisheries and aquaculture for basic to higher level degree, i.e. Bachelor to Ph D in fisheries science and aquaculture. Nepal Agricultural Research Council has been involved in promoting native fish conservation and the development of innovative and adaptive technologies (NARC, 2011). Some foreign universities and international agencies are also contributing to enhance knowledge of fish taxonomy and ecology (IUCN, 2004; Edds & Ng, 2007; Thompson, 2009). Similarly, Hydrolab has developed a four-credit course on fish passage design for Himalayan rivers, for TU (USAID Paani, 2020).

The recommended fish species for conservation are *Tor tor* as endangered, and Barbodes hexagonolepis (*Neolissochilus hexagonolepis*), Chaguni (*Chagunius chagunio*), *T. putitora*, *Danio rerio, Schizothorax plagiostomus*, Snow trout *(S. richardsonii*), Dinnawah snow trout (*Schizothoraichthy sprogastus*), *Psilorhynchoides pseudecheneis*, and Indian mottled eel (*Anguilla bengalensis bengalensis*) as vulnerable species. Though these species are under IUCN red list, they are not on the list of protected animals in Nepal. Although the fish population is declining and facing tremendous pressure from anthropogenic activities, there are no areas like a sanctuary for their conservation in Nepal.

2. Fish sanctuary

2.1 Introduction

The aquatic ecosystems are degrading and inland freshwater biodiversity is declining globally. Approximately, 1% of the earth's surface is occupied by freshwater habitat and hotspots of around 10% of the world's known species (Strayer and Dudgeon, 2010). Valuable ecosystem services provided in terms of economic, cultural, aesthetic, scientific and education (Dudgeon, 2006) are imbalanced due to the climate and human activities. Rising water temperature from climate change and anthropogenic activities such as water abstraction for hydropower and irrigation, habitat fragmentation and degradation, drainage, pollution, overfishing, sand and gravel mining are major threats to the inland fisheries and riverine ecosystems (Hijioka et al., 2014). To conserve marine biodiversity and ecosystems, protected areas including reserves, sanctuaries, parks, and no-go zone are established and managed around the globe. Similarly, river fish sanctuaries, community-based fish sanctuaries, etc., are initiated for improving fish biodiversity and fish production in inland freshwater bodies, under the co-management approach (Mustafa et al., 2017) in south Asia, including Bangladesh, India, Pakistan.

The fish sanctuary is a risk-free shelter for fish, established to protect a particular area in the water body as a permanent shelter of fish for natural propagation. In another word, a fish sanctuary is a demarcated protected area where conservation targeted fish will not be disturbed. The establishment of an aquatic sanctuary is one of the effective tools for conserving fish stock, preserving biodiversity and increasing fish production (Abu Naser, 2010). Fish congregate in the sanctuaries for shelter, lead a peaceful life without any disturbance, and can move independently towards the feeding and breeding grounds. The impact of fish sanctuaries has been reported positive in almost all cases, including fish production, biodiversity and socio-economic condition of the fishing community. No adverse impact on the environment has been found or reported by establishing a fish sanctuary. Moreover, as a part and form of fisheries management, sanctuaries are relatively easy management tools for user communities to implement and adopt. Koshi Tappu Wildlife Reserve is an example of an inland water protected area in Nepal. The reserve is protecting aquatic birds and water buffalo along with the floodplain areas. So far, there is no specific aquatic biodiversity conservation park or fish sanctuary designated in Nepal. The fish sanctuary will not only protect the aquatic biodiversity but also contribute to conserving the precise freshwater

ecosystem which definitely props up the lives of the people in and around the protected river (upstream and downstream) and their livelihood.

Delineation of fish sanctuary areas, conservation, and management, sharing of benefits from water resources, power-sharing between management committee and resources users, coordination among diverse stakeholders, etc., are the key socio-economic challenges. The direct benefit from the fish sanctuary is the prime interest of the local community to fulfill their demand.

The establishment of a fish sanctuary is crucial for the conservation of freshwater biodiversity in the aquatic biodiversity hotspots. This will drastically contribute to the conservation and management of the freshwater ecosystems, and provide an opportunity to promote eco-tourism to support the local livelihood. Also, the fish sanctuary will contribute to increase fish production, provide breeding and feeding ground that helps to increase fish population, enhance fish diversity and also meet the demand for fish seed and nutritional benefits.

The key benefits of fish sanctuary are to:

- Contribute to raising fish production
- Preserve the fish from genetic pollution
- Protect breeding and nursery ground (produce brood fish and enhance fish diversity)
- Restore as well as conserve river habitats
- Increase the number of threatened fish species
- Fulfill the demand of fish seed in regenerating population to maintain stock in and around the sanctuary
- Improve the livelihood of local communities and promote eco-tourism
- Protect many other aquatic fauna and flora, enhance aquatic biodiversity and
- Improve fish productivity in and around the sanctuary

2.2 Fish sanctuary delineation process

2.2.1 Feasibility study and potential sites identification

The identification of the fish sanctuary area needs a credible science-based information system for decision-making. A credible database needs to be formulated for each proposed potential aquatic fish sanctuary, which includes spatial information of the area such as available aquatic flora and fauna;

settlements around the area; both positive and negative socio-economic and environmental impacts, and influence to the people and community; tourism potential; available legal framework supporting the local municipalities and federal ministries for declaring fish sanctuary. A well-illustrated GIS map is a good tool to visualize the attributes of potential conservation areas, which will help the local leaders and community in understanding the situation. Identification of major issues and the status of fishery management in the proposed area are essential. This database will be effective to receive support from the existing federal, provincial and local level legal framework relating to the delineation of the fish sanctuary.

