JHIMRUK KHOLA WATERSHED PROFILE

STATUS, CHALLENGES, AND OPPORTUNITIES FOR IMPROVED WATER RESOURCE MANAGEMENT

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युएसएड पानी परियोजना

Cover photo: Jhimruk River at downstream of Jhimruk Hydro Power near Khaira.

Photo credit: USAID Paani Program / Bhaskar Chaudhary

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ABBREVIATIONS

BZFC	:	Buffer Zone Community Forest
BZMC	:	Buffer Zone Management Committee
CAPA	:	Community Adaptation Plan of Action
CBAPU	:	Community-based Antipoaching Unit
CBS	:	Central Bureau of Statistics
CBOs	:	Community-based Organizations
CFUGs	:	Community Forest User Groups
CIP	:	Community Irrigation Project
CSOs	:	Community Service Organizations
DADO	:	District Agriculture Development Office
DCC	:	District Coordination Committee
DDC	:	District Development Committee
DDRC	:	District Disaster Risk Reduction Committee
DEECC	:	District Environment and Energy Coordination Committee
DFO	:	District Forest Office/Officer
DFRS	:	Department of Forest Research and Survey
DSCO	:	District Soil Conservation Office/Officer
DSCWM	:	Department of Soil Conservation and Watershed Management
EAP	:	Emergency Action Plan
EIA	:	Environmental Impact Assessment
FEDWASUN	:	Federation of Drinking Water and Sanitation Users Nepal
FGD	:	Focus Group Discussion
GON	:	Government of Nepal

GP	:	*Gaun palika* or rural municipality (new federal administrative unit; formerly Village Development Committee)
Ha	:	Hectare
IEE	:	Initial Environmental Examination
IRBM	:	Integrated River Basin Management
IUCN	:	International Union for Conservation of Nature
KII	:	Key Informant Interview
KM	:	Kilometer
KW	:	Kilo Watt
LAPA	:	Local Adaptation Plan of Action
LSGA	:	Local Self-Governance Act
MOE	:	Ministry of Energy
MOFSC	:	Ministry of Forest and Soil Conservation
MOAD	:	Ministry of Agriculture Development
MOE	:	Ministry of Environment
MOFALD	:	Ministry of Federal Affairs and Local Development,
MOI	:	Ministry of Irrigation
MOPPT	:	Ministry of Physical Planning and Transportation
MOFALD	:	Ministry of Federal Affairs and Local Development
MM	:	Millimeter
MSC	:	Multi-stakeholder Consultation
NEFIN	:	Nepal Federation of Indigenous Nationalities
NFIWUAN	:	National Federation of Irrigation and Water Users' Association
NP	:	*Nagar palika* (new federal administrative unit; district level)
NPC	:	National Planning Commission
NRM	:	Natural resource management
PAANI	:	Program for Aquatic Natural Resources Improvement

Sec.	:	Second
USAID	:	United State Agency for International Development
VDC	:	Village Development Committee
WECS	:	Water and Energy Commission Secretariat
WWF	:	World Wildlife Fund
°C	:	Degree Celsius

ACKNOWLEDGEMENTS

Water is the single most important natural resource underpinning Nepal's economy and livelihoods. Inclusive, sustainable management of water resources depends on strengthening community resilience and protecting healthy, biodiverse ecosystems in the face of both development and climate change.

This watershed profile is the result of many people working together. Most significant were the generous contributions of time, thoughtful attention, and ideas of members of many community forest user groups (CFUGs), cooperatives, water user groups, and, especially, the communities dependent on aquatic biodiversity and local water management. Leaders of Naubahinia, Gaumukhi, Jhimruk, Malla Rani, Airawati, and Pyuthan municipalities and the local government engaged deeply in the assessment and prioritization and committed themselves to collaborate and integrate the priority agenda into local planning processes.

The USAID Paani Program—युएसएड पानी परियोजना—is grateful for the privilege of having been invited to support the above efforts. The Paani Program (Paani) is a consortium of DAI, WWF, SILT, and NESS that works closely with Nepal's Water and Energy Commission Secretariat (WECS) and draws on the support of the WECS' member agencies. Paani enriched the watershed profile by compiling and reviewing secondary data and by collaborating with FEDWASUN who carried out surveys to assess community perceptions and biophysical conditions. Thanks are also due for several other collaborating government agencies, civil society organizations, and federations for their consistent cooperation and contributions to prepare this watershed profile. These groups include the civil society organizations NFIWUAN, FEDWASUN, NEFIN and several government agencies, including MOEWAI, MOFE, MOAD, MOFALD[1], MOICAS, and MOPPT, who gave their full cooperation and support at the national, district and local levels. Any errors in this discussion document are those of the the USAID Paani Program team.

[1] After federal restructuring of government in Nepal (2018), MoFALD has been changed to the Ministry of Federal Affairs and General Administration.

EXECUTIVE SUMMARY

The Jhimruk watershed profile assesses the status, major challenges and opportunities for water resource management for the multiple users within Jhimruk Watershed of Province No. 5.

The USAID Paani Program — also known as युएसएड— facilitated the preparation of this profile, in close coordination with the Government of Nepal and local stakeholders and with support from the United States Agency for International Development (USAID). The USAID Paani Program aims to increase the knowledge, engagement, and benefits of local water users in target river basins to build local capacity to water resource management.

This watershed profile provides critical baseline information for local government, community, civil society, and private sector stakeholders within the Jhimruk watershed to strengthen water resource management to benefit human development and protect the natural resource base upon which well-being depends. This profile also helps local stakeholders to design and test interventions to strengthen community resilience and conserve freshwater biodiversity, for which additional resources are available through the Paani local grants program.[2]

With a population of 145,005, the Jhimruk watershed (figure 1) sits in southwestern Nepal, extending over 680 km^2. The watershed touches upon five rural municipalities or gaunpalika, (Airawati, Gaumukhi, Jhimruk, Mallarani, and Naubahini) and one municipality, or nagarpalika (Pyuthan). The Jhimruk River originates in Gaumukhi and flows along the Mahabharat Range until it merges into the Madi River and

[2] It should be noted here that the research for this watershed profile, and the other profiles under the Paani initiative, was conducted before and after the country elected to move to a federal system of government. This change means that former governmental units, such as village development committees (VDCs), are being superseded by new units such as the municipality (*nagar palika)*, rural municipality (*gaun palika*), and province.

Watersheds as a unit of analysis do not align with past or current administrative units; however, as our research began and ended after this change, you will note references to both the new and old forms – VDC, *gaun palika* (GP) and *nagar palika* (NP). When we refer to liaising with or providing support to local governments, we are making reference to the units of the new federal system.

Watersheds occasionally sit within a single province, which presents a particular incongruence when offering recommendations for action. However, for biological and socio-economic research, a watershed is optimal because it provides a discrete area in which to examine the effects of climate change and human-environmental interactions. As all rain water and snow melt drain toward a primary river, the watershedprovides an integrated perspective of environmental and socio-economic change.

later downstream into the Rapti River. The Arkha Khola and Lung Khola are upper tributaries to the Jhimruk.

The Jhimruk watershed contains sub-tropical and warm temperature climates, determined by elevation. The fertile alluvial soil of the watershed makes it conducive to paddy plantation, giving the area its nickname, "The Rice Bowl" of Nepal. In the northern part of the watershed, the Mahabharat Range is comprised of metamorphic rock, such as slate, sandstone and limestone. This combination of rock types makes the zone susceptible to folding, faulting and thrusting.

