Designing a Payment for Ecosystem Services (PES) scheme: Lessons from revisiting the PES mechanism at Rupa and Kulekhani Watershed

Report of the study conducted under Darwin Initiative (DI) funded project "Market-led Approach to Sustainable Management of Agrobiodiversity for Livelihood Outcomes"

Report prepared by:
Tejaswee Shiwakoti, Indra Prasad Paudel and Ram Bahadur Rana

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Authors Tejaswee Shiwakoti, Indra Prasad Paudel and Ram Bahadur Rana

Cover Photos Kulekhani Reservior (left), Jagdishpur Reservoir (right)

Photos Tejaswee Shiwakoti and Indra Prasad Paudel

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Executive summary

The feasibility study was carried out in both the Kulekhani and Jagdishpur Reservoirs, two wetlands which provide wide arrays of ecosystem services with wider range of benefits at the local, national and global level. The feasibility study tried to understand the key challenges faced by Kulekhani and Jagdishpur Reservoirs for the management of the wetlands and also compared the past case of Rupa Lake with both the Reservoirs. The study also tried to understand the opportunities and constraints of initiating PES in both Kulekhani and Jagdishpur Reservoirs. From the previous learnings of PES in Kulekhani and Rupa watershed, PES design should take local context into account which is not seen in most cases.

The study used SWOT Analysis to understand the gaps/ weaknesses and threats as well as identify strengths and opportunities within the watershed area. From the findings of SWOT analysis, recommendations to overcome identified gaps and weaknesses have been provided. The analysis result suggests that the attention should be given to support the conservation as well as diversifying income generating activities in both the watershed areas. Both the areas should focus on including real users of the common property which was grossly lacking in both the cases. Also, PES related plans and policies should be prioritized, a specific PES law can be created by incorporating local level customary laws and indigenous practices by implementing PES pilot projects, which can then be shared at national level. Awareness raising and capacity building programmes to community, community institutions, governmental institutions and other relevant stakeholders should be prioritized as they have limited knowledge on and organizational skills to wetland management and conservation.

Acknowledgement

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Abbreviation

PES	Payment for Ecosystem Services
ES	Ecosystem Services
ICIMOD	International Centre for Integrated Mountain Development
LCPV	Lake Cluster of Pokhara Valley
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
NEA	Nepal Electricity Authority
RUPES	Rewarding Upland Poor for Environmental Services
CFUGs	Community Forest User Groups
DDC	District Development Committee
DI	Darwin Initiatives
SWOT	Strength Weakness Opportunities Threats
JRMMSF	Jagdishpur Reservoir Management Multi-stakeholder Forum
IPM	Integrated Pest Management

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1 Introduction

1.1. Background

Globally, wetlands are amongst the most diverse and productive ecosystems providing many ecosystem goods and services. Ecosystem goods includes food, water, timber, whereas services include water supply, air purification, natural recycling, pollination and raw material and recreation to millions of people around the world (Hansson et al., 2005; Baral et al., 2016). Wetlands provide goods such as Wetlands provide habitat to a large number of organisms which lives in these ecosystems, such as birds, insects, fishes, mammals and amphibian species (Bhusal et al., 2020). Furthermore, goods and services coming from wetlands protect the environment against the impacts of climate change and ecosystem degradation (Baral et al 2016). The Article 1.1 of Ramsar Convention of Wetlands, 1971 defined wetlands as "*areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meter*". Wetlands play a significant role in maintaining a healthy ecosystem but the degradation of catchments due to agricultural use, urbanization, water diversion, excessive exploitation, and poorly planned development activities, the wetlands is under threats (Baral et al., 2016). Due to the degradation of worlds ecosystem services (ES), the people who are dependent on such goods and services are affected the most (IUCN 2004).

Wetlands in Nepal have significant values like any other wetlands found around the world. Those values include water retention, replenishment, water quality improvement, decomposing organic wastes and use for food production (IUCN, 2004). Wetland in Nepal are freshwater inland which can be natural and artificial and ranges from floodplains of snow melted rivers from Himalayas to rivers from mid hills, glacial lakes to hot springs, marshes and swamps (IUCN 2004; Shrestha et al., 2020). In Nepal, 5% of the total landmass (743,563 ha of area) hosts wetlands diversity and provide sanctuary to 42 globally threatened species and supports globally important biodiversity (Baral *et al,* 2016). Although, wetlands of Nepal are one of the most productive ecosystems with ecological, cultural and economic significances, they face degradation/ loss because of population growth and increasing demand of resources, inadequate technical knowledge on proper management, lack of financial resources, lack of coordination amongst multiple institutions to control unabated encroachment, unclear policies, etc. (MoFE, 2018). These wetlands ES generate economic value but is poorly realized by different stakeholders. There is a need for a balanced approach between wetland conservation and its sustainable utilization so that communities depended on the wetland for their livelihood are actively engaged in conservation of these resources (Baral et al., 2016).

1.2 Watershed ecosystem and its Services

Watersheds, also called as "catchments", "drainage basins" or "river basins", is the area of the land that provides water into a river through the process of precipitation (Smith et al., 2006). The topography, geology, soil type, vegetation, land use and other human activities define the quality and quantity of the water flowing along rives to the downstream users of the watershed. The forest, grasslands, agricultural areas, and wetlands are the different groups of ecosystems which is formed within a watershed which supports plant and animal diversity providing goods and services for human being. Such goods and services provided by the watershed are shown in Table 1.

Table 1: Major services provided by ecosystems in a watershed

Ecosystem Services	
Provisioning Services Services focused on directly supplying food and non-food products from water flows	*Regulating Services* Services related to regulating flows or reducing hazards related to water flows
» Freshwater supply » Crop and fruit production » Livestock production » Fish production » Timber and building material support » Medicines » Hydro-electric power	» Regulation of hydrological flows (buffer runoff, soil water infiltration, groundwater recharge, maintenance of base flows) » Natural hazard mitigation (e.g. flood prevention, peak flow reduction, landslide reduction) » Soil protection and control of erosion and sedimentation » Control of surface and groundwater quality
Supporting services Services provided to support habitats and ecosystem functioning	*Cultural and Amenity Services* Services related to recreation and human inspiration
» Wildlife habitat » Flow regime required to maintain downstream habitat and uses	» Aquatic recreation » Landscape aesthetics » Cultural heritage and identity » Artistic and spiritual inspiration

Source: Smith et al., 2006

However, the ability of ecosystems to provide same quality and quantity of ES over the past years have been affected due to global environmental changes and others stressors. Also, these ES have been regarded as free services which is affecting to achieve expected conservation and development outcomes (*Bhatta et al.,* 2014). Over the past decade, different set of conservation innovations have taken place due to growing scarcity of ES and decreasing interest in conservation (Gauli & Ghimire, 2014). This emerging scarcity has led to address the ecosystem and natural resources management problems through Payment of Ecosystem Services (PES) program.

1.3 Watershed management and initiation of Payment for Ecosystem Services (PES) mechanism

Ecosystem services were considered as free services. Though the ES's have economic value, they generally don't have a market or a price. Despite that, there are such actors who conserve the land and manage ecosystems without being rewarded and compensated. One group who are the providers of ecosystem services bear the costs or subsidize the provision whereas the other groups/sector benefits from the ES and gain high profit from using it (Bhatta *et al.,* 2014).

In recent years, PES mechanism emerged as a response to develop systems in which the ES providers are rewarded and compensated by the users of the ES. PES is a voluntary approach which is targeted to secure economically, socially and culturally valuable ecosystem. According to Wunder (2005), PES is a voluntary transaction where a well-defined ES is being bought by minimum one ES buyer from minimum one ES provider if and only if the ES provider secures ES provision (conditionality). This definition is the basis of true PES scheme through which participants are assured a continuous supply of ecosystem services without compromising on social goals (Bhatta *et al.,* 2014). After a decade of PES implementation and research, the 2005 definition of PES was criticized for being narrow as it was seen too market based which misses out on alternative institutional frameworks. Consequently, PES is redefined as "*voluntary transactions between service users and service providers that are conditional on agreed rules of natural resource management for generating offsite services*" (Wunder, 2015).

Until 2000 AD, Nepal has not practiced PES or PES-like schemes. The major stakeholders lacked awareness of ecosystem services and their importance. However, in the year 2003, PES study was carried out in Nepal with the support of International Centre for Integrated Mountain Development (ICIMOD) and World Agroforestry Centre (Amatya et al., 2018). Likewise, in the year 2002 an exemplary work of successful local stewardship was recognized at Rupa Lake, of Lake Cluster of Pokhara Valley (LCPV), where the watershed services scheme is implemented by the Rupa Restoration and Fishery Cooperative in Rupa watershed. This was only possible with the formation of cooperative and the support of Fishery Research Station, NARC and Local Initiatives for Biodiversity, Research and Development (LI-BIRD). Conferring to the study of Chaudhary et al. (2015), PES was adapted in Asia due to the failure of top-down policy on environmental governance. Rupa lake was an example of bottom-up approach where both upstream and downstream communities worked together for watershed management through the formation of cooperative.

Nepal has been practicing PES or PES-like schemes which redistribute financial resources to the local communities. Nepal being a country rich in water resources and wetlands, if ecosystem services and PES are considered, they can help in uplifting the livelihood of the people residing in the wetland area. PES is a policy tool for environmental conservation which relies on the idea that if ecosystem services are given economic values and assigned rights then efficient environmental outcomes can be created (Khatri, 2011). Nepal has adopted PES-type schemes which incentivize local communities that made significant advances to conserve natural resources through established institutional mechanism (Bhatta et al., 2014). However, the present scenario do not clearly consider management of ecosystems and the services that they provide. The PES mechanism, which is a community-based approach, is currently working without efficient monitoring or evaluating its management and livelihood consequences (Bhatta et al., 2014).

1.4 PES potential and opportunities

Reviewing the past PES practices: Rupa Lake and Kulekhani Reservoir

In Rupa Lake, a benefit sharing mechanism was initiated in 2002 by forming the Rupa Lake Rehabilitation and Fishery Cooperative. To begin with, the ecosystem services of the Rupa watershed were explored and ways to provide economic benefits to upstream and downstream communities were figured out (Riggs et al., 2014). The cooperative was formed with the help of two community-based organizations, and the mechanism was initiated through the critical support of a local NGO, LI-BIRD. Together with the benefit sharing mechanism, the communities were trained by LI-BIRD regarding sustainable agriculture and forestry practices and biodiversity conservation (Chaudhary et al., 2015). The Rupa cooperative distributes 10% of its profit received from fish sale to upstream communities in the form of cash or other payment mechanisms such as community contribution, capacity building and awareness raising, and collaborative activities (Riggs et al., 2014). According to Chaudhary et al. (2015), Rupa cooperative has been facing certain challenges in fishery management, monitoring and enforcing its lake use rules, transparency in endowment sharing, and a perception that downstream communities benefit more than upstream communities regarding

road access to market, water use for irrigation, and educational opportunities. Chaudhary further added that these issues can be addressed through community negotiation efforts, transparency in information and benefit sharing, and hearing the voices of upstream communities through participatory forums.