Based on the above mentioned credible database, the analysis of the feasibility of the proposed site should be carried out the basis on:

1. **Biophysical**: Fisher communities, present catch status (species-wise and total) of the proposed river along with monthly fluctuation, the gear used, number of boats, number of fishermen involved in active fishing, and the daily duration of fishing for each fisherman. Similarly, the water quality parameters, monthly fluctuation of water depth, flow, and velocity are also key factors determining biophysical feasibility.
2. **Technical**: Technical feasibility assures the area, method, and manpower, which will provide feasibility for the fish sanctuary.
3. **Legal**: It assesses whether the proposed fish sanctuary conflicts with legal requirements.
4. **Socio-economy**: Conservation activities should be planned considering the socio-economic conditions, fishing in the peripheral area, fish consumption pattern, species-wise fish selling price and month-wise price fluctuation, and perceptions and attitudes of people within the watershed.
5. **Others**: Time, operational, and resources should also be considered.

Furthermore, along with the feasibility assessment, resource and cost appraisal should be carried out to decide on the declaration of the sanctuary. The information will provide basic information for preparing operational and management plans.

2.2.2. Identification of issues and threats

Potential issues and threats to biodiversity, in the watershed, can be assessed through secondary data from the literature as well as primary data through direct field observations. Focus group discussion, key informant interviews, questionnaire survey, walkthrough, etc., are the possible tools to collect

information on issues and threats caused by human activities, and climatic and non-climatic events.

2.2.3 Demarcation of potential watershed area and fish sanctuary

Potential watersheds and associated areas for fish sanctuary should be delineated, based on keystone fish species and their potential sites/hotspots, including the biophysical environment in consultation with relevant stakeholders including local, provincial, and federal level government institutions and non-government organizations. Furthermore, for a gap analysis, existing policies and legislation related to wildlife conservation, protected area management, and the IUCN category of the protected area should be reviewed. Similarly, it can consider the guideline relating to the protected area management category (Dudley, 2008), GAP analysis (Jennings, 2000), and endangered or vulnerable species (IUCN red list). These protocols envision a "Fish sanctuary" that falls under protected area category VI as a conservation area.

Following factors should be considered during site selection:

- Include the deepest part of the river, a relatively low water current place, where fishes use as spawning and foraging ground.
- The place should have less probability of siltation.
- The transportation road along the riverbank should be avoided.
- River stretch should fall under boundary where the local government has enacted AABC acts to ensure fishing is allowed following regulatory provisions.
- River stretch should have pool and littoral areas that provide good habitat for breeding and rearing.
- The river reaches should have a sufficient amount of boulders and grassland closer to the water bodies.
- Socio-economically acceptable at a local level
- The length of river stretch (average >5 km) and core area around 20 ha, for a fish sanctuary should be manageable by user groups.

2.2.4 Statutory framework

The Government of Nepal has timely supported the formulation of required policy and legal instruments to enable the DNPWC for the successful establishment and operation of a network of the protected areas in the country. As per the Constitution of Nepal, water resource management is the concurrent power of the federal, provincial, and local levels. There are several

acts, policies, and regulations related to the environment and water resources (table 6, detail in annex 2). However, federal acts and regulations guide the local acts and regulations. For instance, as per the Environment Protection Regulation (2020), schedule-2 (related to rule-3), clause ka (5)- the proposal should conduct Initial Environmental Examination (IEE) to establish or extend national park, wildlife reserve, buffer zone, protected forest area, conservation area or environmental conservation area (GoN/MoFE 2020, pp 73). The fish sanctuary will fall under conservation area or environmental conservation area. If the size of the fish sanctuary is less than 20 ha and considered as a zoological garden, then it should do a brief environmental study (BES) (as schedule-1, ka (3) of GoN/MoFE, 2020, pp 69). However, the recently formulated water resource (management and regulation) bill 2020 is integrating water-related legal frameworks with envisioning water and energy commission. The commission has the power to implement water-related management and conservation.