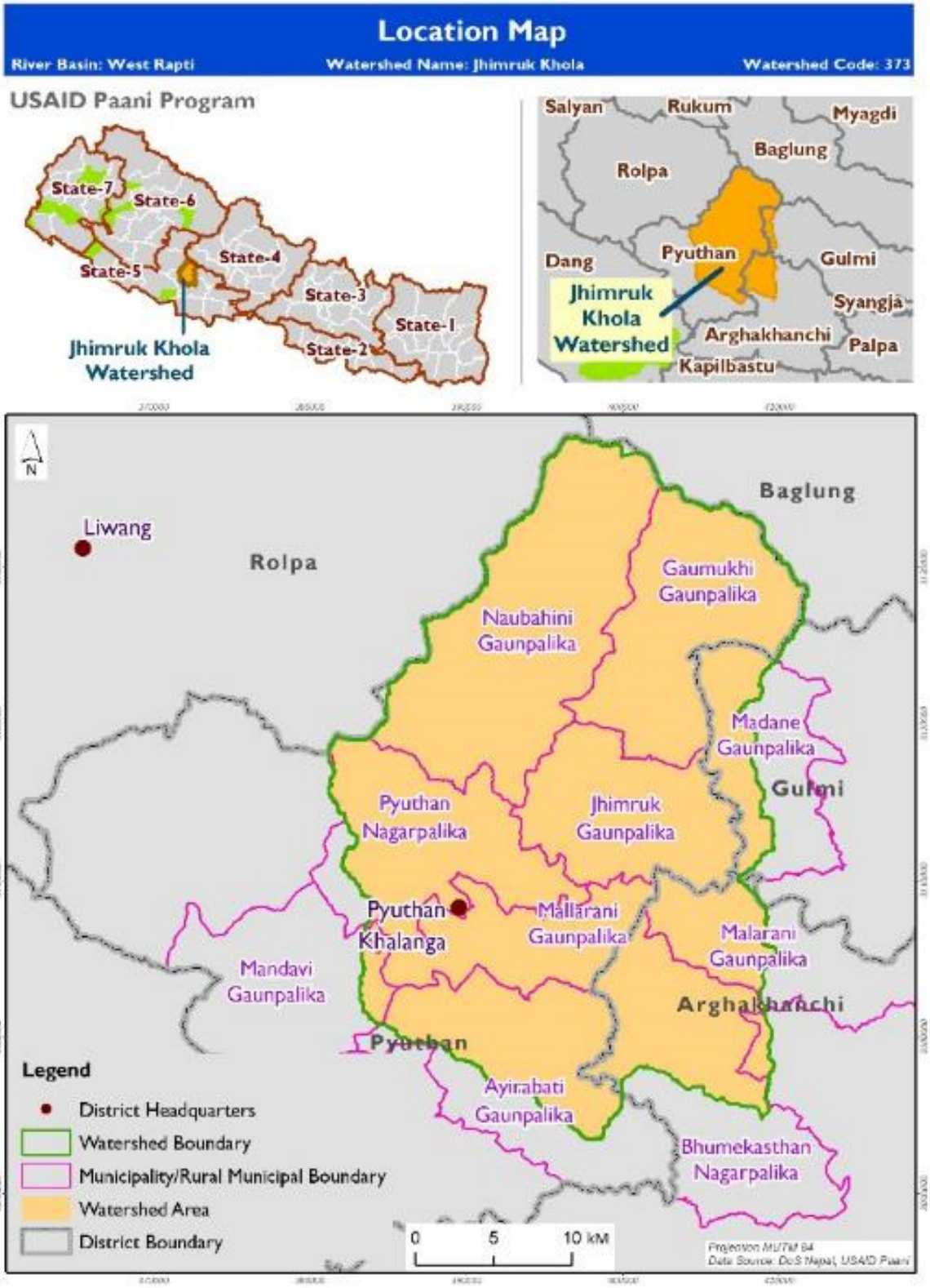

Figure 1: Location map for the Jhimruk watershed

The Jhimruk watershed includes 169 streams and water supports a variety of domestic and commercial purposes that differ as seasons change. Microhydro plants in Jhimruk produce a combined 114 kw, providing 1,284 households with electricity. In the northern reaches of the watershed, the Gaumukhi protected forest provides important habitat for musk deer and red panda. Chir pine predominates in northern forests while Sal mixed is most common in the south.

In addition to its energy and economic services, the Jhimruk River provides habitat for a rich diversity of aquatic species, including many important local fish and fresh water crustaceans. However, these habitats are increasingly at risk as poorly-designed infrastructure in the form of roads has intensified the outbreak of landslides and soil erosion, which damage and eliminate important spawning areas in the river. Unregulated dumping of waste into the river has diminished water quality for plants, humans, and animals in Jhimruk. In terms of population, the major groups are Brahmin/Chhetri/Thakuri (37.1%), Janajati (35.2%), Dalit (22.5%) and Madheshi (5.2%). Of the Janajati population, 29% identify as Magar. Kumal and Bote families comprise the primary fishing communities in the watershed.

Priority Issues for the Jhimruk watershed

Based on a series of community consultations, stakeholder fora and literature reviews in late 2016 and early 2017, prior issues for the Jhimruk watershed are summarized in Table 1 and described below with recommendations for addressing each challenge.

Table 1: Priority issues in the for the Jhimruk watershed

SN	Priority Issue	Impacts
I	Improper road construction	Roads built without following environmental guidelines often increase the likelihood and intensity of landslides and soil erosion in Jhimruk. These events exact a large toll on river health through sedimentation and the availability of water for human and aquatic life alike.
II	Floods, landslides, and forest fires	Increased flooding and landslides due to climate- and human-induced pressures are having a disproportionate effect on downstream communities. Forest fires have also increased, which intensifies soil erosion rates and diminishes soil fertility.
III	Decreasing fish populations	Improper road construction and destructive fishing practices are contributing to declining fish stocks in the watershed. Not only does these practices affect traditional fishing communities, but also impact other vulnerable households that depend on fish to supplement food security and income.
IV	Decreasing water sources and water use conflicts	Due to climate- and human-induced pressures on the environment, available water has declined throughout the watershed, in some cases, leading to conflict between upstream and downstream communities.
V	Water pollution	Growing urban settlements and increased use of agro-chemicals have contributed to rising water pollution in the watershed. While the effects are not yet fully understood, local residents are concerned about long-term impacts on biodiversity and natural resources.

I. Improper road construction

The push for development relies heavily on road construction in the rural areas of the country, including the Jhimruk watershed. However, many roads have been constructed without proper observance of environmental methods and, often times, without conducting an environmental impact assessment prior to construction. As a result, rural roads can intensify the incidence of landslides and soil erosion that can lead to river cutting and downstream flooding. These events degrade natural habitats for aquatic species along the many tributaries of the Jhimruk watershed.

Poor road construction also negatively impacts water availability as landslides and hill construction affect local water sources. Households in Kusumkot and Dharampani reported that 15 springs had been lost due to construction of a road linking Khalanga to Girichaur via Bukeni, Chuja and Dharampani. This loss of water has a cascading effect on livelihoods as households struggle to obtain enough to meet their domestic and agricultural needs.

An obvious solution would be to strengthen the enforcement of environmental evaluations prior to construction and monitor the construction to ensure these guidelines are followed.

Recommendations

- Conduct training for government staff and laborers on green road construction;
- Advocate for stronger enforcement of environmental guidelines related to road construction;
- Employ bio-engineering technology in road construction where possible;
- Prioritize the needs for rural roads prior to construction;
- Upgrade poorly built roads to meet higher environmental standards; and
- Improve drainage and debris management during road construction.

II. Floods, landslides, and forest fires

The Jhimruk watershed's fragile geology and undulating topography make the area prone to hazards such as floods, landslides and forest fires (figure 2). Combined with a high density of rivers and increasing human pressures on the environment, flooding downstream has increased in recent years. Because the use of early warning systems is not yet customary in Jhimruk, loss of property and human life tends to be higher than necessary.