Kulekhani watershed area has evolved a lot since the development of Kulekhani hydroelectric project in 1992. Nepal Electricity Authority (NEA), which is a Nepal government own entity, is the owner of the project and uses the water to generate electricity. The NEA has a mechanism whereby it pays certain amount from the revenue generated from the hydroelectricity to the wards of Indrasarowar Rural Municipality and Thaha Municipality on annual basis. However, the interaction with ward officials revealed that they are not aware about the revenue amount as it is not clearly included with the other budget which comes to each ward. Before, PES initiatives was facilitated under Rewarding Upland Poor for Environmental Services (RUPES) program where the mechanism was developed and successful distribution of revenue was done among the upstream communities for environmental protection. Despite the initiation, PES in Kulekhani could not bring the clarity among the stakeholders and the communities. Therefore, the revenue generated did not work as per its condition and was diverted to other activities like road construction or infrastructure development. At the present moment, there is no clarity or awareness regarding the ecosystem services among the local leaders and the communities.

From the literatures we found that PES in Kulekhani had fundamental flaws and weak institutional mechanism which did not provide any incentives to existing local resource management organizations like Community Forest user Groups (CFUGs). Though it had some positive outcomes for the community development, the mechanism still lacked better role for local communities. As per Khatri's (2009) analysis, it revealed that it felt short of meeting environmental outcomes due to 1) negative consequences of development projects like road construction, 2) excluding main resource management institutions like CFUGs from PES mechanism, and 3) undermining the role of the principal beneficiary of the ecosystem services.

Sustainability of PES

If we see the past PES practice at Kulekhani then many factors have been hindering the establishment of a real PES scheme. These factors, if considered then can help in gaining the sustainability of PES schemes in Kulekhani and can be an example for implementing PES schemes in other ES providers of Nepal. Scope abound to replicate successful PES in major hydroelectricity production sites operated by NEA and private hydroelectricity producers. Having said that, Nepal has yet to come up with a successful case to emulate to other similar areas, so the PES mechanism in Nepal is still a work in progress with a long way to go.

First, the community understood municipality as the main buyer when NEA receives the direct benefits from the ecosystem services. There is still no clarity about service buyers and service providers and this misunderstanding has created complexities in the mechanism. Secondly, PES when introduced first in Kulekhani, was outcome of interaction and negotiation among the boarder set of actors like local communities, District Development Committee (DDC), VDCS, political parties, Kulekhani Watershed Conservation and Development Forum and other district level line agencies. After Nepal transitioned to federalism, the concept of federal system brought three-tier government system, namely federal, provincial and local levels, which made the previous mechanism redundant. This has affected the entire negotiation process which was done before federalism with the most important and powerful actors of that time. Now, due to that change, the whole negotiation process has to take place again with the new actors. Thirdly, support of an intermediary organization is lacking. When going through the literatures, RUPES-Kulekhani program comes to highlight because it acts as an intermediary organization for initiating PES mechanisms. Though certain lobbying was done by local communities to receive the revenue from the NEA but it was only possible with the support of RUPES program. The program conducted different activities like identifying watershed services, providers of those services and their beneficiaries. Also, assessment of the economic value of the sedimentation reduction was carried out which became the basis for the negotiation. At the present, such program is needed to assess the

Kulekhani area and generate new and strong evidence regarding the ecosystem services for the interaction and negotiation with the new governments at local level. Fourthly, community perception (Upstream and Downstream Community) on PES is really important. The understanding regarding the main aim of the PES is to support the livelihood of the upstream communities for ensuring conservation and reducing sedimentation in the reservoir. Lastly, a monitoring and program executing body should be formed under the local government who built relevant program from the revenue generated and execute it in a transparent way.The points discussed above can lead us to achieve the sustainability of the PES schemes. However, like any other program, proper monitoring of the mechanism, fund management and execution of the projects should be also taken into account for achieving the sustainability of the PES mechanism.

This study report tries to understand if the Kulekhani Reservoir and Jagdishpur Reservoir are feasible enough to replicate the PES mechanism of the Rupa Lake watershed. LI-BIRD, who worked with Rupa through various development oriented agricultural and natural resource management projects, has once again worked to improve the livelihood of local people and for sustainable watershed management of LCPV with financial support from Darwin Initiative (DI). This report is one of the outputs of the DI project for scaling up market-led approaches for agrobiodiversity management for improved livelihood outcomes.

1.5 Objective of the study

The main objective of the study is to conduct a comprehensive feasibility study to assess the potential to replicate Rupa model at Kulekhani Reservoir and Jagdishpur Reservoir for sustainable management of agrobiodiversity for livelihood outcomes.

The specific objectives of the study are:

- Assess the socio-economic status of the communities, focusing on economic and social indicators such as education, occupation, income, landholding size, and food sufficiency.
- Evaluate the major ecosystem services provided by the ecosystems in both the watersheds.
- Understanding existing PES/benefit sharing mechanism functioning at Rupa watershed, Kulekhani Reservoir and Jagdishpur Reservoir and assess the potential to replicate Rupa PES model as part of a long term/sustainable strategy for better management of ecosystems.
- Assess dependence and perception of local communities (upstream and downstream) on wetland resources, especially on wetland products and services and suggest measures for improving the livelihoods of local communities and conservation of wetland resources.

2 Methodology

Study Areas

The study was conducted in two sites, i.e. Kulekhani Reservoir and Jagdishpur Reservoir. Kulekhani reservoir and Jagdishpur reservoir provide economic benefits to local people through hydropower and irrigation development respectively. Jagdishpur Reservoir supplies water for irrigation to around 6,200 ha of cultivable land and around 54,358 people are dependent on it for irrigation, fish, foods and recreational use (Dhonju, 2010; Baral, 2016). Besides that, the reservoir is rich in biodiversity and is home to many species of birds. It was declared as a Ramsar site in 2003 for the fact that it is a habitat for vulnerable, endangered, critically endangered species and threated ecological communities (Baral, 2016). Jagdishpur reservoir is included in the Ramsar list and found in the Terai lowlands, whereas Kulekhani reservoir is found in mid hills of Nepal and is a government-initiated pioneer PES-type scheme providing water for hydropower. Kulekhani reservoir faced high rate of sedimentation after its construction. To tackle such situation, the government initiated integrated watershed management program which later improved the condition of the forests and reduced the sedimentation (Khatri, 2011).

Both the reservoirs are considered to have valuable ecosystem services, community managed ecosystem that serves as the main source of livelihoods for the majority of population surrounding these reservoirs. Forests, water, irrigation for agriculture form an

integral part for these populations. The Kulekhani case shows a reward system for the upland community to reduce soil erosion and siltation.

Study Methodology

The feasibility study is based on case study approach where primary data and secondary data were collected. Primary information were collected through focus group discussions, interview and consultation (Annex 1) with key stakeholders, and direct field observation of selected watershed sites. In order to collect primary field level data, checklists and semi-structured questionnaires were developed and administered to the local groups, farmers, and representatives of the local government. The questionnaire helped to assess the wetland ecosystem services of the area and understand the possibility of PES implementation. Local stakeholders were contacted and focus group discussions were organized. Comprehensive discussions on issues, constraints, and opportunities were held with the local communities through the organization of focus group discussions, while consultation meetings were organized with the relevant line agencies at the district level. Representative of different communities/wards/leader farmers from downstream and upstream communities were consulted during the field exercise. At Kulekhani, discussion was also held with boat association and fish farming association whereas at Jagdishpur, Jagdishpur Reservoir Management Multi-stakeholder Forum (JRMMSF) was consulted (Annex 2). The opinions of the major stakeholders were solicited, consolidated and presented succinctly in the report.

Secondary information were obtained by reviewing national and international literatures, policies, program documents and ward profiles. The literature review comprised of national and international reports on PES mechanism. The reports from the government, non-government and other local stakeholders were also collected and reviewed. Other existing policies, legislation, management plans of the wards, and development strategies of the area were reviewed. Relevant documents have been duly cited in the report at appropriate places.

The field work was carried out in Kulekhani Reservoir of Indrasarowar rural municipality and Jagdishpur Reservoir of Kapilbastu municipality. Kulekhani watershed, lying 50 km southwest of Kathmandu, is the source of water for the reservoir of to the hydropower plant downstream. On the other hand, Jagdishpur Reservoir is the source of irrigation for more than 6,200 hectares of agricultural land. A SWOT (Strength, Weakness, Opportunity, and Threat) analysis of both the reservoirs had been undertaken. A SWOT analysis was conducted during field exercise involving relevant stakeholders, and the results obtained have been presented as a separate section in the report.

3. Description of study area

This chapter presents findings on bio-physical assessment, socio-economic assessment, and biodiversity assessment of the study area. Physiology/Geology, Climate, Land use is assessed for bio-physical profiles; (Table 2) demography, economic activities, agriculture and livestock, tourism is assessed for socio-economic profiles; flora/fauna diversity, agriculture diversity is assessed for biodiversity of both the watersheds.

Table 2 Showing the basic attributes of kulekhani and Jagdishpur Reservoir

	Kulekhani Reservoir		Jagdishpur Reservoir	
Year Of Construction	1982		1970	
Purpose of construction	Electricity Generation		Irrigating 6200 ha land	
Altitude Range	1,485 to 2,534m asl.		107 to 121m asl.	
Latitude-longitude	85° 02' to 85° 12' E & 27°36'-27°40' N.		83° 05' to 83° 06' E & 27°37' to 27°38' N.	
Total Household	2993		12,385	
Land Use (sq. Km)	**2010**	**2020**	**2010**	**2020**
Agriculture area	24.4	18.3	106.12	112.15
Forest area	66.7	64.7	3.83	5.6
Grassland	0.14	0.03	0.33	0.63
Barren land	2.68	9.2	19.10	0.79
Buildup areas	1.18	2.67	5.43	13.53
Water body	2.02	2.24	1.9	2.74
Flooded vegetation		-	-	0.43
Total area (sq Km)		97.27		136.82

3.1 Physiography/Geology

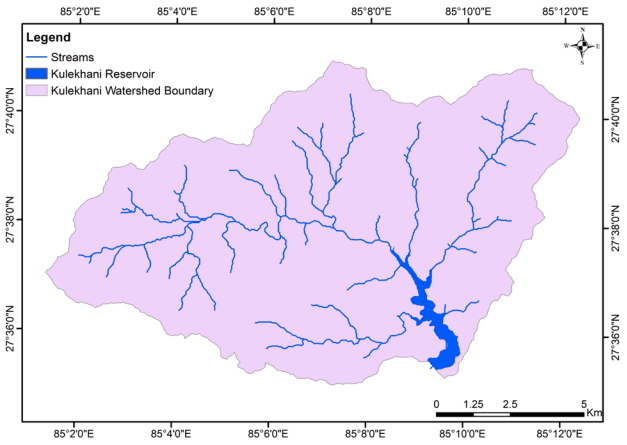

Figure 1 Map showing Kulekhani watershed

Kulekhani Reservoir is about 50 km southwest of Kathmandu and spread over 12,492 hectares (Khatri 2011). It lies between 85° 02 ' to 85° 12 'E and 27°36 ' to 27°40 'N (Figure 1). The reservoir supplies water to 92 MW Kulekhani hydropower plant which collects monsoon rain rather that rivers emerging from the Himalayas (Karky & Joshi, 2009). The Kulekhani watershed is spread over Ward no 1 and 2 of Indrasarowar Rural Municipality of Makawanpur district and 8,000 HHs reside around the watershed whose subsistence economy is based on sloping land agriculture and livestock rearing (Khatri, 2011; Karki & Joshi, 2009). The Kulekhani watershed area is one of the few PES schemes which was piloted at local level which focuses on promoting sustainable natural resource management and alleviating poverty of upstream communities through payment on use of environment services.