Table 6. Legal frameworks related to aquatic biodiversity in Nepal

SN	The Constitution of Nepal (2015)
1	National Water Resource Policy 2077 (2020)
2	Science, Technology and Innovation Policy 2019
3	Irrigation Policy 2013
4	National Wetlands Policy 2012
5	Industrial Policy 2011
6	Tourism Policy 2009
7	National Agricultural Policy 2004
8	Nature Conservation: National Strategic Framework for Sustainable Development 2015
9	National Ramsar Strategy and Action Plan, Nepal (2018-2024)
10	Nepal National Biodiversity Strategy and Action Plan (2014-2020)
11	Water Resource Strategy 2002
12	Water Resources Act 1992
13	Water Resource (Management and Regulation) Bill, 2020
14	Environmental Protection Act 2019
15	Local Government Operation Act 2074 (2016)
16	National Parks and Wildlife Conservation Act 1973
17	Aquatic Animal Protection Act 1960
18	Environmental Protection Regulation 2020
19	Water Resource Regulation 1993

20	Conservation Area Management Rules 1996
21	Aquatic Animal and Aquatic Biodiversity Conservation Act of Local Government 2018
22	International Treaties and Commitments of Nepal Government

The Government's policy towards establishing the ex-situ conservation of wildlife to promote wildlife conservation education and entertainment (such as Zoological Garden) in every province (at least one such project in every province) has facilitated the initiation of the feasibility level study of the alternatives for Zoological Garden. With the recent amendment of the National Park and Wildlife Conservation Act 2029 done in 2073, the institutions and local governments initiated to operate Zoological Garden at a local level. This amendment has allowed the Nepal government to establish the Zoological Gardens.

National and international targets for declaring fish sanctuary

National Biodiversity Strategy and Action Plan (NBSAP) 2014-2020 is a key milestone in the conservation history of Nepal, following the Biodiversity Profiles of Nepal (1996) and Nepal Biodiversity Strategy (2002), expressing to safeguard the wetland resources including biodiversity and habitats. The NBSAP identified one of the actions that "declaration and management of at least three suitable wetlands as fish sanctuaries, by 2017 (GoN/MoFSC, 2014). Following the declarations, DNPWC called for a feasibility study of zoological gardens including wetlands in 2020 but it was canceled due to COVID-19 pandemic. Since the government is working closely with international organizations fulfilling several targets, it has to meet international targets such as the Aichi target (2011-2020), Sustainable Development Goals (2015-2030). Besides, the government has already endorsed the National Wetland Policy (2012) involving the local people in the management of Nepal's wetlands and conserving wetlands biodiversity. However, it has not well documented the declaring fish sanctuaries for conserving keystone fish species towards meeting the targeted national and international goals.

2.2.5 Detail proposal development

A fish sanctuary declaration proposal should develop by implementing organization such as river stretch user groups with the technical support of experts based on information of feasibility assessment. The proposal includes background, the rationale of the fish sanctuary with objectives, methodology, or the process of delineating the proposed fish sanctuary. Furthermore, the

site-specific existing geophysical, socio-economic, cultural, chemical, biological information, basics of determination of conservation status, threats to biological resources, conservation measures, legal and institutional framework, monitoring and evaluation framework, etc., should be included in the proposal (annex 6, format).

2.3 Fish sanctuary approval process

The size and area covered by the fish sanctuary will vary depending on the geophysical, social, and environmental parameters of the proposed location/site. If a Fish Sanctuary needs to be delineated in a river that runs between two or more provinces, then the power should be with the Federal Government. If the river is a state river then the power should be with the province. Similarly, if a river is shared by more than two local government units then again the province should have the power to declare fish sanctuary. Finally, the river stretch that runs or lies in one local government's area, or jurisdiction, the respective local government should have the power to declare and manage fish sanctuary inside its area, or jurisdiction. Similarly, where a river is a border between two local governments, the concerned local governments should have the power to jointly delineate and manage the fish sanctuary. This would be the best approach and is in line with the Constitution of Nepal and few other laws that are in draft form and yet to be enacted.

The protocol highlights the approval process at the local level only. With the support of an expert team, river stretch conservation user groups like Community Aquatic Animal Conservation Groups (CAACGs) will present the prepared proposal with relevant stakeholders at the local level. The role of local government is organizing presentation at municipality and making coordination among federal and provincial level stakeholders. Local conservation groups/communities are usually deprived of necessary resources and linkage establishment with provincial and federal level stakeholders. The representative of local agencies of concerned Provincial ministries especially the Ministry of Industry, Tourism, Forests & Environment, Ministry of Infrastructure Development, Ministry of Land Management, Agriculture & Cooperative, Ministry of Internal Affairs and Law, and the relevant local municipalities should be invited during the presentation. However, more importantly, the local government should closely coordinate with the concerned sub-national/local line agencies of Federal ministries such as the Ministry of Forests & Environment, Ministry of Energy, Water Resources and

Irrigation, Ministry of Agriculture & Livestock Development, etc.

Furthermore, 35 local governments in Karnali, West Seti, and West Rapti River Basins have already enacted the Aquatic Animal and Aquatic Biodiversity Conservation Act developed with Paani Program's technical support. These local governments have already practiced the management and conservation approaches of river stretch in partnership and coordination with user groups such as Community Aquatic Animal Conservation Groups, inhabiting the river stretch. If the local governments and the user groups have already identified the potential sites, and detailed information of these sites, systematic documentation of feasibility study with gap analysis and potential sites identification, detailed proposal development, , including comments from different stakeholders should be done for declaring the fish sanctuary area (Figure 3).