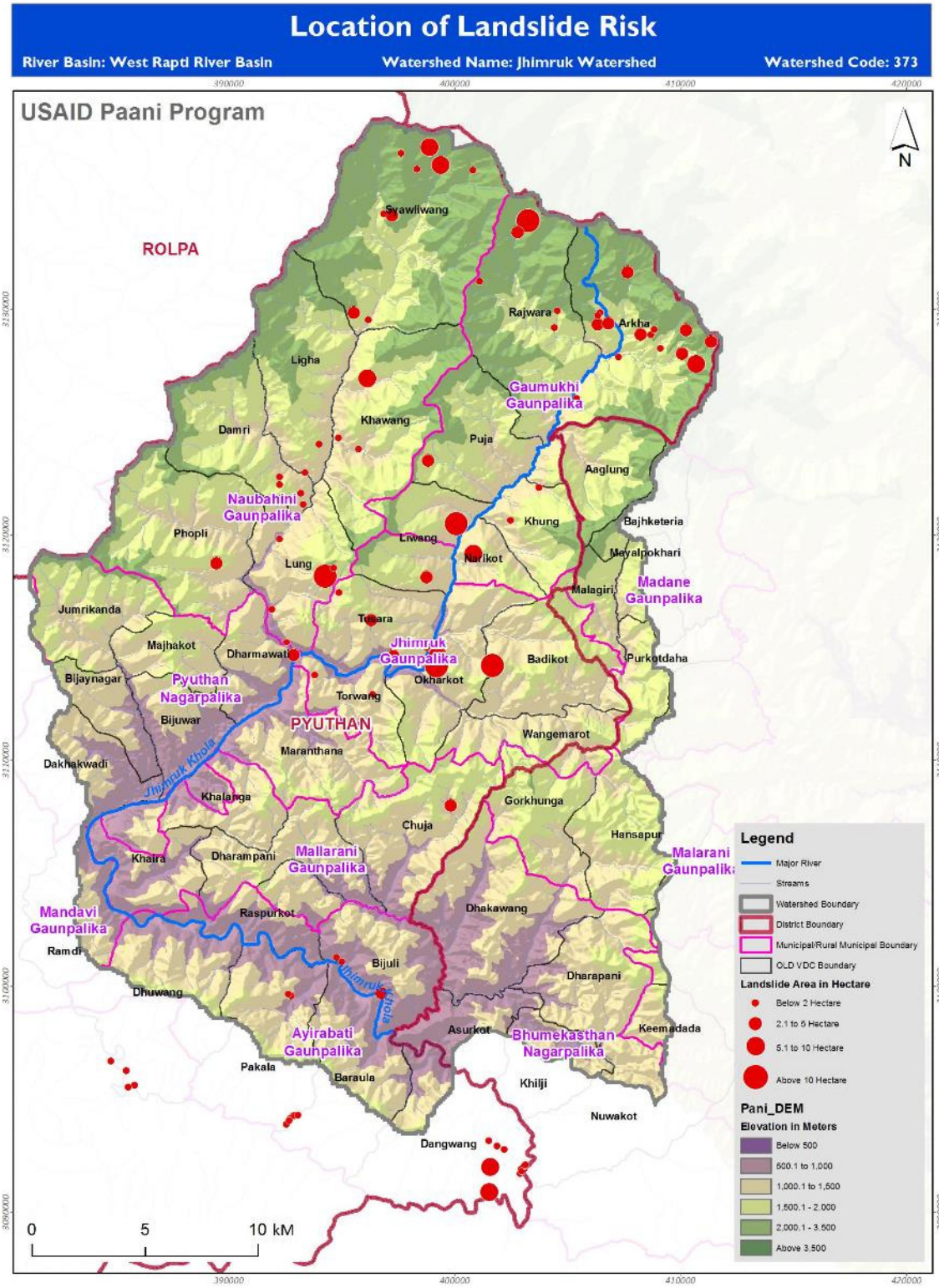

Figure 2: Map of landslide risk areas in the Jhimruk watershed

Dry areas in the southern reaches of the watershed are covered with pine trees. Local communities remove fallen pine needles that protect the forest floor and provide important nutrients to the soil. As a result, forest fires, when they occur, spread more easily.

Recommendations

- Estabilsh an early warning system for the watershed;
- Re-plant species in soil-eroded areas;
- Improve regulation of rural road construction; and
- Educate forest users about the needs and methods for improved forest conservation.

III. Decreasing fish populations

Higher sediment loads over the past decade due to increased mining and road construction is affecting fish habitats in Jhimruk. In some cases, fish passages have been erected to cut through sediment, but incorrectly, allowing increased water velocity to prevent sufficient mobility to fish. Furthermore, the rise of destructive fishing practices such as poison and electric current have reduced fish stocks and pose a threat to biodiversity overall. Lack of effective upstream and downstream fish passage and maintainence of minimum flows particularly in summer season have further aggravated the problem.

The restoration and protection of fish is of particular importance to traditional fishing communities in the Jhimruk watershed as these groups are often marginalized and have fewer alternatives for generating income.

Recommendations

- Improve monitoring of gravel mining operations;
- Increase public awareness about the threats to fish populations;
- Increase the knowledge base on native fish and their habitats;
- Build infrastructure friendly to aquatic species;
- Increase enforcement of the Aquatic Animals Protection Act 1961, which outlaws destructive fishing practices; and
- Promote alternative livelihood options for traditional fishing communities.

IV. Decreasing water sources and water use conflicts

In our surveys, numerous communities reported drying water sources, making the availability of and access to water more complicated and the daily procurement of water more onerous. The impacts of this situation are far-reaching – from decreased income generation to increasing worries about public health. Much of the blame for this situation has been placed on poor road construction throughout the watershed.

The decrease in available water has spurred tension and conflict between upstream and downstream water users. Downstream households complain that upstream communities release water to them only after fulfilling their own needs. Some hydropower plants have also complained that the decreased baseflow makes it more difficult for them to provide optimum energy to families that need electricity.

Whether diminished water availability is a natural or human-use issue, more research is needed to understand the nature of the problem and to find ways to promote responsibility and incentivize more efficient and fair use of water.

Recommendations

- Plant trees and shrubs on barren land to retain water;
- Create water recharge ponds in communities;
- Improve soil erosion control;
- Promote rainwater harvesting;
- Facilitate workshops to discuss water conflicts and conflict management; and
- Conduct awareness programs on water use policies.

V. Water pollution

Increasing urbanization and increased usage of agro-chemicals are the two primary drivers of water pollution in the Jhimruk watershed. As towns become more developed and densely populated, unregulated disposal of solid waste into rivers and tributaries are diminishing water quality, affecting human life and aquatic species. Lack of awareness and lack of proper waste management facilities are two large issues that could correct this problem in the future.

In spite of this problem, it is not perfectly understood which factors in poor water quality are occurring naturally and which are human-made. Further studies are required to extricate and evaluate these drivers.

Recommendations

- Improve waste management at local levels;
- Promote awareness about dangers of waste dumping in rivers;
- Construct drinking water tanks equipped with water purification technology;
- Train government representatives in health and sanitation standards; and
- Increase water quality monitoring of the Jhimruk River and tributaries.

1. JHIMRUK WATERSHED: NATURE, WEALTH AND POWER

This Jhimruk watershed profile is organized around three interrelated themes that influence the management and overall health of the watershed: nature (environment and natural resources), wealth (socioeconomics and infrastructure—the many ways that people **use** nature), and power (governance and institutions—the ways that the different people and groups **make decisions** together about the watershed and its uses)[3]. The analysis draws on multiple data sets associated with these themes to identify critical issues and opportunities for this watershed. We introduce this watershed in terms of its local natural and social dimensions. We examined the ways climate change and other drivers threaten and impact local livelihood and biodiversity.

In 2016-17, the USAID Paani program conducted a series of literature reviews, household surveys, focus group discussions, and key informant interviews to characterize the watersheds, including the identification of priority threats and opportunities. Through exit workshops, the Paani team shared preliminary results with multiple stakeholders, based on which stakeholders identified priority issues and environmental assets by location and impact groups. During the exit workshop, the Paani team also identified champions among stakeholders and local government agencies for leveraging funds and expertise to support water resources management initiatives.

The USAID Paani Program took the critical feedback and suggestions to identify priority issues and actions (section 8), and with the participants, developed a 20-year vision for improving watershed management. The representatives of local bodies also expressed eagerness to allocate their resources in support of activities in all aspects of watershed conservation.

Related annexes
Annex 1: Methodology

[3] The full text from which this report's structure was taken (NATURE, WEALTH, & POWER 2.0: Leveraging Natural and Social Capital for Resilient Development) is available here: https://rmportal.net/library/content/nwp-2.0

2. NATURE

This section examines the environmental and natural resource dimensions of the watershed, including climate and weather, hydrology, biodiversity, fisheries, and land use within the Jhimruk watershed. The main channel of the Jhimruk River flows through the center of the watershed, and its tributaries and proximate wetlands, support a rich aquatic biodiversity. The water resources in the Jhimruk watershed also provide water for drinking, irrigation, and sanitation that contribute to the subsistence and income generation of the area.

2.1 JHIMRUK WATERSHED

The Jhimruk watershed forms a drainage system for the Rapti River basin (figure 3). Ranging in elevation from 3,000 meters in the north to 410 meters in the south, the watershed contains five rural municipalities (Naubahini, Jhimruk, Gaumukhi, Mallarani, and Airawati) and one municipality (Pyuthan). The Jhimruk River forms from the confluence of Jhimruk and Lung Kholas upstream at Batule. The river system supports a watershed rich in natural resources, provides water to approximately 60 irrigation systems, and drives one hydroepower plant (Jhimruk) and several microhydro schemes for electricity.