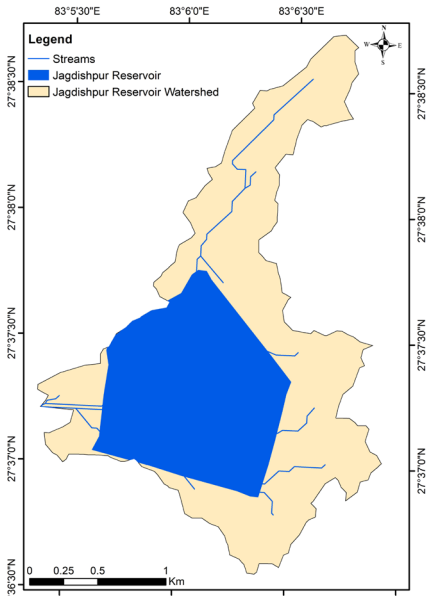

Figure 2 Map showing Jagdishpur Reservoir

The Jagdishpur reservoir is the second biggest manmade reservoir in Asia which was constructed for irrigation purpose with an area of 225 hectares and was designated a Ramsar Site in 2003 (Baral et al., 2016; Bhusal et. al., 2020). The Jagdishpur Reservoir is about 10 km north-west to Taulihawa at geographical coordinates between 83° 05 ' to 83° 06 'E and 27°37 ' to 27°38 'N (Figure 2). The reservoir is spread over Ward no 8 and 9 of Kapilvastu Municipality. The reservoir collects water from nearby Banganga River which has a catchment area in Chure Hills. Together with that, the reservoir is surrounded by cultivated lands and two lakes, namely Sagarhawa and Nigilhawa, which comprise a buffer habitat for bird movements (Bhusan et al., 2020).

3.2 Physiography

Kulekhani watershed has high variation in altitudes where the elevation ranges from 1,485m at low point to 2,534m at the peak (Figure 3). The Kulekhani river basin combines both steep mountains together with valleys, river terraces and flood plains. The middle part of the watershed where the dam is located falls under gentler topography. The watershed falls under two major climatic zones i.e. the warm temperate humid zone (1500-2000m) and cool temperate humid zone (>2000 m).

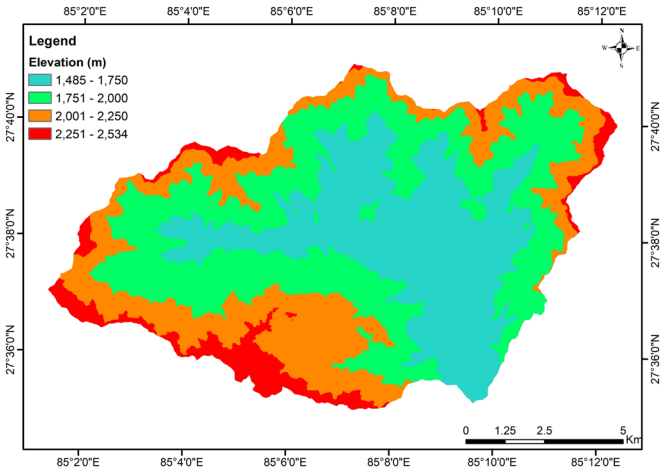

Figure 3 Map showing elevation of Indrasarobar Rural Municipalit

Jagdishpur Reservoir is located in Terai region so it is mostly flat land. There is not much variation in the elevation and ranges between 107 to 121m asl (Figure 4).

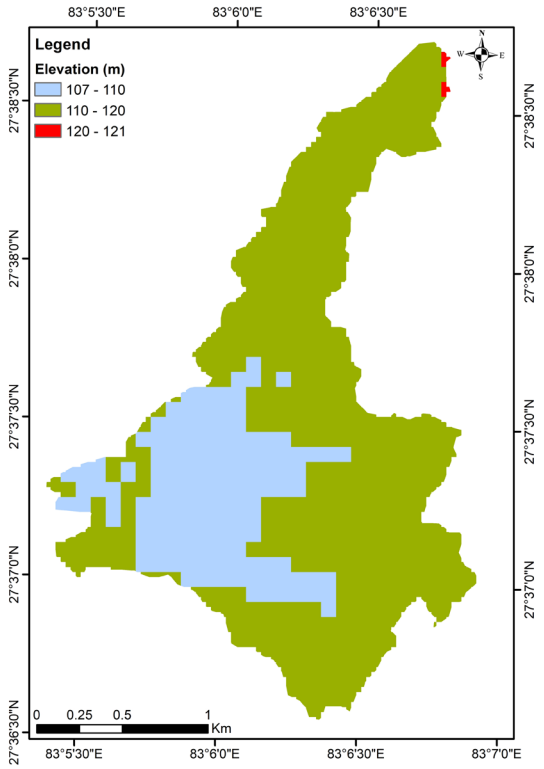

Figure 4 Map showing elevation of Jagdispur Municipality

3.3 Climate: Annual Rainfall

The data analyzed through the past records of 30 years (1990 to 2020) showed that the average annual precipitation is decreasing by about 10.78 mm at Kulekhani watershed area (Figure 5). The annual precipitation distribution of nearby station from Kulekhani, i.e. Markhu Gaun and Daman shows there is increase in precipitation at Daman compared to Markhu station (Table 3). Daman is the farthest rainfall station compared to Markhu but falls under the Kulekhani watershed area. So, changes in rainfall pattern at any of the stations may have significant impact on the electricity generation at Kulekhani.

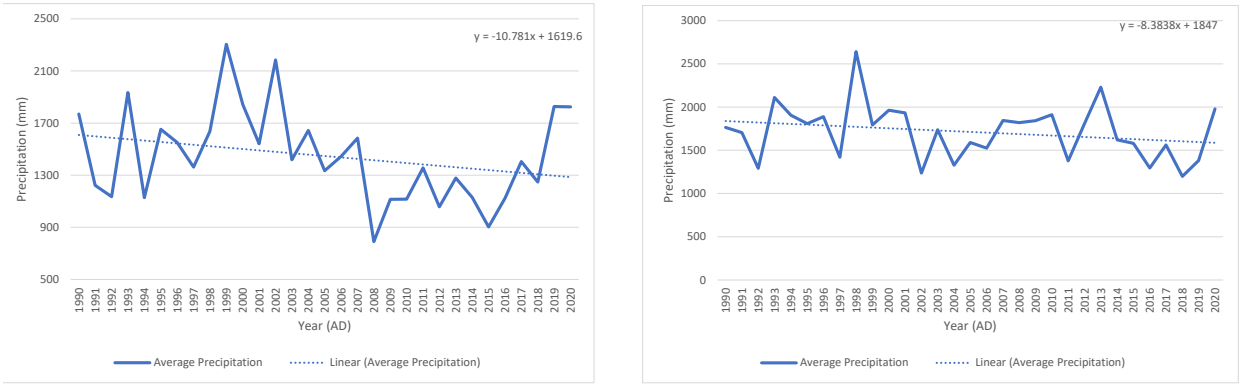

Figure 5: Average Annual Precipitation Occurring in the Kulekhani and Jagdishpur Watershed showing decreasing trend

For Jagdishpur reservoir also, the data analyzed showed decreasing average annual precipitation by about 8.38 mm (Figure 5). Average annual precipitation distribution of three nearby stations from Jagdishpur Reservoir, i.e. Taulihawa, Pattarkot West and Bhagwanpur, shows different rainfall trend. Pattharkot West shows highest average precipitation followed by Bhagwanpur and Taulihawa station. Taulihawa is the nearest rainfall station among others, which shows that changes in rainfall trend have high impact in reservoir (Table 3).

As rainfall is necessary for electricity generation and for irrigation, decrease in the annual average rainfall will affect the energy generation in the Kulekhani reservoir, and less area will be covered during irrigation at Jagdishpur Reservoir.

Table 3. Average monthly and annual rainfall (mm) recorded at hydro-meteorological stations of Indrasarowar and Jagdishpur between 1990 and 2020 (Department of hydrology and meteorology 2021)

	Indrasarowar		Jagdishpur		
Station Name	**Daman**	**Markhu**	**Taulihaawa**	**Pattharkot (West)**	**Bhagwanpur**
Elevation (m)	2314	1530	94	200	80
Latitude	27d36m	27d37m	27d33m	27d46m	27d41m
Longitude	85d05m	85d09m	83d04m	83d03m	82d48m
Station ID	905	915	716	721	723
Average Rainfall (mm)					
Jan	13.34	19.62	14.79	15.43	21.51
Feb	24.85	28.31	20.64	23.39	24.73
Mar	36.54	34.32	15.29	15.18	17.25
Apr	63.74	70.54	21.96	22.63	24.14
May	149.77	128.17	55.94	95.68	72.39
Jun	230.55	231.21	201.16	374.65	272.91
Jul	425.37	363.49	493.65	624.06	532.21
Aug	350.07	271.96	364.76	563.55	428.89
Sep	220.17	197.26	214.19	403.43	306.51
Oct	54.38	38.56	33.68	75.05	63.98
Nov	5.83	8.98	6.22	8.62	8.62
Dec	13.10	19.07	8.38	16.13	13.21
Annual	**1587.71**	**1411.48**	**1450.67**	**2237.80**	**1786.35**

3.4 Land use

Indrasarowar Rural Municipality has a total areas of 97.27 sq. km. Within a decade (2010 to 2020), the forest area decreased from 66.7 to 64.7 sq. km and agriculture area from 24.4 to 18.3 sq. km whereas the building and other infrastructure area increased from 1.18 to 2.24 sq. km (Figure 6).

Likewise, Jagdishpur Municipality has a total area of 136.82 sq. km. There is an increasing trend on agriculture area and forest area from 106 to 112.15 sq. km and 3.83 to 5.6 sq. km. in the interval of 10 years (2010 to 2020) (Figure 7). The data also reveal that barren land area has decreased over the time indicating change of barren land to agricultural land. However, in the recent years, it shows that there is flooded vegetation area of 0.43 sq. km.