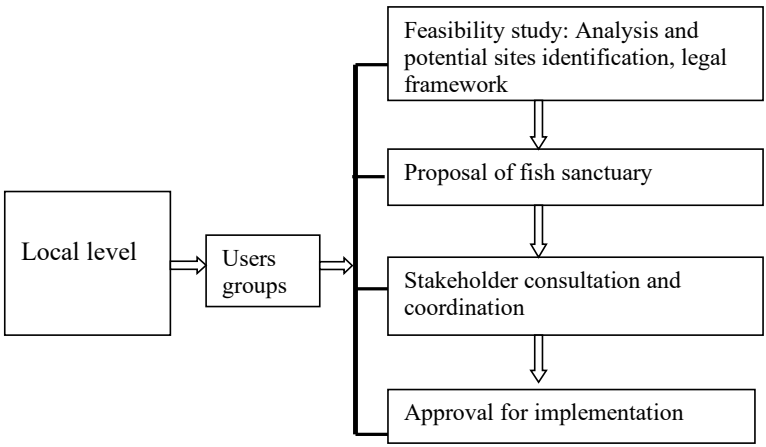

Figure 3: Fish sanctuary approval process

2.4 Fish sanctuary management

The approach and modality of management will be different based on the status of keystone fish species, size/area and objective of the fish sanctuary, and involvement of government and other stakeholders. There will be National Park/Wildlife Reserve management model as strict conservation or conservation areas/community participatory model as a wise use of common fish species and protection of engendered and other keystone species will be another model. The protocol adopts an adaptive management approach with

participating different stakeholders particularly local CBOs where there is flexibility in implementation and course-correction options after learning and feedback (O'Donnel, 2016). The adaptive management includes the enabling environment by creating an institutional framework, knowledge generation, decision-making process; providing resources, developing the culture of networks and relationships; collaborating, learning, and adapting (PPL, 2019).

Depending upon the level of government, the roles and responsibilities will also differ in management. The federal-level government bodies will formulate national-level laws and legal instruments. Ministry of Forests and Environment (MOFE) will create enabling situations by formulating policies and legal framework and allocate resources to its line agencies to manage and conserve wetlands. Similarly, the Ministry of Energy, Water Resources and Irrigation, Ministry of Agriculture & Livestock Development, Ministry of Federal Affairs and General Administration, Water and Energy Commission Secretariat (WECS), and Central Fisheries Promotion and Conservation Centre (CFPCC) are other federal institutions related to water resources.

Provincial-level ministries and their line agencies will formulate state-level laws and legal instruments and provide resources and guidance to the local governments. Particularly, the Ministry of Industry, Tourism, Forests and Environment is the key ministry at the provincial level to support water, forest, and environment-related activities. Besides it, the local government has the power and authority to formulate local laws, regulations, and other legal instruments to manage and conserve water resources. The local bodies will coordinate with different governments, non-government, communities, and other stakeholders. Universities and research institutions, development partners, private sectors, and Community Aquatic Animal Conservation Groups that are working related to water resources will contribute to fish and aquatic biodiversity conservation, restoration of habitats, and wise use of resources (Table 7).

Table 7. Actors and their main roles in the implementation

Actors	**Key Stakeholder**	**Major roles**
Federal government	Ministry of Forest and Environment	Laws, legal instruments, policy, guideline, resource, facilitation, and advice for program implementation

Provincial government	Ministry of Industry, Tourism, Forests & Environment	Laws, legal instruments, guidelines, resource; Steering program implementation and facilitation within a state; coordination and monitoring of program implementation
Local government	Environment sector/ Environmental Inspector	Local laws, implementing legal instruments, coordination, partnership development, financial support, creating enabling policy, joint planning, management, and monitoring
Development Partners	Working in conservation and development	Financial assistance, advisory, capacity building, and knowledge dissemination
Academic Institutions	University, Campuses	Research, knowledge generation, and technology development
Private Sectors	Water resources related	Collaboration, support for the fund, entrepreneurship development
Organizations and local NGOs	Conservation related	Implementation, partnership, resource leverage and advocacy, awareness for conservation and capacity building
Community	Water resource-dependent	Implement conservation program, adapt resources sustainable practices, feedback

Source: MoFE,2018a, USAID Paani, 2020

The local government has the main role to conserve and manage the water resources in close coordination with forming a management committee as per their local acts and regulations, within the federal and provincial legal frameworks. Local water user groups, community-based organizations, such as Community Aquatic Animal Conservation Groups, and representatives of the private sector will be the member of the management committee. Academic and research institutions will support generating knowledge and share lessons learned to government and communities that will support policy formulation and assist for adaptive management. Development partners will provide technical and financial support to government and CBOs where water user groups and community people will involve in management, capacity building, and awareness activities. Finally, the federal and provincial governments will formulate laws, policies, and other legal instruments by providing resources through local government as creating the enabling environment (Figure 4).