The watershed contains active copper and limestone mines. The limestone is located near Lupling and extracted for cement manufacturing. The copper mine sits on the border of Khawang and Liwang VDCs and was traditionally used for making pots and other utensils. Today, the government regulates copper extraction there. As in many parts of Nepal, gravel mining is active for supplying material for construction.

As forest covers 68% of the watershed, this resource is perhaps the most valuable. Use and management of the forests in Jhimruk is overseen by 243 community user forest groups (CFUG), who collaborate to promote sustainable harvesting of timber and other non-timber forests products (e.g., resin), which are the primary source of revenue in the watershed.

The population of the Jhimruk watershed is 145,005, of which 44% is male and 56% female. More than one-half (54%) of the adults in the watershed participate in a natural resource management (NRM) group that share responsibility for managing the sustainability of water and/or forests.

Agriculture is the dominant form of livelihood, as households produce a range of crops (e.g., wheat, maize, potato, millet, mustard, and lentils) and livestock. The fertile soil of the watershed is particularly conducive to cultivation, especially rice. Beyond agriculture, more people are migrating for work – within Nepal and outside the country. A small portion of the population relies on local enterprise for supporting their households.

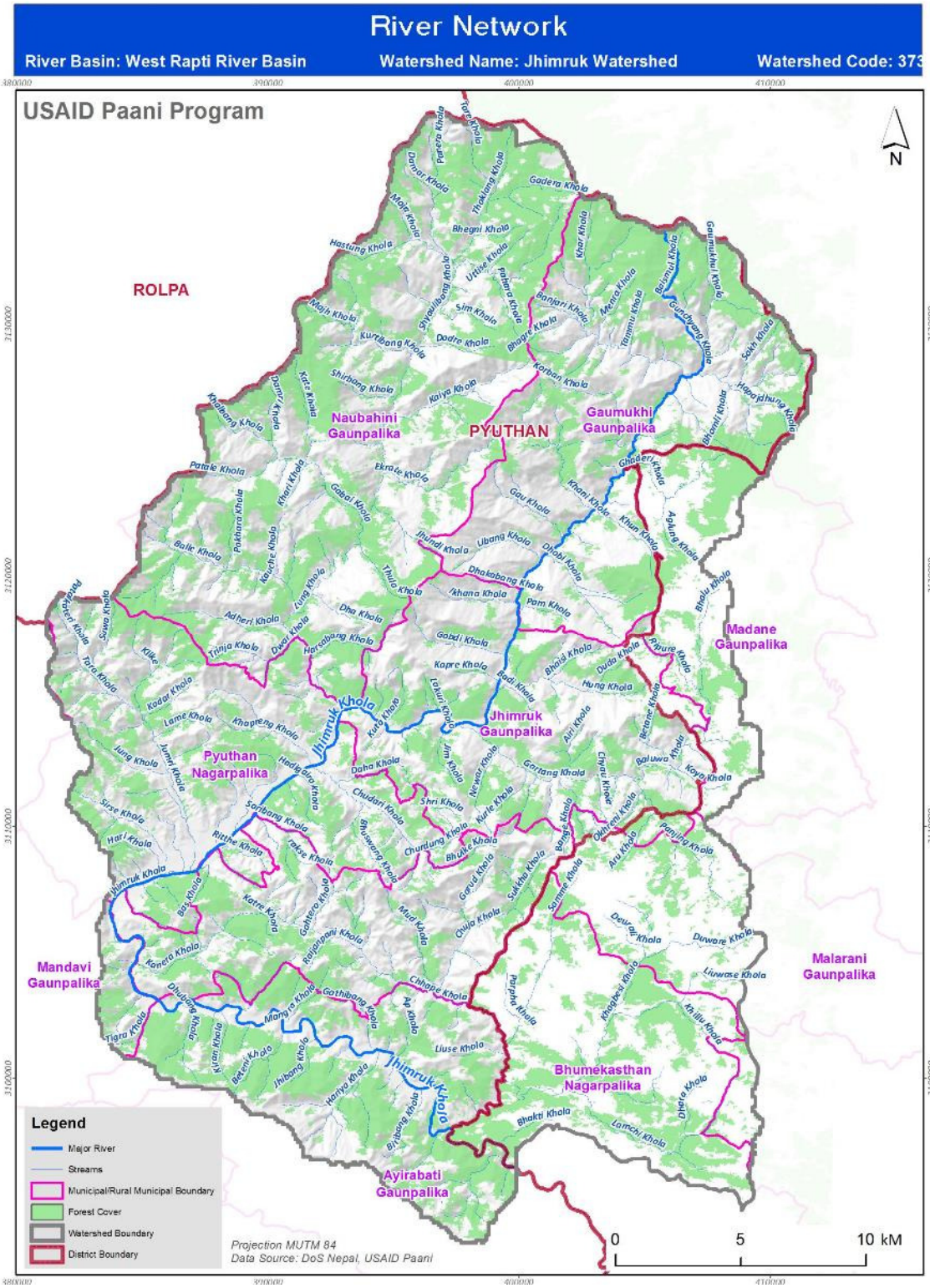

Figure 3: River network of the Jhimruk watershed

Related annexes

Annex 3: Population

2.2 WATER AVAILABILITY AND QUALITY

The Jhimruk watershed is a complex network of 169 rivers and streams that cover 27 km^2, while ponds and lakes cover 0.52 km^2 (figure 3). The total drainage density of the network is 10,105 per km^3.

Available water is uneven throughout the watershed and some areas face annual periods of water scarcity (e.g., Dharampani, Narikot, and Baraula). To access water, most households (79%) have piped water, followed by surface water collection (16%), and wells (4%). Those households that rely on surface water are at increased risk for consuming unsafe water.

In the study, 93% of households reported difficulty-obtaining water due to drying water sources and 60% of families said they devoted more than 30 minutes per day to collecting water. Disaggregating those households by caste and ethnicity, the data show that 38% are Dalit, 21% Brahmin/Chettri/Thakuri, and 17% Janajati.

Overall, 11% of households reported having unequal access to water. Of that 11%, 66% attributed their unequal access to water shortages, 15% to the long distances required to collect water, 13% to caste discrimination, and 6% to security reasons. Looking more closely at perceptions of access disaggregated by caste, the data show that 91% of Dalit, 86% of Brahmin/Chettri/Thakuri, and 96% of Janajati feel they have equal access to water sources in the Jhimruk watershed.

Some households in the survey allege that the Jhimruk hydropower plant exacerbates water availability issues. Owned and operated by Butwal Power Company (BPC), this hydropower plant occasionally impounds water (especially during the dry season) to insure consistent electricity supply. BPC defends its position saying that overall water volume in the river has decreased, not the amount of water the company diverts. Residents of the watershed are concerned not only for having enough water for domestic needs, but also for the potential effects on irrigation and biodiversity.

As in many parts of the Nepal, water, lakes, and rivers hold a sacred significance in the communities of the Jhimruk watershed. Many households refer to the Jhimruk River as Dharamwati, because it provides water to irrigation facilities. The Gaumukhi cave contains water springs that some households believe have religious significance. Sim puja (worship of water sources) is regularly practiced in Jhimruk, as households believe this will insure water quantity and quality.

Periods of water scarcity are threatening to foment conflict in parts of the Jhimruk watershed, as recently witnessed in Narikot, Pyuthan. Households there reported having to go to neighboring VDCs to collect water where they faced resistance from local residents, who believe their sources are providing less water than in years past. For women, water scarcity adds more stress to an already burdensome workload. In Narikot, women reported walking 1-2 hours for water and occasionally holding children out of school to assist them with this labor.

Paani worked with citizen scientists to estimate water discharge in the Jhimruk watershed using the floating method and area velocity during a biophysical survey on the availability of water in 2017 and 2018 (table 2).