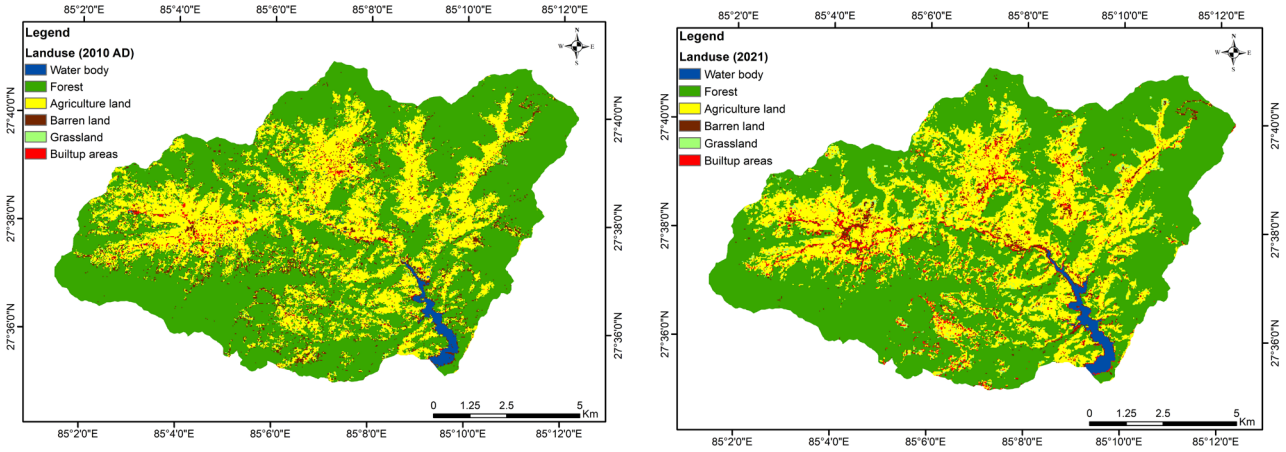

Figure 6 Land use map of 2010 and 2020 for Indrasarowar Rural Municipality

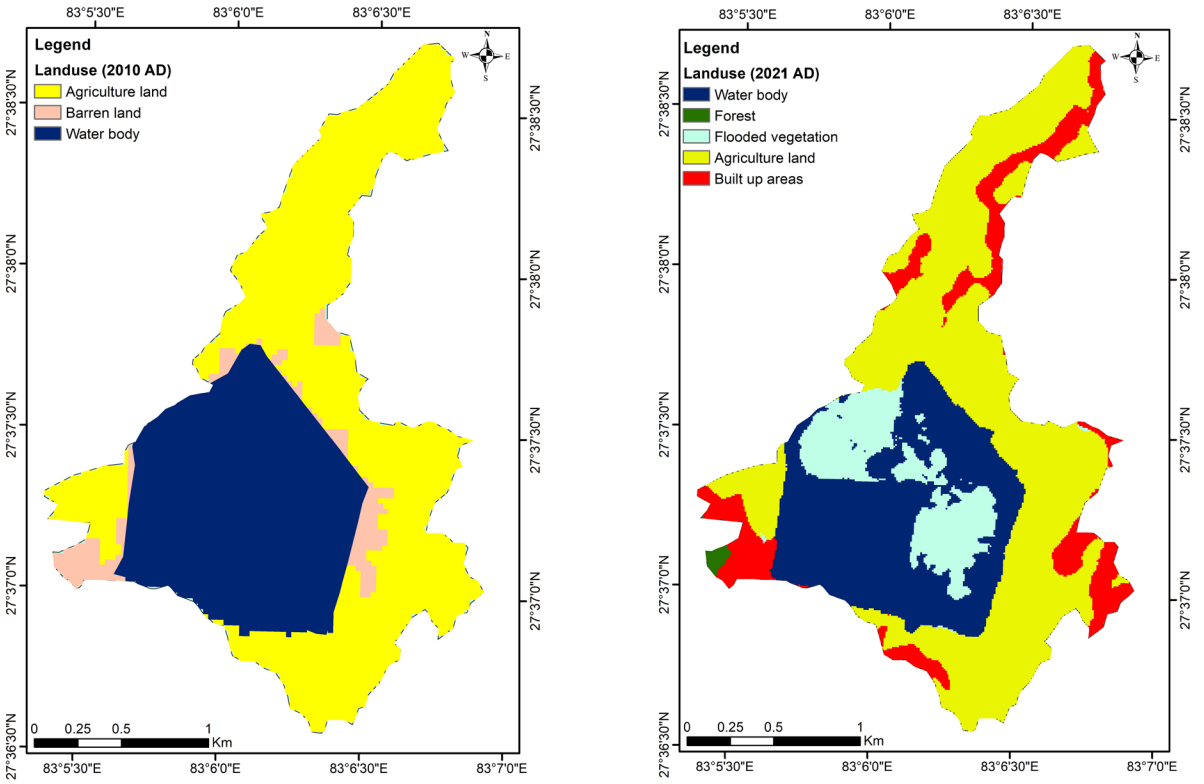

Figure 7 Landuse map of 2010 and 2020 for Jagdishpur Municipality

3.5 Socio–economic Profile

Demography

Indrasarowar Rural Municipality has a total population of 18,070 where male population (i.e. 50.8%) is slightly higher than female population (49.2%). The municipality has a total of 2,993 households with average family size of 5.51. The demographic composition of Indrasarowar is heterogeneous where Tamang, Newar, Magar, Brahmin, Chettri and Thakuri are the major ethnic groups. Agriculture is the main source of livelihood followed by business and job. Farmers are mostly growing seasonal and off-season vegetables (rainy season vegetables) and selling them to major cities, namely Kathmandu and Hetauda. Around 38% of the households are food sufficient for 3-6 months from their own production whereas 22.6% of the household have sufficient food for 9-12 months (Ward profile 2076 BS).

Jagdishpur Municipality has a total population of 75,069 with 12,385 households. Among the total population, the percentage of male and female population is 52.4 and 47.6% respectively. The average family size of Jagdishpur is 6 members per family. Like Indrasarowar, agriculture is the main source of livelihood for the population in Jagdishpur. Around 40% of the household is food sufficient for whole year and also sell surplus, whereas 27% of the household do not produce at all (Ward profile 2075 BS).

Economic activities- Wetland goods and services

In Kulekhani Reservoir, water is mainly used for generating electricity. Besides that, the area around the reservoir has been developed for agricultural purpose which mostly lies in upstream. In addition to generating electricity, Kulekhani reservoir is extensively used for cage fish farming throughout the year. The cage farming is one of the main sources of income for the people living nearby the reservoir. In recent years, the reservoir has become a touristic destination (hill station) attracting many seasonal tourists from around Nepal. This has given opportunity to hotels, restaurants and boat businesses to flourish in a short span of time.

In Jagdishpur Reservoir, water is mainly used for irrigating 6,000 ha of farm lands for summer and winter crops such as paddy, wheat, maize and vegetables. Water is also used for livestock for drinking and bathing/wallowing. Therefore, the reservoir has addressed the irrigation issues and directly contributed to production of agricultural commodities. This is one of the major economic activities of the reservoir. Besides, farmers pay fees for using water for irrigation. As the reservoir is the habitat for different migratory birds, it attracts both international and national tourists in that area thereby increasing income from the tourism of Jagdishpur. However, the number of tourists visiting the reservoir is limited as there are not much facilities (infrastructure) for accommodating or providing recreational facilities to the tourists. Likewise, fish and crabs are also other wetland goods consumed by the local communities.

3.6 Resource Status: Biodiversity services of the watershed

Flora/Fauna Diversity and Biodiversity loss

Aquatic fauna play an important role in providing food and generating income through ecotourism and small scale aquaculture at Kulekhani Reservoir. The composition and population of fish in the river encountered a profound change after formation of the Kulekhani reservoir. In 1980, Shrestha et al. first documented the fish species in Kulekhani where it was found that fish species such as Garra lamta (Gray), Neolissochilus hexagonolepis (McClelland), Puntius chilinoides (Ham), Schizothorax richardsonii (Gray), Puntius ticto (Ham), and Puntius sp. of the family Cyprinidae (Dark Mahsheer) were abundant in the river. Later two exotic carps, Aristichthys nobilis (Bighead Carp) and Hypophthalmichthys molitrix (Silver Carp) and one indigenous fish species Tor putitora (Masheer) were introduced in the reservoir to increase the fish production. These fish were not native to the reservoir and its introduction caused an increase in their population within a short time of reservoir formation (Singh & Swor., 2018). Due to which, a drastic decline in the number of fish species of Schizothorax richardsonii (Snow Trout), disappearance of Puntius sp., G. lamta, Nemacheilus sp., C. gachua, Glyptosternum sp., P. ticto, and Coraglanis sp., were seen whereas the population of S. richardsonii sharply declined (Singh & Swor., 2018). Other two indigenous species, Neolissochilus hexagonolepis and Puntius

chilinoides remained dominant (Zhongming, et al., 2018).

According to local residents and forestry division, 28 community forests can be found in Indrasarowar where wild animals like Pangolin, Jackal, and King Cobra can be found. Some of the local bird species observed in the area are *Streptopelia chinensis* (Dhukur), *Columba livia* (Malewa), and *Pycnonotus cafer* (Jureli) but no migratory birds were reported in the area.

Indrasarowar has adverse geological conditions, prolonged and high intensity rainfall which triggers the mass movement causing landslides resulting in siltation. In the past, soil conservation program was implemented in the watershed areas where the main measures such as tree plantation on degraded land, introduction of fruit trees in farmland, on-farm conservation, road slope stabilization and landslide stabilization was done. But those measures were insignificant compared to the needs. Therefore, it still faces huge sediments in the reservoir affecting the habitat of faunal community underwater.

Jagdishpur Reservoir was built in the early 1970s for irrigation purpose but after two decades it has developed its own ecosystem. The reservoir has high faunal diversity as it is one of the important bird areas of Nepal. A total of 68 plant species, 43 species of fish, 52 species of herpetofauna, 168 species of birds, and 32 species of mammals are recorded in the area. Among the 168 species of bird, 28 species are either globally or nationally threatened (Baral et al., 2016). The reservoir is extensively covered with floating leaf species mainly lotus (Nelumbo nucifera) followed by wild rice (Hygrorhiza aristata) and pondweed (Potamogeton nodosus). Other species include water velvet (Azolla imbricata) and duckweed (Lemna spp.), water nymph (Naja minor), hydrilla (Hydrilla verticillata) and hornwort (Ceratophyllum demersum) (Dhakal et al., 2015). Jagdishpur is identified as an important bird area (IBA) by Bird Life International because of its international importance for threatened species and their habitat conservation. Therefore, government agencies, non-government organizations and international conservation partners are implementing various projects and programmes for biodiversity conservation, wetland restorations and livelihood improvements. This has somehow helped in conserving the floral and faunal diversity around the lake. However, the illegal fishing and pollution has been seen in the recent years which might affect the diversity of the indigenous fish species in the lake.