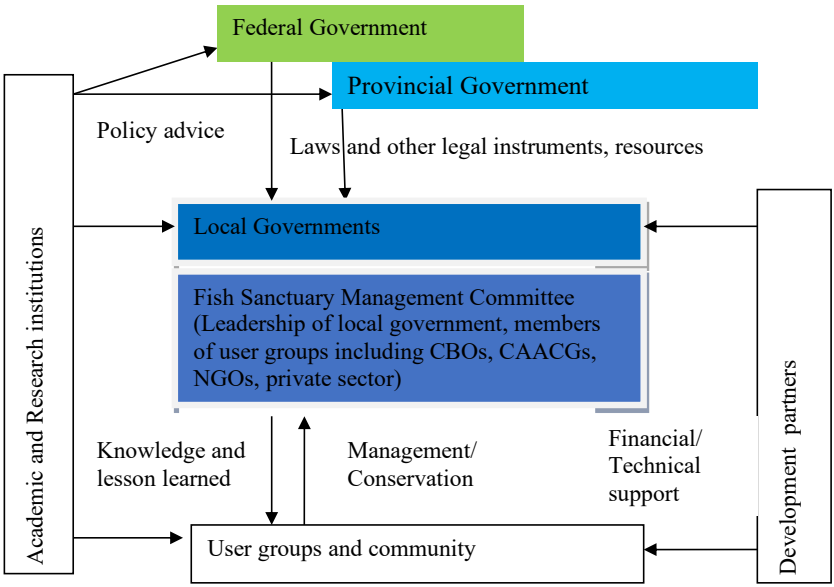

Figure 4: Framework for fish sanctuary management at Local Level
Source: Based on USAID Paani, 2020

3. Conclusions

In the wake of impending impacts of climate change and human activities on native fish species, the establishment of a fish sanctuary is an excellent example of nature-based solutions for keystone fish species conservation and river ecosystem restoration. The proposed protocol is developed to initiate the fish sanctuary in Nepal. It is prepared in consultation with relevant stakeholders at local, provincial, and federal levels as well as experts. The protocol guides how to select the fish sanctuary sites and possible steps of sanctuary delineation and management approach at the local level. The establishment of a fish sanctuary is not only providing a safe place for native and keystone fish species but also contributes to whole aquatic biodiversity conservation and enhances the capacity of local communities who are depending on water resources for their livelihood. The local government can initiate a small-scale river stretch conservation and management as the concept of the fish sanctuary, however; the federal and provincial government should play a crucial role to establish the fish sanctuaries in Nepal.

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Annexes

Annex 1: Categories of Protected Area of Nepal

S.N	Protected Areas	Gazetted	Area (km^2)	Physiographic region
1	Chitwan National Park (CNP)	1973	932	Inner Terai (Low-lands)
2	Sagarmatha National Park (World Heritage Site, 1979) (SNP)	1976	1148	High Himal
3	Langtang National Park (LNP)	1976	1710	Mountain to high Himal
4	Rara National Park (RNP)	1976	106	High Mountain
5	Khaptad National Park (KNP)	1984	225	High Mountain
6	Bardia National Park (BNP)	1984	968	Terai to Inner Terai
7	Shey Phoksundo National Park (SPNP)	1984	3555	High Mountain
8	Makalu Barun National Park (MBNP)	1991	1500	High Mountain to High Himal
9	Shivapuri –Nagarjun National Park (SNNP)	2002	159 (144)	Middle Mountain
10	Banke National Park (BaNP)	2010	550	Terai to Inner Terai
11	Shuklaphanta National Park (ShNPR)	2016	305	Terai (lowland)
12	Parsa Wildlife Reserve (PWR) now PNP	2017	627.39	Terai to Inner Terai
	Subtotal		11785.39	
	Wildlife Reserve			
1	Koshi Tappu Wildlife Reserve (KTWR)	1976	175	Terai (Lowland)

Mammal species symbolic of the park	Fish and aquatic animals	IUCN management category
One-horned rhinoceros (*Rhinoceros unicornis),* Royal Bengal tiger (*Panthera tigris tigris), and Asiatic elephant (Elephas maximus)*	124 fish sp., gharial, migratory water birds, crocodile	NP II & Buffer zone VI
Snow leopard (*Unci auncia*), Musk deer (*Moschus chrysogaster*), and Red Panda (*Ailurus fulgens)*	1 fish sp.	NP II & Buffer zone VI
Snow leopard (*Uncia uncia*), Clouded leopard *(Pardofelis nebulosa*), Musk deer (*Moschus chrysogaster*), and Red panda (*Ailurus fulgens*)	2 fish sp.	NP II & Buffer zone VI
Snow leopard (*Uncia uncial*), musk deer (*Moschus chrysogaster*) and Red panda (*Ailurus fulgens*)	3 fish sp.	NP II & Buffer zone VI
The common leopard (*Panthera pardus*), Himalayan black bear (*Selenarctos thibetanus*), wild dog (*Cuon alpinus*), and musk deer (*Moschus chrysogaster*)		NP II & Buffer zone VI
The Royal Bengal tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*) and Black buck (*Antelope cervicapra*)	124 fish sp, dolphin, mugger, gharial	NP II & Buffer zone VI
Snow leopard (*Uncia uncial*), Blue sheep (*Pseudois schaeferi*), Musk deer (*Moschus chrysogaster*), wild dog(*Lycaon pictus*), and Tibetan wolf (*Canis lupus*)		NP II & Buffer zone VI
Snow leopard (*Uncia uncia*), Musk deer (*Moschu schrysogaster*), and Himalayan black bear (*Ursus thibetarus)*	13 fish sp.	NP II & Buffer zone VI
Common Leopard (*Panthera pardus*), Wild boar, (*Sus scrofa*) and Himalayan black bear (*Ursus thibetanus*)		NP II
Bengal tiger (*Panthera tigris*), Asiatic elephant (*Elephas maximus*)		NP II
Swamp deer *(Cervus duvaucelli)*, Bengal tiger (*Panthera tigris*), Asiatic elephant (*Elephas maximus*), and Hispid hare (*Caprolagus hispidus*)	28 fish sp.	NR II & Buffer zone VI
Royal Bengal Tiger (*Panthera tigris*), Gaur (*Bos gaurus*), wild elephant (*Elephus maximus*), and Hyena (*Hyaena hyaena*)	8 fish sp.	National Park-II & Buffer zone VI
Wild water-buffalo *(Bubalus arnee*) and the Gangetic dolphin (*Platanista gangetica)*	105 fish sp., water fowl and other migratory birds	Wildlife Reserve IV & Buffer zone VI