Table 2: River and stream discharge rates in the Jhimruk watershed

Name of river / Stream	April 2017	August 2017	January 2018	May/June 2018	Avg. Discharge
Balipuk Khola	2.51	No flowing water	139.20	48.11	63.27
Jhundi Khola	31.20	No flowing water	Dry	Dry	31.20
Lung Khola	783.00	Too much water; could not measure[4]	2,398.42	2,701.44	1,960.95
Bolde Khola	49.25	1,763.09	422.27	304.49	634.78
Andheri Khola	46.00	379.69	43.69	45.02	128.60
Batule (@ junction of Jhimruk and Lung Khola)	2,241.00	Too much water; could not measure	Too much water; could not measure	4,967.18	3,604.09
Khapreng Khola	117.83	422.65	92.73	76.06	177.32
Jhimruk (Bagdula Bridge)	3,210.00	Too much water; could not measure	5,657.14	1,933.73	3,600.29
Jumri (below Jumri dumping site)	94.20	No flowing water	35.07	508.66	212.64
Jhimruk (@ confluence point of Jhimruk and Jumri Kholas)	3,320.00	Too much water; could not measure	6,798.27	5,129.59	5,082.62
Jhimruk (@ dam site)	3,780.00	78,700.00	5,072.00	2,786.00	22,584.50
Hareya Khola	35.50	322.88	7.38	6.04	92.95
Jhimruk Khola @ Arlabang	321.32	Too much water; could not measure	1,034.42	229.90	528.55
Jhakristhan Kandre Khola	NA	NA	32.78	19.89	26.34
Chhape Khola @ Daredhunga	221.21	3,891.08	444.00	294.00	1,212.57
Saribang Khola	42.30	123.94	13.91	5.00	46.29

[4] As the study relies on citizen-scientists to gather some data for the analysis, "too much water; could not measure" refers to instances when flood conditions were high. Out of concern for the safety of our collaborators, measurements were not taken during these times.

Jhimruk Khola (Thulabesi)	850.00	Too much water; could not measure	2,198.30	1,785.00	1,611.10
Dhaute Khola @ Salibisauna	NA	Too much water; could not measure	152.00	91.98	121.99
Hungadh Khola @ Darimchaur	55.63	1,559.12	71.50	37.54	430.95
Gartan Khola @ Machhi	321.00	Too much water; could not measure	797.82	440.34	519.72
Jhimruk Khola @ Machhi	1,253.00	Too much water; could not measure	2,248.04	1,365.76	1,622.27
Chundri Khola Maranthana	147.30	1,082.72	198.90	169.80	399.68
Gaumukhi Tal @ Luplung	NA	NA	8.26	4.59	6.42
Gaumukhi	NA	NA	195.98	104.87	150.42

Water quality in the watershed was determined by testing a range of parameters, including pH, nitrate nitrogen, ammonium and phosphate (figure 4). All were found to be in the normal range for drinking, domestic use and irrigation. The water was sampled at several locations in the watershed using an Akvo Caddisfly kit.

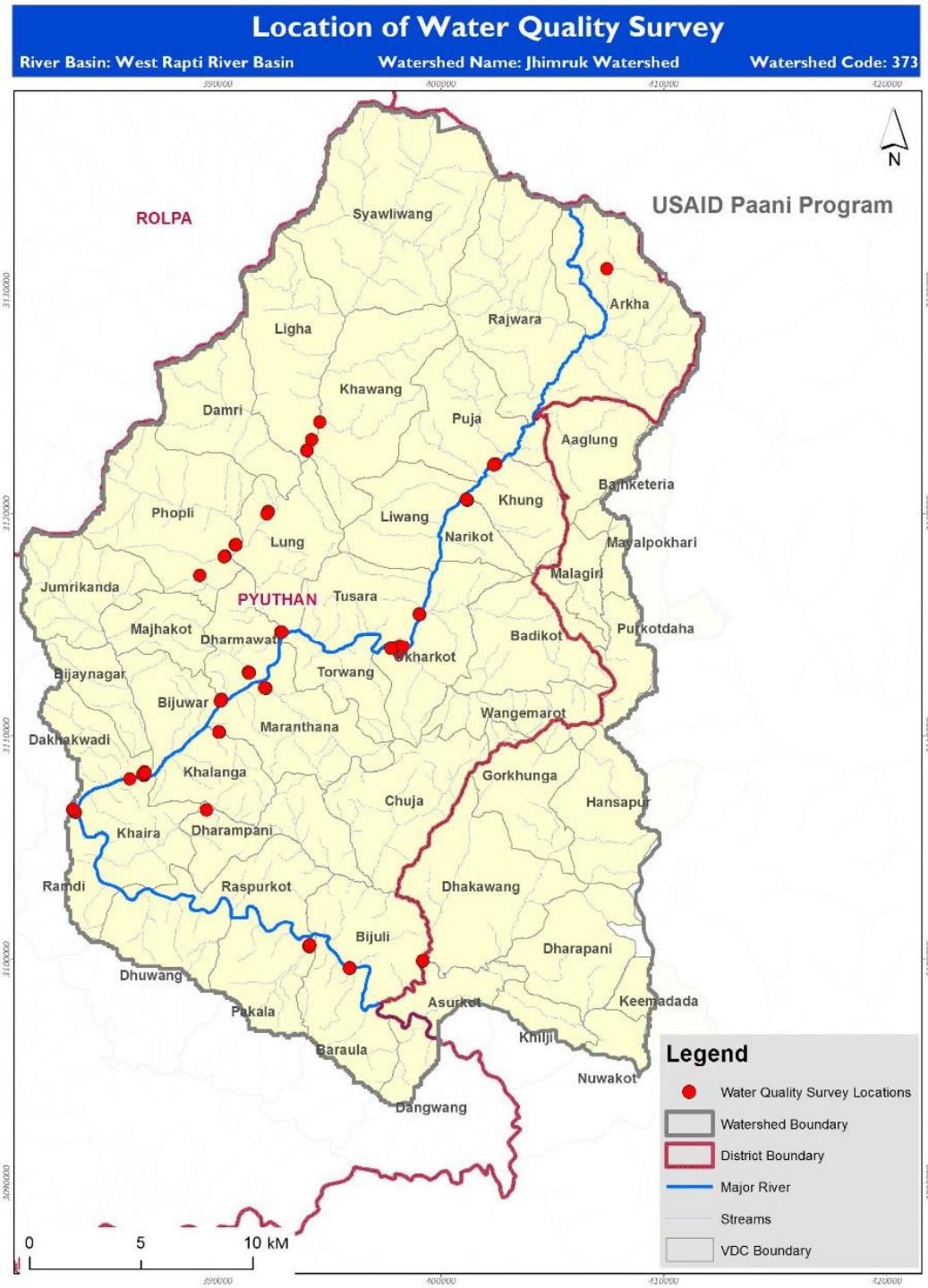

Figure 4: Locations for water quality survey sites in the Jhimruk watershed

Related annexes

Annex 5: Lakes, streams, rivers, and sub-watersheds
Annex 11: Micro hydropower – potential rivers and streams
Annex 12: Irrigation projects
Annex 13: Water quality

2.3 LAND USE AND LAND COVER

Figure 5: Land cover map of the Jhimruk watershed

Forest covers 68% of the total area in the Jhimruk watershed, followed by 15% for agriculture, 12% for grazing land, and the remaining 3% is shrub-forest (figure 5). Respondents noted that shrub areas could increase in the future due to climate change impacts and high rates of deforestation in the watershed. Of the 463 km^2 covered by forest, mixed hardwood is most common (51%), followed by pine (31%), oak (12%), Sal (4%), and Deodar cedar (1%).

Deforestation combined with forest fires and improper road construction have raised concerns about increasing soil erosion and landslides. Furthermore, the regional geology, comprised of slate, limestone, and sandy loamy boulder, is fragile and susceptible to landslides if not protected by firm ground cover. In 2015, 86 landslides were recorded in the watershed with a combined perimeter of 64,783 meters and containing 3.75 million cubic meters of sediment. These numbers correlate with local perceptions: 83% of households say landslides have increased over time.

However, these concerns about deforestation, while important to biodiversity conservation, do not appear as severe when looking at data from Global Forest Watch (figure 6). Between 2000-2016, the Jhimruk watershed has lost 95 ha of forest (0.2% of overall cover) in some places, while gaining 116 ha (0.3%) in others.