In general, these lakes serve their specific purpose, i.e. generation of electricity (Indrasarowar), and providing water for irrigation (Jagdishpur). This means that the lake appearance does not remain constant all year round. Since the reservoir is mainly used for irrigation purpose, the water level fluctuates which might imbalances the whole ecosystem of the lake. However, this does not bring drastic change in the lake but somehow affects the floral and faunal diversity.

4. Results and Discussion:

4.1 Wetland services and their contribution to human kind: Jagdishpur Reservoir and Kulekhani Reservoir

Wetland ecosystems provide many services that are vital to the wellbeing of humankind. The people residing around Kulekhani and Jagdishpur are dependent on the services provided by the reservoir. The provisioning services such as food and fibre, supporting and regulating services such as biodiversity conservation and nutrient cycling are some of the vital ecosystem functions which are essential for human being. In addition, wetlands have cultural and aesthetic values and provide opportunities for tourism and refreshment, as have been reported in both the cases. Nevertheless, striking a fine balance between conservation of delicate ecosystems and their sustainable utilization for the benefit of local population is a difficult task. Usually, the common properties tend to be overexploited with limited attention paid to their sustainable management. The fate of these two reservoirs are no different than other common property resources. These wetland ecosystems are harmed due to haphazard use of the resources, with insufficient mechanisms in place for their conservation.

Kulekhani reservoir provides two of the most important wetland ecosystem services i.e. Hydroelectricity and fish production. Nepal being rich in water resources, production of hydroelectricity

is of particular importance. Kulekhani reservoir has set example for being a man-made reservoir with primary focus being electricity production. Fishery is also another important services which contributes to local and national economies by promoting internal tourism. Likewise, Jagdishpur Reservoir provides one major wetland ecosystem services i.e. irrigation to the agricultural land. In addition, these reservoirs provide other regulating, supporting and cultural services (Table 4).

Table 4: Watershed services provided by Kulekhani Reservoir and Jagdishpur Reservoir

	Watershed Services			
	Provisioning services	**Regulating Services**	**Supporting Services**	**Cultural and Amenity Services**
Kulekhani Reservoir	1. Hydro-electricity 2. Fish Production 3. Freshwater supply 4. Agriculture: Crop and fruit Production 5. Food for wildlife 6. Fibre and fuel	1. Carbon Sequestration 2. Soil protection through vegetation and soil biota 3. Control of soil erosion and sedimentation	1. Biodiversity conservation	1. Tourism and recreation
Jagdishpur Reservoir	1. Irrigation for agricultural land 2. Water for livestock	1. Water Retention 2. Groundwater replenishment 3. Carbon Sequestration	1. Wildlife habitat 2. Habitat for migratory birds	1. Tourism and recreation 2. Cultural/ religious activities by homestay groups

4.2 Situation Mapping through SWOT Analysis: Kulekhani Reservoir and Jagdishpur Reservoir

To fully understand the potential of the area for conducting PES, situation analysis through SWOT has been done to assess the gaps and constraints as well as identify opportunities and treats within the watershed area. The findings of SWOT analysis are summarized below in the Table 5.

Table 5: SWOT analysis of Kulekhani Reservoir and Jagdishpur Reservoir

Kulekhani Reservoir	
Strength	**Weakness**
» Watershed Services as drinking water and electricity generation » Formation of boat, fishery, and hotels association which helps with income and employment generation through fish production, tourism and boat operation at the lake » Commercialized area for vegetable production » Good roads and near to a major market hub - Kathmandu valley	» No fingerling production. Fish production is minimum, not enough for the hotel consumption » No diversity in fish species » Local institution and local community lacks awareness and knowledge for enhancing ecosystem services » No proper study done to check the siltation condition of lake » Boaters and fishery association is more income focused but not conservation oriented
Opportunities	**Threats**
» Attracting more tourists by diversification of program- Cycling /walking trail » Including indigenous fish cage together with fishery development center » Kulekhani Lake has potential to hold more than 50 lakh fish fingerlings which can help to increase the fish production » Fish fingerlings can be produced with technical support from Fishery development centre	» No proper waste management leading to water and soil pollution affecting the fish growth rate » Road construction leading to soil erosion and siltation of lake » Heavy use of fertilizers and pesticides leading to effect in health of farmers and change in quality of lake water » Conflict between Thaha Municipality and Indrasarowar Municipality regarding the ownership of the lake and the allocation of revenue received from the NEA
Jagdishpur Reservoir	
Strength	**Weakness**
» Water used for irrigating 6,200 hectares of agricultural land around the reservoir » Ramsar Site with diverse fish species, animal species and wild plants	» No diverse livelihood options » Less investment done through provincial or municipal level for lake management » No proper coordination between the relevant stakeholders done before implementing development activities around lake
Opportunities	**Threats**
» Increasing the water capacity of the lake so more farmers can be benefitted with the irrigation » Future PES institution with major actors such as Banganga Irrigation Office, Irrigation Forest Division, JRMMSF, wards, and local communities » Diversifying livelihood options for generation income and employment opportunities	» Less awareness regarding conservation among the local community » Restriction to fish farming results in illegal fishing » Conflict between forest department, irrigation department and JRMMSF regarding the ownership of the lake » Confusion regarding ownership of the lake among province and Kapilvastu municipality » Siltation of around 5-7 m in the lake

Summary of the SWOT analysis:

The SWOT analysis suggests that the key strengths of Kulekhani Reservoir include the ecosystem services like electricity generation and income generation through fish farming, hotels and restaurants and tourism sector. Kulekhani Reservoir is one of the nearest touristic destinations for the people from capital so the tourism in this area is flourishing day by day. Not only tourism but the area is also well-known for commercial vegetable production. Within a few years, the face of Kulekhani has changed drastically and it has helped the people residing there to engage in tourism activities as well as in commercial vegetable production. Other opportunities which can be explored in Kulekhani include diversification of tourism program such as opening of homestays, walking trails, introduction of local cuisine in the homestays, and production of safe and healthy food.

Kulekhani could be a good example of development, and carries many new opportunities which need to be explored. However, there ae many weaknesses when it comes to the sustainability of the development of this area. In short-run, there is no doubt that the area will flourish but if we see for a long run, there are lot of complications seen with this kind of development. The lake/reservoir is one of the major tourist attractions of Kulekhani but efforts for its conservation cannot be seen in local level planning, and also there is lack of awareness among the relevant stakeholders. These pose serious threats on the sustainability of the lake, especially pollutions arising from unplanned construction of hotels and restaurants. Right now, the lake is facing a huge sedimentation due to haphazard and unplanned road construction works in upstream/ watershed area. Though access to road is one of the important infrastructures to enhance the local economy, such intensive economic activities tend to degrade the environment. Such activities cause soil erosion, landslides and the eroded soil flows into the stream and finally to the reservoir. This threatens the sustainability of the Kulekhani reservoir as well as the watershed ecosystem. The water quality is compromised which directly affects the growth of the fish in the lakes which is major source of the income. Another weakness is the excessive use of the chemical fertilizers and agrochemicals (pesticide and fungicide) for vegetable production which may pose threat to the health of the farmers as well as the consumers. Holistic approach to development with active participation of relevant stakeholders is the way forward where conservation (reduction of siltation) activities should receive priority along with other development activities.

Jagdishpur Reservoir, which was solely constructed for irrigation purposes, has now become a valuable ecosystem which provides services like water for irrigation as well as a hub for different migratory birds, diverse fish species, wild plants and animals. It is the strength of the reservoir that has made it to the list of Ramsar sites. Though its significance is recognized on a global scale, it is less well known among national tourists and locals. Just like Kulekhani reservoir, Jagdishpur reservoir has full potential, but unlike Kulekhani, Jagdishpur reservoir has its own niche when it comes to attracting visitors. Jagdishpur is a hub for migratory birds, and the tourists who visit here come to watch the different species of birds. On average, 12 tour groups visit the wetland each month, which shows that tourism has improved drastically (UNDP, 2016). Although there isn't an exact record of the visitors coming to the lake, the JRMMSF shared that around 200-400 visitors every month, which mostly includes tourists visiting through groups, students, and researchers. During the bird watching season, around 1000-1200 visitors normally visit the lake, which is mostly international tourists. The reservoir does not have proper accommodation facilities for visitors to spend quality time, thereby reducing their stay in the area. Tourism can generate income and employment at the local level, and revenue for the government only when tourists/visitors spend time and money at local level. Investment in infrastructure is a prerequisite for tourism to flourish in any area. So, this can be one opportunity to generate income and provide employment to the people of the community. Another opportunity can be establishing cage culture in the reservoir where the fish species do not affect the food and space of indigenous fish, which means local people can generate a good income by selling it in the market. Till now, there is no commercialized fish farming done in the lake, so establishing a formal group or cooperative to carry out fish farming could be an option to generate income locally. However, the importance of indigenous fish species should be known to the people of the community. One of the major strengths of the Jagdishpur Lake is that it has the capacity to pilot the PES scheme.

Just like Kulekhani, Jagdishpur also has its weaknesses. The reservoir can be a good source of income through fish farming, hotels and restaurants which effectively means diversified livelihood options for local population. Since fish farming has not been legalized in the reservoir, locals have resorted to illegal fishing to sustain their livelihood and supplement family income. Though the people in the community are already trained regarding the importance of conservation of the lake, but in the absence of motivation for action in terms of income opportunities, locals have not shown much enthusiasm in conservation efforts. Experiences from elsewhere have shown that local communities actively engage in conservation efforts when they see a clear link to income opportunities or direct benefits in other ways (Chaudhary et al., 2015). At Jagdishpur Reservoir, there can be seen conflict between the major actors i.e. municipality, ward, irrigation, and forest division. This can pose serious threat regarding the planning and development of the reservoir. This has led to confusion regarding the ownership of the lake. Also, it is seen that there is no proper coordination amongst the relevant stakeholders.

The irrigation office built the reservoir because there was need of irrigation water for irrigating agricultural land. But now, its only purpose of irrigating has changed and other ecosystem services have emerged. This brings us to think broadly and use the interdisciplinary approach to redefine the problems and come up with solutions based on the new understanding of the complexity of the situation.

4.3. Key challenges to obtain quality ecosystem services

Human Impact on Watershed

Biodiversity is the variety and variability of living organisms and plays functional role behind the delivery of ecosystem services which is valuable for the human kind. If there is decline in biodiversity, the structure and functioning of whole ecosystem is altered. Both Kulekhani and Jagdishpur Reservoir are facing multiple environmental threats which have been affecting the biodiversity hence disturbing the whole ecosystem. The ecosystem services are integral parts to the local communities. Human disturbances, development works and water use are major pressures which impact the delivery of ecosystem services. Many people in Nepal reside in the rural areas where the forests, streams, lakes, reservoir are important for the livelihood of those people. The local communities also depend on their land for producing agricultural products which often leads to change in land use practices. All these changes brought by the livelihood practices could lead to the loss of natural habitats affecting the biodiversity.