	Subtotal		175	
	Hunting Reserve			
1	Dhorpatan Hunting Reserve (DPR)	1987	1325	High Mountain
	Sub total		1325	
	Conservation Area			
1	Annapurna Conservation Area (ACA)	1992	7629	High Mountain to High Himalaya
2	Manaslu Conservation Area (MCA)	1998	1663	High Mountain to High Himalaya
3	Kangchenjunga Conservation Area (KCA)	1997	2035	High Mountain to High Himalaya
4	Gauri Shankar Conservation Area (GCA)	2010	2179	Mountain to High Himalaya
5	Api Nampa Conservation Area(ANCA)	2010	1903	High Mountain to High Himalaya
6	Krishnasar Conservation Area (KCA)	2009	16.95	Terai (lowland)

Source: Bhuju et al., 2007; and Acharya & Dhakal, 2012; DNPWC, 2020

Blue sheep (*Pseudois nayaur*), snow leopard, and musk deer (*Moschuschryso gaster*)		Hunting reserve VIII (Multiple Use management
Snow leopard, Musk deer, Tibetan argali, and Tibetan wolf		Conservation VI
Snow leopard *(Panthera uncia, Uncia uncia*), Musk deer (*Moschus chrysogaster*), Himalayan Tahr (*Hemitragus jemalhicus*), and ground squirrel (family Sciuridae)		Conservation VI
Snow leopard, musk deer and Red panda (*Ailurus fulgens*)		Conservation VI

Annex2: Legal provisions for conservation/protected area declaration

Legislation frameworks	Provisions
The Constitution of Nepal (2072)	Schedule 7: Concurrent power at the federal and provincial level SN 19: National forest, water use, and environment management within province premises Schedule 8: List of power in local level SN 10: Local market management, environment conservation, and Biodiversity SN 21: Watershed, wildlife, mines, and minerals conservation Schedule 9: Concurrent powers in federal, provincial, and local level SN 7: Forest, wildlife, birds, water use, environment, ecosystem and biodiversity
National Water Resource Policy-2077 (2020)	The policy highlights water resource area conservation, development, management and regulation with research and proofs by coordinating three tiers of governments
Science, Technology and Innovation Policy 2019	The policy highlights the maximization of STI use in sustainable use of natural resources, environmental balance and disaster risk reduction. • It encourages research-oriented education, modernization of traditional knowledge and technology and skilled human resources.
Irrigation Policy 2013	The policy promotes the implementation of strategy relating to the management of climate risks, and mitigation and adaptation to the effects of climate change. • It highlights the construction of irrigation projects and/or systems in a manner that minimizes negative environmental effects. • It commits to using only the portion of water for irrigation from any river after releasing minimum water in the river to sustain aquatic biodiversity.

National Wetlands Policy 2012	The policy envisions healthy wetlands for sustainable development and environmental balance and aims at conserving and managing wetlands resources sustainably and wisely. • It emphasizes (i) identifying and prioritizing wetlands on the basis of ecological, social, and economic importance and the conservation, rehabilitation, and management of such areas; (ii) identifying, respecting, and utilizing traditional knowledge and skills of wetland dependent communities; (iii) making provisions for equitable distribution of the benefits arising from the utilization of wetland-based resources; and (iv) promoting good governance. • It provides working policies for the conservation, restoration, and effective management of wetland areas; wise use of wetlands; and promotion of good governance in the management of the wetlands.
Industrial Policy 2011	The policy emphasizes special measures to be taken to promote green industries and make established industries pollution-free with zero carbon emissions. • It provides a basis for the deduction of capital expenses from the technology and installation of pollution-control systems, which have less impact on the environment.
Tourism Policy 2009	The objectives are to develop Nepal as a major tourism destination by conserving, promoting, and developing tangible and intangible natural, cultural, and biological heritages. • The policy emphasizes formulation and implementation of separate environmental protection and solid waste management guidelines for sustainable management and cleanliness to promote tourism.