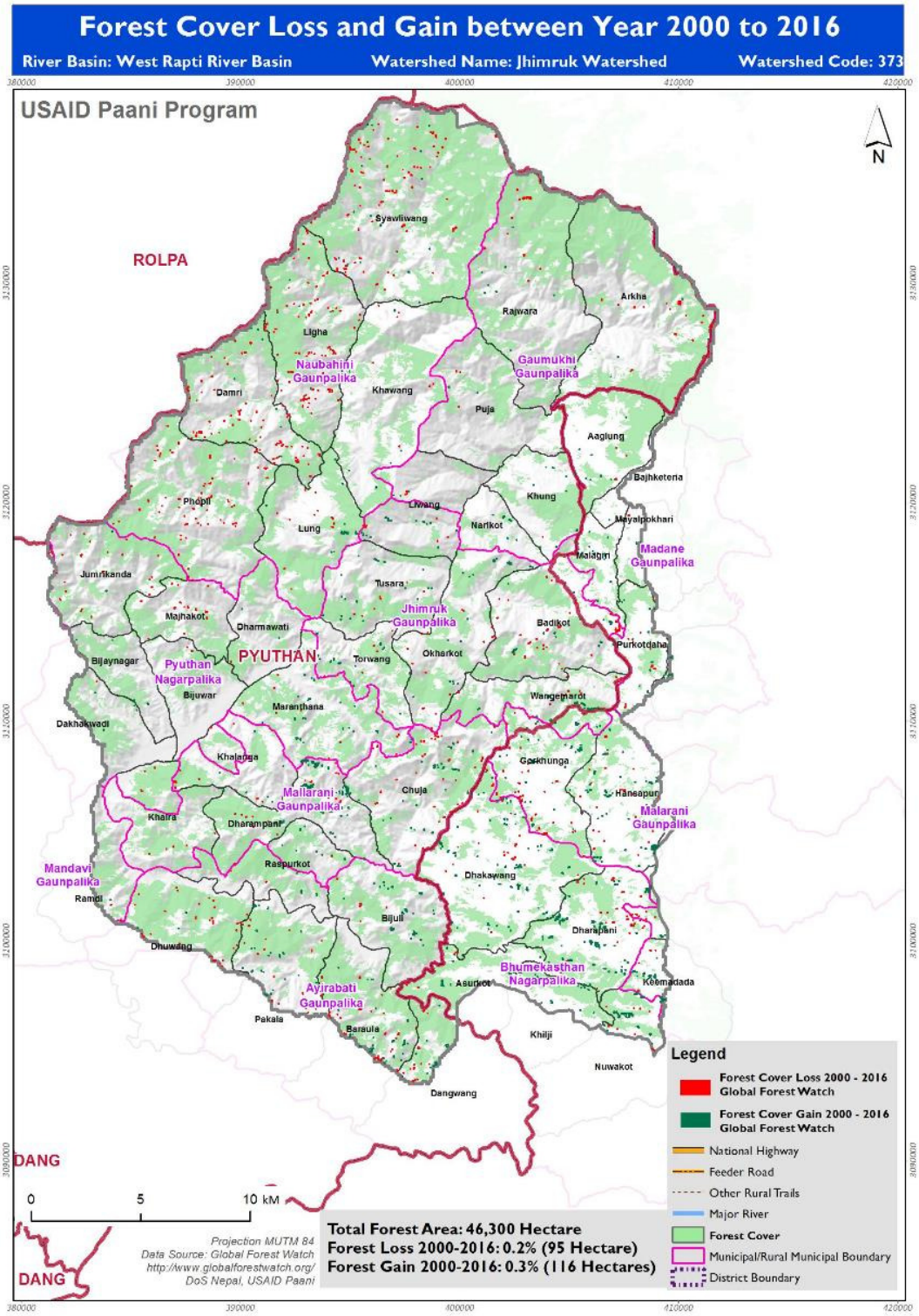

Figure 6: Forest loss and gain in the Jhimruk watershed, 2000-2016

Related annexes

Annex 2: Land use and land cover

Annex 6: Forest types and composition

2.4 BIODIVERSITY AND INVASIVE SPECIES

The Jhimruk watershed contains numerous and diverse habitats for terrestrial species among its numerous forests, rangelands, and wetlands. The forests are dominated by mixed hardwoods including Sal (Shorea robusta) in lower altitudes and oak (Quercus) at higher elevations.

The growth and population of flora and fauna species provide a strong indication of a watershed's health and functionality (more complete lists of these species are located in the annexes marked at the bottom of this section).

Through focus groups and key informant interviews, communities noted the existence of several important mammals including sloth bear (Melursus ursinus), musk deer (Moschus moschiferus), rabbit (Caprolagus hispidus), chital (Axis axis), goral (Naemorhedus goral), red panda (Ailurus fulgens), leopard (Panthera pardus), porcupine (Hystricidae), and wild boar (Sus scrofa).

Like many watersheds in Nepal, Jhimruk features a wide variety of bird species, such as danphe (Lophophorus impejanus), munal (Tragopan satyra), kalij (Lophura leucomelanos), dhukur (Streptopelia) luiche (Gallus gallus), koili hans/khoya hans (Anser indicus), titra (Rollulus Rouloul), and parrot (Psittacula cyanocephala). Communities reported river ducks on the Jhimruk River near the Jhimruk Dam at Cherneta.

The Jhimruk watershed contains a rich terrestrial plant diversity. The vegetative cover of Jhimruk supports rainwater retention and facilitates ground water recharge. The main species of the watershed include dhupi (Juniperus indica), nigalo (Arundinaria spp), gurans (Rhododendron comaldulensis), bans (Bambusa strictus), bet (Calamus spp), banjh (Anogeissus latifolia), patale katus (Castanopsis hystrix), dhalne katus (Castanopsis indica), chilaune (Schima wallichii), champ (Michelia champaca), okhar (Juglans regia), chiuri (Diploknema butyracea), timur (Zanthoxylum armatum), sal (Shorea robusta), khote salla (Pinus roxburghii) and sissoo (Dalbergia sissoo), tejpat (Cinnamomum tamala), Himalayan allo (Girardinia diversifolia), and aishelu (Rubus ellipticus). One aquatic invasive species – cattail (Typha spp) – was reported in the area.

The rivers and tributaries of the Jhimruk watershed include a variety of habitats (e.g., deep water v. shallow) that are conducive to a vast array of fish species. Through community surveys, we identified 18 different fish, including snow trout (Schizothorax spp), bai (Botia spp), bam (Mastacymbelus spp), buduna (Garra spp), charinga (Channa spp), chokare (Labeo spp), gadera (Nemacheilus spp), katala (Catla catla), milki (Labeo spp), phakata (Barilius spp), ruti (Blotched minnow Spp), sahar (Tor spp), sidhra (Puntius spp) and tite (Glyptothorax spp), and yaki (Labeo spp). The IUCN has "red listed" several of these species above as endangered, including snow trout, tite, and rim. Local residents added the bai, jhinge (Penaeus monodon), otters, ruddy shelduck and freshwater mussels as rare in the watershed.

Invasive species are generating some concern among watershed residents: 22% reported having seen new species within the last decade. These invasive species include kalo banmara (Ageratina adenophora) and wild sage (Lantana camara) reported in parts of Bijuwar, Bagdula and southern areas of watershed. Though kalo banmara and wild sage are good for erosion control, their aggressive growth threatens other species. The local district offices have encouraged residents to harvest these species to make bio-briquets or use as fodder for livestock.

Meanwhile, communities have found cattails (Typha spp.) growing down stream of the Jhimruk hydropower site, which can impede irrigation and managed water systems.

Related annexes

Annex 7: Fish and aquatic life
Annex 8: Mammals and population trend
Annex 9: Birds and population trend

2.5 CLIMATE AND PHYSIOGRAPHY

There are four prominent climatic seasons in Nepal: winter (December-February), spring/pre-monsoon (March-May), summer/monsoon (June-September) and autumn/post-monsoon (October-November). Temperature and rainfall variations persist not only by season but also by altitudinal gradients.

2.5.1 RAINFALL

There is only one hydrometeorological station in the watershed in the southern portion at Bijuwar. To help account for the wide altitudinal gradients in the watershed, we used information from a second station at Bobang, located 10 km outside the watershed boundary.[5] Figure 7 shows the estimated monthly rainfall (the solid blue line) using these sources. The average dry season rainfall (Nov – April), average monsoon rainfall (June – September) and the average annual rainfall were estimated at 24 mm, 311 mm and 1,516 mm, respectively.

[5] See annex 4 for the location of these data stations mapped relative to the Jhimruk watershed.