Most of the households of Indrasarowar Rural Municipality are dependent on agriculture. The farmers are involved in commercial production of vegetables. These farmers are fetching good income by selling the agricultural products to nearby cities. On one hand the agriculture sector is booming whereas on other hand to keep up with the demand the farmers are cultivating vegetable in a very unsustainable way. Heavy use of pesticides, chemical fertilizers, and herbicides are seen in these areas. Due to the adverse geological condition, the heavy use of such chemicals in the upstream communities is indirectly affecting the reservoir as the chemical fertilizers and agrochemicals leach through the soil and mix with the water source thereby adversely affecting water quality. Due to improper management and utilization of reservoir, challenges such as change in water quality, sedimentation and reservoir eutrophication are seen.

In Jagdishpur reservoir also, most of the households depend on agriculture and use of chemical fertilizers is seen as it is one of the commercial areas for agriculture production in Nepal. The reservoir's ecological water quality is seen poor because of pollution coming through inlet and seepage from the farms around it. Other human activities like washing clothes, bathing, defecation has worsened the reservoir condition and heavy siltation was observed. Jagdishpur wetland has faced many environmental threats such as overexploitation of wetland resources, illegal fishing, land encroachment and water pollution. The farmers residing around the reservoir are highly dependent on the wetland water for irrigation. However, the weather events such as droughts and flooding pose serious challenge for the farmers. In order to maintain the reservoir and support the people residing around the reservoir, a Community Wetland User Group (CWUG) was formed under JRMMSF. The CWUG were actively participating to address local poverty, promoting alternative livelihood options, raising awareness for

conserving the reservoir in the past. However, the CWUG has seen to be passive in recent times. This was seen due to no budget and staff to support daily operations in the JRMMSF.

Impact of Climate change

The study of rainfall pattern of about 30 years showed decreasing trend in the annual precipitation in both the Kulekhani Reservoir and Jagdishpur Reservoir. In case of Kulekhani, river flow has significant effect on the electricity generation of the hydropower. The changing climate shows decline in the amount of annual rainfall. This change in precipitation pattern shows monsoon receives more rainfall in lesser number of days indicating short monsoon period. There is decrease in the total amount of rainfall in winter and post monsoon season. The self-life of hydropower plant depends on precipitation and discharge during various seasons and years. Climate change impacts are inevitable if we see its effects to the precipitation and flow regime of the Kulekhani watershed area.

For Jagdishpur watershed also, the decrease in annual precipitation will result in water scarcity for irrigation purpose. In the land use data of 2020, it is seen that 0.43 sq.km of the land is flooded. Due to climate change the farmers faced floods from farmers managed irrigation systems in the Jagdishpur Reservoir. The Reservoir area get flood in the rainy season whereas drought in the summer season. Besides that, Jagdishpur Reservoir is an important bird sanctuary. As a result of climate change it is anticipated that many species may decline, hence a close monitoring of how species composition change over the years need to be recorded and appropriate measures to decelerate the process must be taken. .

Specific PES related Policies and Plan

In Nepal, there is no specific PES law, policies or plan made till now. However, there are few environmental related legislations such as National Parks and Wildlife Conservation Act (1973), Soil and Watershed Conservation Act (1973), Water Resources Act (1992), and Forest Act (1993). These acts plays a major role for implementing specific activities as well as checks the activities which have adverse effects on the environment. Among these acts, National Park and Wildlife Conservation Act and Forest Act provides opportunities for institutionalizing PES mechanism. The Forest Act recognized community-based forest user groups whereas National Parks act charges fees for entry or hunting. This shows that there are some policy and legislative frameworks with provisions for incentives for providing ecosystem services. However, institutional mechanism still needs to be developed to fully establish and implement a PES scheme in Nepal. As Nepal does not have specific PES law and policy, it can be drafted by incorporating indigenous practices of specific ecosystem services for the conservation of the catchments from where the services are provided.

Community Perception on PES mechanism and benefit sharing

In any PES schemes, upstream and downstream communities play important role and should be engaged in the decision making process for the smooth and effective operation of PES projects. If we take an example of Kulekhani Reservoir, the NEA is the service buyers whereas the upstream communities are service providers. The PES concept was introduced in the first place to support the livelihoods of upstream communities for ensuring forest conservation and decreasing the sedimentation in the reservoir. However, the communities from both upstream and downstream receive 50-50% of the revenue. This has created conflict between the upstream and downstream communities because the upstream communities argue that they should be receiving the full benefit whereas the downstream communities argue that they should continue to receive benefit as currently in practice. Even though there is unresolved conflict going on, the PES scheme is considered to be a good initiative to maintain water flow to the reservoir. Such unresolved conflict on the benefit sharing mechanism asks for a concrete institutional framework or at least a clear negotiation needed before such PES schemes are implemented.

The upstream and downstream communities play an important role in conserving the watershed areas. Most of the burden lies with the upstream community to play their role in the conservation matters. And this can only be achieved if the downstream community are motivated to pay for the service provided by the upstream community to conserve the watershed. This clarity is still not seen in the communities of Indrasarowar Rural Municipality.

5. Way forward: Overcoming the key challenges/gaps for the management of wetlands

Environmental sustainability: Biodiversity and ecosystem services together can be used as an overall adaptation strategy to help people adapt to the loss of biodiversity through different factors. Such approaches to adaptation could be accessible and cost effective for the upstream and downstream communities of the watershed areas.

Both the watersheds have different land uses, such as agricultural, residential, commercial, and forest. Due to improper use of crop fertilizers and manure, the nutrients such as nitrogen, phosphorous, and potassium runoff from the land and reach the water sources, which may affect the plant growth in the water (algal bloom) and may limit oxygen in the water for fish production. In order to overcome this, emphasis on sustainable land management measures should be considered. In that way, the productivity of land is improved and production is increased on the basis of land capacity. Land management practices should be aligned with natural processes such as on-farm conservation, fruit tree planting, conservation plantation, and degraded land rehabilitation. Likewise, farmers should practice agroecology-based farming on their farm where organic manure is used, which somehow limits the runoff. Otherwise, farmers can opt for Integrated Pest Management (IPM), where other control methods besides chemical methods are focused. And if necessary, chemical pesticides and fertilizers are used judiciously, keeping the sustainability of soil in mind. Other options for managing erosion on agricultural land can be done through mulching, cover cropping, contour farming, trip cropping and conservation agriculture practices. Besides that, the water sources are highly polluted by some visible household waste or waste coming from hotels and restaurants, so some awareness regarding this should be done.

Community based conservation awareness: Community based conservation awareness should be prioritized by providing conservation related awareness programs to the local people with focus on poor and marginalized communities. In Kulekhani, it was seen that people involved in hotel business, boating association and fishery association and people residing in the upstream and downstream community were less aware regarding the importance of wetland and its management. Therefore, the associations and people residing in the upstream and downstream communities should be made aware about the wetland conservation and importance of its conservation for wider benefits. It is the upstream communities' responsibility to conserve the watershed areas as they are the service provider. This can be done by informing the upstream communities regarding their role on increasing the water holding capacity and controlling the soil erosion. Upstream communities will be interested in conservation efforts only when they see the benefit accruing to them for following good conservation practices.

In Jagdishpur Reservoir, the local communities have less knowledge regarding conservation of Ramsar Site. The local communities should be trained regarding valuable species identification (fish, birds, wildlife, and wild plants).Together with that they should be sensitized on bird conservation, indigenous fish conservation, and wild plant conservation through conservation related programmes such as displaying local biodiversity information, media coverage, street dramas, schools programs, and establishing eco-clubs. Also, programs like community based anti-poaching programs, water quality monitoring and good aquaculture practice promotion programs should be focused in Jagdishpur area.

Diverse livelihood Interventions: In both watersheds, many income generating activities can be initiated to decrease the pressure on the local ecosystem. Kulekhani has already diversified the livelihood option and many local people are earning good income and generating new employment opportunities. Whereas in Jagdishpur, due to low level of awareness, the poor and marginalized communities are dependent on illegal hunting of fish and birds for their livelihood. One of the option to control this situation is to identify such communities and support in diversifying the livelihood of those communities. In case of Jagdishpur, the community managed homestays which reflects the traditional knowledge and food culture already exists there. Strengthening such homestays and supporting them for active functioning can help to diversify the livelihood of

the local community. Besides, the lake can establish a mechanism of collecting entrance fee from the visitors, which can be used for carrying conservation activities. This also creates employment opportunities at the local level. Other income generating activities can follow which can be developing small enterprises such as small tea shop, hotels, souvenir stalls, guide services etc. further diversifying livelihood options. Another option can be establishing cage culture in the reservoir where the native fish species or the species which does not affect the food and space of indigenous fish can be introduced. Such diversified livelihood activities should target poor, disadvantaged groups and local youth of Jagdishpur.

Capacity building of community institutions and governmental institutions for conservation and wise use of wetland resources: The level of understanding and knowledge of wetland conservation and wise use of wetland resources vary among the community institutions, governmental institutions and other relevant stakeholders. The staff of these institutions should be capacitated on wetland issues and threats, wetland friendly plan and programme. In both the study sites it has been seen that there is limited knowledge and skills on wetland management and conservation. So, capacitating these institutions will help on including wetland conservation activities in their regular plan and programme preparation. In case of Jagdishpur Reservoir, a mechanism for smooth operation of JRMMSF should be developed. This will help in strengthening coordination and building partnership with governmental agencies to plan and implement wetland conservation related activities. Also, there is limited budget allocation for the management of the wetland resources so strengthening the forum with adequate budget and human resource should be thought of. The members of forum need to be sensitized on their roles and responsibilities for wetland conservation including networking skills so they can lobby the relevant governmental and non-governmental agencies for its support.

Climate Change Adaptation: Though the impacts of climate change are inevitable, the only option to deal with the changing climate is through adaptation. Climate change is a cross cutting issue which has impacted all the sectors, particularly the rural households whose livelihood depends on agriculture. The erratic rainfall pattern has resulted in landslides and erosion in the hills whereas more intense rainfall causes floods in the Terai region of Nepal. In the community level there is limited awareness and knowledge to understand the climate change scenarios and how to address such issues in the longer term basis.

In order to conserve the water level in these reservoirs, conservation activities like afforestation can be done in upstream areas to store more water with regulated release of water in the lakes. Also, plantation helps to recharge the ground water that would help in conserving water. As most of the people impacted by the climate change are farmers, adaptation strategies related to agriculture should be formulated and acted upon. Some of the adaptation ways include shift the cropping patterns, choosing the crops which are resilient (drought tolerant crop varieties), conserving the water resources by constructing ponds, shifting from agriculture to agroforestry and so on. Such practices will help to recharge ground water, control soil erosion and reduce siltation in rivers which will ultimately protect fisheries in the lakes.

Operationalizing PES in both the watersheds: Public institutions (local, provincial and national) and private institutions (non-governmental organizations) can play a major role for PES scheme implementation. Both public and private institutions can come together to form a watershed management committee and strengthen its capacity to implement the PES scheme at local level.