National Agricultural Policy 2004	Its objectives include the conservation, promotion, and proper utilization of natural resources, environment, and biodiversity. • It encourages in situ conservation and provides a basis for the establishment of gene banks and participatory biodiversity parks.
Nature Conservation: National Strategic framework for sustainable development 2015	The strategic framework is with extensive analysis of nature conservation, issues, and expected results and risks of achievement of existing sectoral plans and strategies. It highlights how to integrate nature conservation into development efforts and then formulates the nature conservation national strategic framework where biodiversity and ecosystem are on the components.
National Ramsar Strategy and Action Plan, Nepal (2018-2024)	The strategy highlights the importance of wetlands for species diversity and ecosystem services, integrated water resources management, payment for ecosystem services, threats and issues of wetlands. One of the strategic and objective is to manage the wetlands at the footprint of wisely use principle.
Nepal National Biodiversity Strategy and Action Plan (2014-2020)	The plan aims at the conservation of biodiversity for sound and resilient ecosystems and national propriety. • The specific strategies and actions are grouped into six biodiversity themes and 15 crosscutting subjects. • It aims to reduce the rate of loss and degradation of forest habitats, improve biological connectivity, and enhance knowledge and understanding about the conservation of species. • The strategies for wetland biodiversity focus on effective conservation and sustainable utilization of wetlands resources. It states the need to address the legislative gaps and administrative ambiguities

Water Resource Strategy 2002	The strategy calls for the sustainable management of watersheds and aquatic ecosystems.
Water Resource (Management and Regulation) Bill, 2020 (approval process)	The bill integrates all water-related act and regulations for management and regulation and provides guidance for determining beneficial uses of water resources, preventing environmental and other hazardous effects, and keeping water resources free from pollution. • The bill also envisions the water resources conservation by Government of Nepal and to make the clear right and responsibilities of three government in conservation and management
Environmental Protection Act 2019	EPA 2019, Chapter-2, Section 3. Environmental study report to be prepared and Chapter-5, section 30. Special provision related to environment protection areas, subsection 2. In making any road, building, river management or other physical infrastructures, the Government of Nepal may, in coordination with the concerned body and by a notification in the Nepal Gazette, specify any specific area as an open or green area with a view to protecting the environment of such area.

Local Government Operation Act, 2074 (2016)	Section 11: Duties, responsibilities and power in municipalities Subsection 2: Clause (j): Formulation and implementation of policy, law and standards and plans related to local biodiversity and environmental conservation. Clause (U): Formulation of Local policy, law, Guideline, plan implementation and monitoring related to watershed, wildlife, mines and minerals. Sub section 3: Should Follow The constitution of Nepal, 2072, Article 9 Sub section 4: Municipality can authorized the following work under state or province without affecting sub section 3: Clause (e): Formulation of Local policy, law, guideline, plan implementation, monitoring and regulation related to forest, birds, wildlife, water use, ecosystem, environment and biodiversity. Clause E (19): Inventory of Biodiversity. Clause E (22): Indigenous species conservation and promotion Sub section 5: As per requires, municipalities can formulate law, policy, plan, guideline and directives.
National Parks and Wildlife Conservation Act, 2029 (1973), fourth amendment 2050/2/27	Article 3: Section 1: Government of Nepal may, if it deems necessary, declare an area as national park or reserve or conservation area by publishing a notice in the Nepal Gazette and indicating the boundary thereof.

Aquatic Animal Protection Act,1960	The legislation indicates an early recognition of the values of wetlands and aquatic animals. Introduced poisonous, noxious, or explosive materials; and/or electric current in a water resource with intent of catching or killing aquatic life is prohibited and punishable. The act made it mandatory for authorities constructing a dam for electricity, drinking water, irrigation, or other purposes to construct a fish ladder or fish hatchery and nursery in the nearby area for breeding and rearing of fish to release in the river. The act empowers the government to prohibit catching, killing, and harming certain kinds of aquatic animals through notification in the Nepal Gazette.
Environment Protection Regulation 2020 (2077)	EPR-2020, Chapter-2, Rule 3- To be done environmental study, Schedule-2- Initial Environmental Examination Forest area, section 5. National park, wildlife reserve, buffer zone, forest protected area, conservation area or environment protection area establishment or extension, and section 7. Management plan preparation of National parks, wildlife reserve, hunting reserve, wetland, or protected watershed areas.
Water Resource Regulation, 1993	The regulation makes it mandatory to take appropriate measures to minimize the adverse effects of water resource development projects on the overall environment. • Measures must be taken for the conservation of aquatic life and water quality

Conservation Area Management Rules, 1996	Chapter 2: Section 3: The boundary of a Conservation Area shall be as determined by the Government of Nepal, by publishing a notice in Nepal Gazette Chapter 3: Section 8: Conservation area management committee should be in each local unit within conservation area for the effective implementation of the construction works related to the community development activities in the Conservation Area
Aquatic Animal and Aquatic Biodiversity Conservation Act of Palika 2018	As per the rights and responsibility of section 226 of the Constitution of Nepal and provision of section 102 of Local Government Operation Acts 2074 (2016), Gaunpalika and Nagarpalika formulated the AABCA in Mahakali, Karnali and Rapti river basins (eg. AABCA of Talkot, Bajhang). It emphasizes community based wetlands including river stretch conservation and management with coordinating local government.
International Treaties and Commitments of Government	Nepal has committed more than 30 international treaties, conventions and agreements. Among them, Convention on Wetlands of International Importance especially Waterfowl Habitat (Ramsar Convention 1971), Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973), Convention on Biological Diversity (1992) are important to aquatic biodiversity. Nepal also prepared the sixth national report for the CBD in 2018. The fifth and sixth reports contains plan for achieving the Aichi Biodiversity Targets.