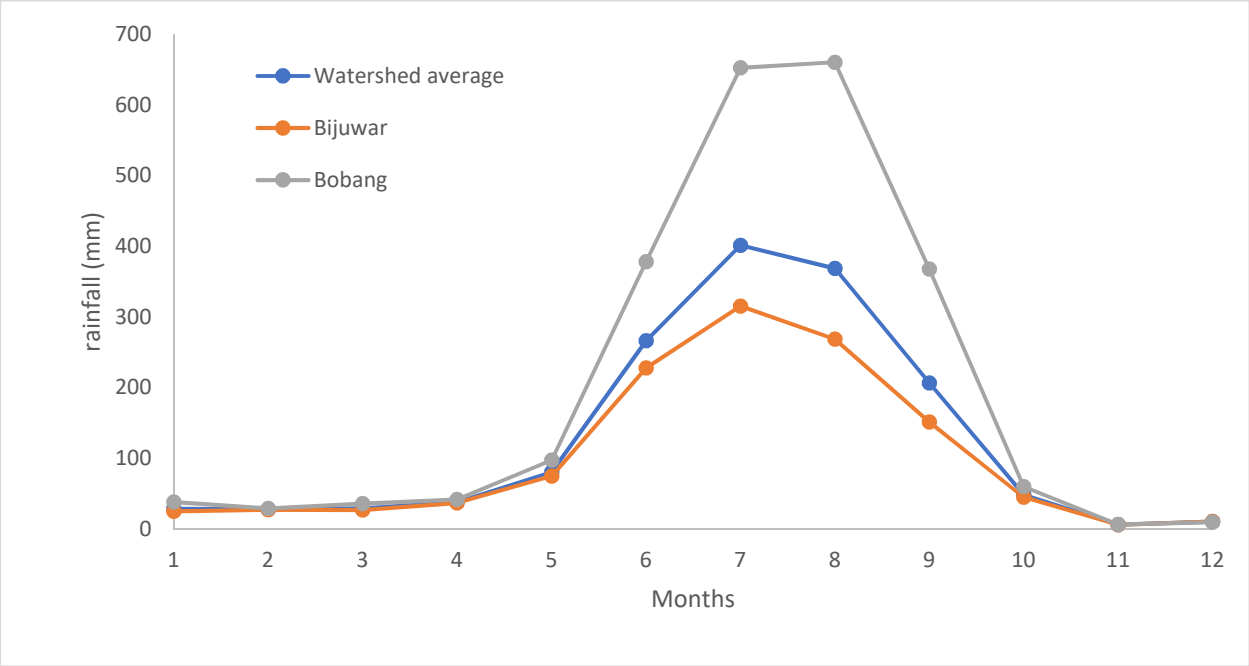

Figure 7: Long-term average monthly rainfall (in mm) estimated in Jhimruk Khola watershed

2.5.2 TEMPERATURE

We estimated temperature trends, using meteorological data collected at Bijuwar and combining that information with data taken from Kanchikot, Tamghas, and Ghoraria – three stations located outside the watershed but close to its boundary.

Monthly average temperatures ranged from 8°C, in winter, to 18°C in the summer season (Figure 8). The maximum and minimum monthly temperature varied from 4°C and 12°C in winter to 15°C and 22°C in summer. Maximum temperatures were observed in June and the minimum in January.

Paani analyzed long-term temperature data to monitor change in temperature against the altitudinal gradients. Temperature decreases at an average rate of 4.4 °C, 4.6 °C, 4.8 °C per km rise in altitude in winter, pre-monsoon and monsoon seasons, respectively. Similarly, the annual average temperature decreased at the rate of 4.9 °C per km rise in the altitude.

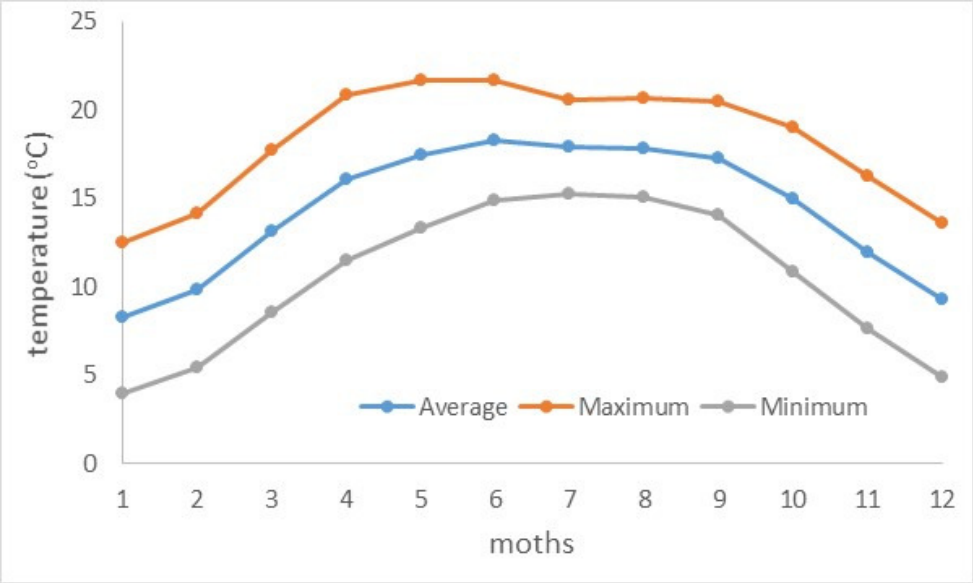

Figure 8: Maximum, minimum and average long-term monthly temperature (°C) in Jhimruk watershed

Related annexes
Annex 4: Temperature and precipitation

2.6 CLIMATE RESILIENCE AND DISASTER RISK REDUCTION

Increased human activity combined with climate change impacts are escalating environmental degradation in many parts of the Jhimruk watershed, and, in some cases, increasing the likelihood and intensifying the effects of natural hazards such as floods and landslides.[6] According to vulnerability ratings established by the District Disaster Risk Reducation Committee in Pyuthan, 11 of 31 VDCs in the watershed were at "high" risk for natural hazards, and only two rated low. In Phopli in 2015, for example, 58 people lost their lives in natural hazard events, and more than 20 million rupees of property was destroyed. In this context, watershed residents are beginning to realize the importance of climate resilient activities to fortify their livelihoods in the short- and long-terms. Field visits observed a few of these practices, including bio-engineering (e.g., Gabion walls) for road construction, and off-season vegetable farming to strengthen income streams for farming families.

Landslides have become a particularly frequent occurrence in the watershed as soil erosion due to farming and limestone mining (in Luplung) weaken the terrain on fragile slopes.

There are no early warning systems in place in the watershed. Hazard information is distributed through SMS, radio, and newspapers when disaster-conducive conditions occur. In Jhimruk, households noted, marginalized communities tend to have greater vulnerability to natural disasters. An early warning system could greatly assist these families and others to use precious time to move to safer ground.

Related annexes
Annex 19: Natural hazard vulnerability ratings by VDC and GP

[6] See annex 24 for a full list of natural hazard vulnerability ratings by VDC and gaunpalika (GP).

3. WEALTH

The population of the Jhimruk watershed is 145,005, of which 56% are female and 44% male, comprising 30,635 households (4.7 persons per HH). Looking at the population by caste and ethnicity, 37% identify as Brahmin/Chhetri/Thakuri, 35% as Janajati, and 22% as Dalit. Madhesi comprise the remaining 5%.

The Jhimruk River forms a floodplain from Okharkot to Baraula within which settlements and markets developed, including Thulobeshi, Machhi, Maranthana, Bahane, Bagdula, Bijuwar, Jumri, Bijaynagar, Dakhakwadi and Baraula. Khalanga is the district headquarters. The Jhimruk watershed contains five gaunpalika (GP): Airawati, Mallarani, Jhimruk, Gaumukhi and Naubahini. Pyuthan is the lone nagarpalika (NP) in the watershed.

Agriculture is the main source of livelihood (48%), while 13% migrate for work, 9% raise livestock, and the remainder engage in private businesses. Many respondents said they rely on capture fishery when necessary to bolster their incomes. The Jhimruk hydropower plant employs 67 local residents for its operations.

The floodplain of the Jhimruk River is the primary agricultural production area of the watershed due to the fertile alluvial soil available. Major crops such as paddy and wheat are grown in large amounts, but farmers are also focusing on high value, off-season crops such as lentil, mustard, and garam.