In the changed political scenario, Kulekhani Reservoir can form a committee which includes the representatives from all the major stakeholders including Indrasarowar Rural Municipality, NEA, community forest user groups, NGOs, political institutions, ward representatives, fishery association, hotel association, and other relevant community institution. A conservation fund should be developed by the committee which should be timely monitored by the committee members. The revenue gathered from NEA can be used to develop the conservation fund. The committee later can work on conservation project activities which compensate the community member for better livelihood support. Bundling other

ecosystem services such as recreation, cage farming may give better return to the community. Specific PES law can be developed by incorporating local law and indigenous practices through the implementation of PES project. The draft of PES law can be endorsed with the provincial and national authorities for institutionalization of PES as a policy instrument.

In case of Jagdishpur, capacity building of JRMMSF should be focused for carrying out the reservoir management tasks. The forum should be made well aware the importance of ecosystem services and why PES is necessary for benefitting the community. There is limited budget allocation for the management of the wetland resources so here also bundling of ecosystem services such as recreational activities, biodiversity conservation, fish farming, ticketing system for the visitors can give good return to the community thereby motivating locals for their participation in conservation activities. Certain percentage of the profit can be allocated by creating a conservation fund. Later, the lake conservation fund can be mobilized by the forum in a transparent way and the fund can be used for carrying out conservation related activities around the lake. As the Jagdishpur Reservoir is in direct influence of many governmental agencies so creating synergy between Jagdishpur Municipality, Irrigation office, and Forest division to support JRMMSF is crucial for wetland management.

Endorsing PES mechanism in government policies, act and plan: In recent years, Nepal has witnessed many improved ecosystem conservation approaches which are community based. The importance of conserving ecosystem has not only been seen in the national level but also at community level which has helped to achieving sustainable management of the ecosystems. To achieve the sustainability of ecosystem services and the livelihood, there are many PES-type practices and schemes seen in Nepal which rewards the local communities for their positive efforts. In 2014, Bhatta *et al,* reviewed 10 such PES schemes based on different literatures and key informant survey. The study recommended that PES shows a promising potential but needs concrete legislative and institutional mechanism for its success. Also, they suggested that the existing PES schemes needs constant monitoring to analyze their challenges and effectiveness.

Lately, there has been increasing attention regarding ecosystem services among the policy makers of Nepal. Nepal has list of national level wetland policies, plan and acts which address wetland issues in Nepal. Environmental Protection Act 1995, Forest Act 1993, National wetland Policy 2012, National Biodiversity Strategy and Action Plan (2014-2020) are some of such government policies and plans. However, a special attention to the payment for environmental services has been given in the Forest Act 1993. In case of Kulekhani PES scheme, Local Self Governance Act and its subsidiary regulations were the main policy framework used for institutionalizing PES. This means that the rules for PES institutions come from these policies. Instead of bringing new policies, it relied on the existing policy which did not do justice to core value of a true PES and hampered the performance of the mechanism. Another lesson learned from the Kulekhani PES is that it is imperative to include most important actors in the design process for making rational rules, developing systems for effective implementation and monitoring. This was not seen in Kulekhani PES which hampered the effectiveness of a PES regime. Even there is no specific PES laws, but the PES scheme is run in different parts of Nepal where indigenous practices at the local level is used to conserve the catchments. So, a specific PES law can be created by incorporating local level customary laws and indigenous practices by implementing PES pilot projects, which can then be extrapolated at national level.

In case of PES scheme in Kulekhani Reservoir, Indrasarowar Rural Municipality, community and NEA can play important role in implementing PES schemes whereas at Jagdishpur Reservoir, Jagdishpur Reservoir Management Multi Stakeholder Forum, Irrigation Office, Forestry Office and community can be part of implementing PES projects. Together with that other major actor from the watershed area can be included to minimize the influence of institutional interplay and bring dimensions to meet the goals. The learning generated can be used to draft a specific PES law and disseminated to the provincial government.

Resolving conflict on the benefit sharing mechanism: The PES mechanism in Kulekhani raised the hopes of upstream communities by offering additional fund for community development but its

effectiveness for meeting the outcomes has been questioned. The true PES mechanism was buried under the institutional interplay, politics behind the negotiations of institutions and design deficiencies. Not only in the Kulekhani but in many other PES schemes, it was seen that the upstream community was dissatisfied with the payment size. Therefore, a scientific and standardized basis for negotiations is needed to minimize the potential conflict. Valuation of the ecosystem services is therefore important to determine the size of the PES payment. For such conflict to not arise it is important that such issue is addressed from the start in any PES scheme designs. Another conflict can be raised if one of the PES criteria "Conditionality" is not considered. In most of the PES cases of Nepal, there are no provisions or discussion on conditionality of payment when the supply of ecosystem services does not meet the level indicated in agreement. For example in Kulekhani, the ecosystem provider should secure its delivery of the ecosystem services. If there is siltation, then it means the upstream conservation is compromised. It is still not clear in such case what should the payment mechanism be. So, there should be provisions of adding conditionality of payments in the existing policies or agreements to avoid any future conflicts.

Comparative analysis of Rupa Watershed, Kulekhani reservoir and Jagdishpur reservoir: Kulekhani case shows that it is the beginning of something new in natural resource management of Nepal. Though there are many problems seen with its design but the lessons learned from Kulekhani can pave way to formulate national PES policy of Nepal and implement PES at a larger scale. For instance, the lessons learned from existing PES schemes can lead a way for making PES-related policies and framework to apply in new area like Jagdishpur Reservoir. From our findings, it is seen that there is need of concrete institutional mechanism for making PES successful and there should be conditionality in payment for sustainable ecosystem services delivery which of course should be embedded in the legislation and agreement to avoid future conflicts.

Rupa case showed that an innovative community institution dedicated to the sustainable governance of the common resource (Lake/reservoir) helped to change the conflict into collaboration. This learning can be used in case on both Kulekhani and Jagdishpur. Community institution such as conservation committee in Kulekhani and lake management forum in case of Jagidshpur can demonstrate themselves as strong institution for sustainably managing the wetland overcoming the conflict. The Rupa watershed was not privatized or nationalized instead cooperative was established by the local communities that lead to community based environmental management. Though there are still difficulties faced by the Rupa cooperative, it is common to have ups and downs in resource management of common property. Kulkekhani and Jagdishpur Reservoir is no different from Rupa and it's likely that such conflicts or difficulties will come across when dealing with common resource. In order to manage the watershed areas effectively and efficiently there must be a balance between ecosystem conservation and livelihood enhancement opportunities for the communities. The policies and strategies should be developed keeping this in mind.

Also, it's always seen that support of intermediary organizations is needed. Previous studies done in Kulekhani and Rupa have showed that support from local NGO like LI-BIRD and project like RUPES played an intermediary role for proper implementation of the mechanism. For the sustainability of such benefit sharing mechanism, at the end of the day it's the communities residing there have greater roles. Most importantly the communities have to own the wetland as their own. And it is only possible when equitable sharing of benefits comes from sustainable management of wetland resources. Rupa cooperative has been doing this since 2002 and its still following the same process. From our study, it is seen that both Jagdishpur and Kulekhani Reservoirs lack such ownership among communities. In the absence of strong local organization to work on equitable benefit sharing mechanism means unmanaged wetland resources.

The PES model applied in Rupa watershed has the potential to be replicated in both Kulekhani and Jagdishpur as well as other wetland areas of Nepal. However, detail understanding of the wetlands along with local context, local organization etc. is necessary. Since the PES schemes are location specific, the study report may not completely relate to the other PES schemes of Nepal but its learnings can inspire changes in other new schemes.

References

Amatya, S. M., Cedamon, E., & Nuberg.I. (2018). Agroforestry Systems and Practices in Nepal- Revised Edition, Agriculture and Forestry University, Rampur, Nepal.

Baral, S., Basnyat, B., Khanal, R., & Gauli, K. (2016). A total economic valuation of wetland ecosystem services: An evidence from Jagadishpur Ramsar site, Nepal. *The scientific world journal*, *2016*.

Bhatta, L. D., van Oort, B. E. H., Rucevska, I., & Baral, H. (2014). Payment for ecosystem services: possible instrument for managing ecosystem services in Nepal. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *10*(4), 289-299.

Bhusal, K. P., Rana, D. B., Joshi, B. J., Chaudhary, I. P., Ghimire, P., & Pandey, M. (2020). Diversity and abundance of winter wetland birds in Jagdishpur reservoir Ramsar site, Kapilvasty, Nepal. *Bird conservation Nepal.*

Chaudhary, P., Chhetri, N. B., Dorman, B., Gegg, T., Rana, R. B., Shrestha, M, Thapa, K., Lamsal K., & Thapa, S. (2015). Turning conflict into collaboration in managing commons: A case of Rupa Lake Watershed, Nepal. *International Journal of the Commons*, *9*(2).

Chaudhary, P., Chhetri, N. B., Dorman, B., Gegg, T., Rana, R. B., Shrestha, M., Thapa, K., Lamsal, K., & Thapa, S. (2015). Turning conflict into collaboration in managing commons: A case of Rupa Lake Watershed, Nepal. *International Journal of the Commons*, *9*(2).

Dhakal, G., Khanal, R., Baral S., Basnyat, B., Poudyal, Amit S., Malla, Y., Acharya, R., Khadka, S., Poudel, A., Joshi, R.,& Sedai, R. (2015). Biodiversity and Livelihood Assessment in Jagadishpur Reservoir Ramsar Site.

Dhonju. M. (2010). Status and human impact assessment of Jagdishpur Reservoir-A Ramsar site, Nepal.

Gauli, K., Ghimire, P. L. (2014). Payment of Ecosystem Services in Nepal: Status, Prospects and ways forward.

Hansson, L. A., Brönmark, C., Anders Nilsson, P., & Åbjörnsson, K. (2005). Conflicting demands on wetland ecosystem services: nutrient retention, biodiversity or both?. *Freshwater Biology*, *50*(4), 705-714.

IUCN Nepal (2004). *A Review of the Status and Threats to Wetlands in Nepal*

Karky, B. S., & Laxman, J. (2009). Payment for environmental services-an approach to enhancing water storage capacity. *ICIMOD, Sustainable Mountain Development,* (56), 31-33.

Khatri, D. B. (2011, January). Payments for ecosystem services in Kulekhani Watershed of Nepal: An institutional analysis of mechanisms for sharing hydroelectricity revenue. In *13th International Association of Study of Commons Conference at Hyderabad, India* (pp. 10-14).

MoFE (Ministry of Forests and Environment) 2018. National Ramsar Strategy and Action Plan, Nepal (2018-2024). Ministry of Forests and Environment, Singha Durbar, Kathmandu, Nepal

Riggs, S., Harrison, J., Cory, B. D., & Booth, N. L. Taking a systematic approach to integrated wetland management in Rupa Lake Area of Nepal.