Source: ADB, 2018, NPC, 2015, Chaudhary et al., 2020, USAID Paani,2020, MoFE 2018a

Annex 3. Endemic fish species of Nepal

SN	Fish Species	Common Name (English)	Common Name (Nepali)	Authority	Water Body	IUCN Red List Status
1	*Myersglanis blythii*	Stone Catfish		Jayaram, 1991, (Day, 1870)	Pharping	*Myersglanis blythii*
2	*Psilorhynchus pseudecheneis*	Stone Carp	Tite Machha	Menon and Datta, 1962	Dudh Koshi	*Psilorhyn chuspseu decheneis*
3	*P. nepalensis*			Conway and Mayden. 2008	Rapti, Seti, Narayani	*P. nepalensis*
4	*Pseudeutropius murius batarensis*	Indus Garua	Golmuhi	Shrestha, 1981	Trishuli	*Pseudeutropius murius batarensis*
5	*Schizothorax macrophthalmus*	Nepalese Snow Trout	Trout	Terashima. 1984	Rara Lake	*Schizothorax macroph thalmus*
6	*S. nepalensis*	Snow Trout	Tikhe Asala	Terashima, 1984	Rara Lake	*S. nepalensis*
7	*S. raraensis*	Rara Snow Trout	Asala	Terashima. 1984	Rara Lake	*S. raraensis*
8	*Batasio macronotus*	Cat fish		Ng and Edds, 2005	Sapta Koshi	*Batasio macronotus*
9	*Pseudechenesis crassicaudata*			Ng and Edds, 2005	Mewa Khola (RiverTamor)	*Pseudechenesis crassicaudata*
10	*P. serracula*			Ng and Edds, 2005	Seti, Kali Gandaki, Narayani, Mahakali, and Karnali	*P. serracula*
11	*Erethistoides ascita*			Ng and Edds, 2005	Mechi, Kankai, Trijuga,Koshi	*Erethistoides ascita*

12	*E. cavatura*			Ng and Edds, 2005	Dhungra, Rapti, Narayani	*E. cavatura*
13	*Balitora eddsi*			Conway and Mayden, 2010	Karnali	*Balitora eddsi*
14	*Neoanguilla nepalensis*			Shrestha, 2008	Narayani	*Neoanguilla nepalensis*
15	*Turcinoe macheilus himalaya*			Conway, Edds, Shrestha, and Mayden, 2011	Indravati, Kali Gandaki, Narayani	*Turcinoe macheilus himalaya*

Source: Rajbanshi, 2013

Annex 4. Keystone fish species of Karnali River Basin

SN	Key stone species	English name	Local name	Watershed
1	*Labeo angra*		Kalanch	Lower Karnali
2	*Labeo pangusia*		Gardi	Lower Karnali, Thuligadh, Middle Karnali
3	*Neolissochilus hexagonolepis*		Katle	Tila
4	*Schizothorax sps*		Asla	Thuligadh, Middle Karnali, Tila
5	*Glyptothorax sps.*		Kapre	Tila
6	*Tor putitora*		Sahar	Lower Karnali, Thuligadh, Middle Karnali

Source: USAID Paani, 2020

Annex 5. List of migratory fishes

SN	Long distance migratory species	Short distance migration species
1	*Anguilla bengalensis*	*Chagunius chagunio*
2	*Tor putitora*	*Labeo angra*
3	*Tor tor*	*Bangana dero*
4	*Bagarius yarrelli*	*Labeo dyocheilus*
5	*Clupisoma garua*	*Neolissochilus hexagonolepis*
6		*Tor chelynoides*
7		*Schizothorax plagiostomus*
8		*Schizothorax richardsonii*
9		*Monopterus cuchia*

Source: Shrestha and Thapa, 2020

Annex 6. Format of the proposal (10-15 pages)

Executive Summary: Summary introduction, methods, basic information of proposed fish sanctuary, legal, and management framework, monitoring, and management plan.

1. Introduction
   Background: Brief information on issues or problems of fish conservation, management practices, and gaps in aquatic biodiversity conservation
   Rational of the fish sanctuary: Justification of need for fish sanctuary in the proposed river stretch
   The objective of the fish sanctuary: Key objectives for establishing a fish sanctuary
2. Methodology: Process of information collection for the proposed fish sanctuary
3. Details of the proposed fish sanctuary: brief geophysical, socio-cultural, chemical, and biological status of the proposed site
4. Basics of determination of conservation: Threats to biological resources and conservation measures- brief threats to aquatic biodiversity, and conservation measures
5. Legal, institutional and policy framework: What are the existing legal framework or need an additional legal instrument and Institutional framework for management
6. Monitoring and evaluation framework: Monitoring and evaluation plan with responsible organizations
7. Sustainable management of fish sanctuary: How to manage the fish sanctuary with a brief management plan
8. References/bibliography List of readings or cited materials