S.B. Shrestha et al. 1980. Pre-impoundment survey of the Kulekhani Reservoir Area. A report submitted to Fisheries Development Division, Department of Agriculture, Harihar Bhawan. Kathmandu.

Shrestha, B., Shrestha, S., Shrestha, A., & Khadka, U. R. (2020). Ramsar sites in Nepal: Conservation, present scenario, biodiversity value and threats. *Journal of Wetlands Ecology*, *15.*

Singh, D.B & Swor, D.B. (2018). Impact of dams on fish in the rivers of Nepal. Asian Development Bank.

Smith, M., de Groot, D., & Bergkamp, G. (Eds.). (2006). *Pay: Establishing payments for watershed services*. IUCN.

UNDP (2016). Alliance for Integrated Development, Nepal. Equator Initiative Case Study Series. New York, NY.

Wunder, S. (2005). Payments for environmental services: some nuts and bolts.

Wunder, S. (2015). Revisiting the concept of payments for environmental services. *Ecological economics*, *117*, 234-243.

Zhongming, Z., Linong, L., Xiaona, Y., Wangqiang, Z., & Wei, L. (2018). Impact of Dams on Fish in the Rivers of Nepal.

Annexes

Annex I: Checklist for conducting feasibility study at Jagdishpur and Indrasarovar Reservoir

Stakeholder consultation (KII) with Representative form Ministry of Forest, Environment and Soil Conservation and Municipalities

Lake, Wetland and watershed conservation

» What are the ecological and climatic vulnerability of this area?

» What are the strength and opportunities of ecosystem services of this area? What are the key ecosystem services provided by the ecosystems in the Reservoir?

» What are the risk and issues of ecosystem services in this area? What are the root causes for ecosystem degradation in this area?

» What are the key challenges for the conservation/restoration of ecosystems and improving ecosystem services in the reservoir?

» What are the critical sub-watershed and landscapes that need attention for conservation/restorations?

» Who are the key stakeholders involved in conservation of Reservoir? What are their roles/responsibilities? How they work now and what are the key challenges faced by them?

» Are there other organizations involved in that area for improving the conservation of the ecosystem? If yes, what kind of interventions are done by those organization?

» What were the gaps? What kind of interventions would help improve the conservation of ecosystem as well as improve local livelihoods?

Institutional Roles

» Has your department allocated budget for the management of the wetland resources?

» Are there any joined plan and activities between different government, nongovernment agencies, and community institutions for the conservation of wetland?

» Are there any local initiatives (forums/committee) established for managing resources (watershed resources, forest resources, water resources) and strengthening coordination, collaboration and communication for sustainable management of wetland resources?

» If there is such program, can you list out such forums/committee? How would you rate the coordination and collaboration part of those forums/committee? Poor, average or good?

» What kind of capacity building intervention is needed to aware the local institutions? What kind of support will enhance their capacity?

PES Mechanism

» What do you understand about PES mechanism?

» Does the reservoir have any PES-type schemes? Yes or No

» **If Yes, then:**

1. What is the system of PES in these area?
2. Is the need assessment done before implementing PES mechanism?
3. Was the main problem identified through the need assessment? And was the problem prioritized?
4. Were the budget and activities planned before the implementation of PES schemes?
5. 5. Were the policies, guidelines and framework made before implementing PES project cycle? How was the management done? Was any amendment done to the guideline when needed?
6. IS the PES schemes properly monitored and Evaluated? Is the budget spend on PES related activities?

» **If No, then:**

1. 1. Do you think it is important to implement PES mechanism in the reservoir?
2. 2. Will there be possibility of collaboration in future for carrying out such intervention in these area?
3. 3. What will be your potential role at that time?
4. 4. What may be the option for payment mechanism from the Ministry perspective for transferring financial rewards from those who benefit from the watershed service to those who manage it?
5. 5. How poor and marginalized people are included and benefitted?

In future, if needed will you be willing to co-finance either in cash or in-kind for the benefit of the ecosystem? Is there opportunities for partnership and resource leverage for carrying out such intervention in these area?

KII with Representatives from Ward

Livelihood and Community

» What is the total household in this area?

» What is the major ethnic and minority group of this area?

» What is the income source of the majority of people?

» What are the major crops grown and what is the cropping system of this area?

» Major livestock's and number of household involve in livestock farming?

» Are there any farm based enterprises?

» What is the food security situation?

» What is the poverty status here? Which group are most poor and what do you think is the reason?

» Does the farmer have good access to market? If not, what are the major challenges?

» What is the migration status of youths? Where are the youths seen to be migrated most? What can be done to change this scenario?

Biodiversity and Agrobiodiversity

1. What are the degradation issues of agrobiodiversity in the reservoir?
2. What has been done to capitalize agrobiodiversity related products? (value chain, seed bank, product diversification)
3. What are the unique commodity (local crop- agriculture, tourism, fish) form this area?
4. Does any species or crops growing in these area have socio-economic, cultural, commercial value?

Important Species/crops	Value (socio-economic, cultural, Commercial)	Uses (Own consumption/ Commercialized)
Fish		
Crops		
Medicinal plant		
Wild plants		
Others		

Diversity of the wetlands (bird diversity, fish diversity, wild plants)

5. Have you seen any changes on diversity of species found in the wetland? What was it like before? What is the situation now?

Changes seen (Species, Agriculture, livestock, infrastructure, Forest Cover)	Situation Before	Situation Now (species decline, lost)	What may be the cause? (Not good habitat, climate,)
Bird Species			
Fish species			
Wild plants			
Flora and fauna			
Medicinal plant			
Other endangers/vulnerable species			

Biodiversity and Ecosystem Services

» What are the ecological and climatic vulnerability of this area?

» What are the risk and issues of ecosystem services in this area?

» What are the opportunities of ecosystem services of this area?

» What are the value/importance of ecosystem services for sustaining local livelihoods?

» What are the key challenges for the conservation/ restoration of ecosystems and improving ecosystem services in the reservoir?

» What are the root causes for ecosystem degradation in this area?

» What is the level of awareness about the value to ecosystem conservation/restoration among local residents, hotel/restaurant owners, hydropower authority, irrigation/WUG, and other key stakeholders?

» Does the key stakeholders like home stays and resorts have their interest to promote local biodiversity based foods/products?

» What do you think about providing incentives for ecosystem conservation/restoration?

» What can be done for the restoration and improvement of Ecosystem services?

» What can be done to minimize the risk and issues of this area?

» What is the wards vision, policies and plan to support any initiatives regarding wetland conservation?

» Are there any community based organizations and what is their status as of now?

» Are there any ongoing project or past project which worked for the ecosystem conservation? Can you list it out?

Payment for ecosystem services (PES) (Explain PES example before the question)

» Is there PES scheme found in this area?

Yes ( ) No ( ) don't know ( )

» If yes, did you find any positive change for the ecosystem and the community?.....

» Were there any negative changes seen?.....

» If no, do you think PES scheme is necessary for wetland conservation?

» What kind of role the ward will play for smooth functioning of the PES mechanism?

In future, if needed will you be willing to co-finance either in cash or in-kind for the benefit of the ecosystem? Is there opportunities for partnership and resource leverage for carrying out such intervention in these area?

Questionnaire for Community consultation (FGD)

1. Communities and Livelihood

» What is the major ethnic and minority group of this area?

» What is the major livelihood sources? What are the major income activities of community people?

» What is the food self-sufficiency status?

» Is there enough workforce available to carry out income generating activities?

» What percentage of people have migrated to other district or country in search of job?

» What is the main reason for migration? What do you think would make them stay?

» What is the land ownership status of this area? (% of own land and lease land) And what is common land-size holding?

Livelihood

» What are the agriculture cultivation practices (field preparation, irrigation, manure and fertilizers, pest/disease control, harvesting) of this area? What are the major crops grown?

» What is the situation of external input and agrochemicals use for farming?

» Can you tell me about the Livestock keeping system? What are the major livestock's here?

» What are the major risks for crops and livestock?

» What percentage of households are utilizing the forest resource? What are the resources are mostly used for? (Fuel, fodder, NTFP)

» What are the land use changes seen here? What is the cause for such changes?

» Have you seen any impact on ecosystem due to change in land use system?

» Have you seen any climate change effect? If yes, what is its impact on livelihood assets/ resources (farm, forest, water, pastures, etc?)

» Are there any major risk, hazard and recurrent disasters which has affected your livelihood? (drought, flood, hailstone, landslide, diseases)

» How do you deal with it? Are there any community initiatives/coping mechanism to improve and secure your livelihood and conserve bio-diversity?

Biodiversity and ecosystem Services

» What is the status of agrobiodiversity? Can you find crop diversity in this area? If yes, what is its use?

» Does the farmers uses inorganic manure and fertilizers? If yes, what is the level of its use?

» Are the farmers practicing organic farming/ agro ecological farming?

» Do you save the seeds for next season? Does this area have any community seed bank?

» What are the benefits from watershed services that you are receiving?

Forest products:

Agriculture:

River:

Others:

» Do you think these services are important to you? If Yes give your reason:

Livelihood/irrigation/cultural/tourism/food, fuel, fodder

Others.....

» Does the people around use the natural resources/services around the wetland?

Yes ( ) No ( )

» Is yes, is there are threat to these services?

Yes ( ) No ( )

If yes, what are they?

Growing population/Deforestation/ Others.....

» What are the root cause of these threats?.....

» What do you suggest to minimize the threats? .....

» Does the community institutions like cooperatives/ forest user group have knowledge about the wetland conservation?

» If less knowledge, then how does the institution works on their capacity building? Examples?

» Do you think you can contribute for minimizing the threat for achieving sustainability of the watershed?

Payment for ecosystem services (PES) (Explain PES example before the question)

» Is there PES scheme found in this area?

Yes ( ) No ( ) don't know ( )

» If yes, did you find any positive change for the ecosystem and the community?.....

Were there any negative changes seen?.....

» If no, do you think PES scheme is necessary for wetland conservation?

» What kind of role the community will play for smooth functioning of the PES mechanism?

Annex 2: Photos

2.1: Relevant photos from Kulekhani Reservior


Figure 8: Kulekhani Reservior


Figure 9: Farmers dependent on chemical pesticides and weedicides (Left), Water polluton seen at the Kulekhani Reservior


Figure 10: Showing agricultural area at Kulekhani (Left), Focus Group Discussion done with farmers at Ward 1 of Indrasarowar Municipality (Right)

2.2 Relevant photos from Jagdishpur Reservior

Figure 11: Jagdishpur Reservoir

Figure 12: Showing multiple use of Jagdishpur Reservior i.e. water for animals and agricultural production

Figure 13: KII done with the chairperson of Jagdishpur Reservoir Management Multi-stakeholder Forum

For more information

Local Initiatives for Biodiversity, Research and Development (LI-BIRD)

Head Office
PO Box 324, Pokhara, Kaski, Nepal
Tel 00977-61-576834, 585357

E-mail info@libird.org
Web www.libird.org

Programme Coordination Office
Sanepa, Lalitpur, Nepal
Tel 00977-01-5540330