GESI issues: Women are being encouraged to develop skills in harvesting and creating products with allo (Himalayan nettle; Girardinia diversifolia), a local plant that can be transformed into thread for weaving fabrics. Local organizations, such as Kothi Himal Allo Kapada Udyog, are providing these trainings while also working to create market interest in allo-based products. Currently, most women in Jhimruk devote available time to labor for which they earn only 3,000 rupees per month. Allo products have the potential to increase that amount without the harsh toll of physical labor.

Regular use of banking and financial institutions in the watershed is presently increasing, though participation is low overall. Household surveys found that 44% (888 households) maintain bank accounts in formal financial institutions. Disaggregating by sex, 24% of men and 37% of women hold personal bank accounts, while 34% of households maintain joint accounts. At first glance, the fact that more women than men hold bank accounts may appear surprising giving the patriarchal cultural norms regarding household decision-making. However, upon further investigation, this study found that the high number of men migrating out for work leaves women to manage remittances and other household finances. There are numerous banks and finance institutions available in the established settlements of the Jhimruk watershed, including Bank of Kathmandu, Nepal Investment Bank, Rastriya Banijya Bank, Sine Resunga Bank, and Nepal Bank Ltd, among others.

To bolster livelihood security against climate change impacts, we observed several climate-smart technologies in use, including drip irrigation and plastic tunnels for growing offseason vegetables. In spite of these adaptations, many families still struggle with maintaining a stable reserve of cash to support their households (figure 11).

Time period	Households	Percentage
Less than 3 months	192	36.02
4-6 months	233	43.71
7-9 months	45	8.44
10-12 months	56	10.51
NA	7	1.31
Total	**533**	**100.00**

Figure 9: Household income reserves in the Jhimruk watershed

3.1 FISHING PRACTICES

Two traditional fishing communities live within the Jhimruk watershed: Kumal (2,316 people) and Bote (21 people), the majority of whom live in Ratamata Dandagaun in Bijaynagar. Several Janajati groups (Raut, Dhami, Gurung, and Magar) also engage in fishing as a commercial and leisure activity.

Fishing communities rely on a range of practices: 36% use fishing nets, 18% use hooks, while 9% said they used poison and gill nets (considered harmful). Though no households reported using electric current to fish, some respondents said this practice was also in use. It is perhaps the use of poison, current, and gill nets combined with landslide sedimentation that has contributed to unsustainable harvests: 33% of households said fish numbers had declined over the past decade. Furthermore, new hotels and markets (locally and in India) are increasing the demand for fish, which may be driving some of the destructive practices.

The Jhimruk dam is also a source of concern to communities insofar as it affects fish populations. As the dam restricts mobility of species that need to move upriver for spawning, many respondents believe the dam may be contributing to declining fish numbers especially for migratory species such as Sahar, Snow trout, Katle, and Thed.

3.2 AGRICULTURE PRODUCTIVITY

As noted above, the Jhimruk River supports a large floodplain of fertile soil in which paddy and wheat grow well. Fifteen percent (or 103 km^2) of land cover in Jhimruk is devoted to agriculture. In addition to staple crops, farmers grow large amounts of lentils, mustard, potato, and garam. In recent years, the District Agricultural Develpoment Officer (DADO) has been promoting fruits and other off-season vegetables to supplement agricultural-based incomes.

Per DADO reports, metric tons produced per hectare by crop is as follows: paddy, 3.36; maize, 2.53; wheat, 1.75; and millet, 1.10.

Because of long dry periods in winter months, farmers rely heavily on irrigation where available. There are 62 systems in the watershed: 40 located above the Jhimruk hydropower site and 22 below that

location. Some of these systems have been designed and implemented by development programs such as the USAID-sponsored KISAN I and the Community Irrigation Project (CIP).

In spite of the high reliance on agriculture in the watershed, many families still face periods of food insecurity and food deficits. According to DADO, in 2011, the food deficit in the Jhimruk watershed was 22,794 metric tons, a 52% increase in food deficit from 2004-2005 (9,049 metric tons).

Farmers do have technical assistance available in DADO, which provides trainings for agriculture and horticulture. Some USAID-funded programs like PAHAL, SUAAHARA, and KISAN also support the DADO's capacity building efforts through low-cost adaptable technologies, such as plastic tunnels and drip irrigation.

Farmers with surplus crops can distribute through market centers in Bijuwar, Khalanga, Bagdula, Machhi, Jumri, Dakhakwadi, Maranthana, Bahane, and Thulabenshi.

The DADO and some local private enterprises distribute higher quality seeds; however, there are no seed banks. Residents in Bijuwar reported receiving improved paddy seeds through a local super zone program, a government initiative in western Nepal that provides support to key staple crops (e.g., rice, maize, wheat) for optimized production.

3.2.1 SOIL MANAGEMENT AND FERTILITY

A large majority of households expressed concern about soil fertility in the Jhimruk watershed: 78% say soil fertility has decreased in the past decade because of climate change impacts. Other contributing factors are the declining use of organic fertilizers (32% of respondents), fewer earthworms (21%), prohibitively expensive agro-chemicals (26%), and the loss of topsoil to erosion (12%).

Agricultural run-off is a growing concern as 32% of respondents said they now use chemical fertilizers. This issue is particularly acute in the southern reaches of the watershed that are flatter and do not use terraces that might contain some run-off through improved soil retention. These chemicals leach into nearby water sources and rivers. Water quality (annex 13) shows some elevation of ammonia and phosphate that may have been stimulated by the run-off.

The District Soil Conservation Office (DSCO) says it is not presently active in promoting terrace improvements in the watershed. DADO provides soil issue support to local farmers through trainings on mulching and using manure.

3.3 INFRASTRUCTURE

The design and construction of infrastructure, such as roads and hydropower plants, have an impact on the health of the watershed. For example, poorly designed roads on steep slopes can increase soil erosion and landslides. Similarly, hydropower plants (such as Jhimruk hydropower) that divert or impound water will restrict the amount of water available for aquatic life that people depend on for their livelihoods. Irrigation canals, while bringing benefits to one group of farmers, can also reduce the amount of water available to other farmer populations.

3.3.1 HYDROPOWER

The 12-megawatt Jhimruk hydropower plant, located in Khaira VDC, began operation in 1994. Operated by Butwal Power Company, the dam features a fish ladder to assist with migration for spawning. Still, many respondents believe the fish ladder is inadequate. Local respondents also allege that

BPC does not release enough water downstream in the winter months, thus exacerbating an already difficult dry season.

In addition to the Jhimruk plant, the watershed features nine micro-hydropower projects, producing 114 kW for 1,284 households. Three of these projects are located in Swauliwang, three in Akha, two in Khung, and one in Rajwara. Each of these plants is vulnerable to floods and landslides, which could worsen natural hazards when they occur.

Until recently, clear guidelines for developing sustainable hydropower have not been available nor enforced.

Figure 10:

Location map for select hydropower operations in the Jhimruk watershed

[Related Annexes]
[Annex 11: Micro hydro – potential rivers and streams]

3.3.2 GRAVEL MINING AND CONSTRUCTION MATERIALS

Infrastructure and settlement development are increasing the demand for gravel and sand taken from the rivers and streams in the Jhimruk watershed. Until the recent change to a federal system of government, mining licenses were issued by the District Coordination Office, for which mining has become a major source of government revenue.[7]

There are 12 reported mining sites in the watershed, a majority of those located along the Jhimruk Khola, Lung Khola, and Khaparang Khola (figure 11). Reviews of Initial Environment Evaluations (IEE) of these mining sites estimate that 200-300 cubic meters of aggregate are extracted per day during the nine months of the year when gravel mining takes place. Some safeguards are in place to protect communities: for example, mining is prohibited within 50 meters of a culvert, irrigation canal or drinking water source, nor within 500 meters of a bridge.

IEEs of the riverbed mining sites are pre-condition for issuing licences to the private parties. The evaluation criteria are clear but respondents say there is little monitoring and enforcement of these criteria. This is one area where the Paani Program can support local initiatives to improve the monitoring of mining sites.

Limestone mining in Phopli has become a concern for local residents who blame these operations for degreading local fish habitats and water sources. These groups say the heavy equipment used for excavation and transportation is destabilizing roads and increasing sedimentation of rivers.

[7] At the time of this writing, it is not yet known which office will assume responsibility for issuing mining licenses after the change to a federal governance system.

Figure 11: Map of mining operations in the Jhimruk watershed

Related Annexes

Annex 15: List and location of gravel mining operations in the Jhimruk watershed

3.3.3 ROADS

The Jhimruk watershed contains 294 kms of road, only 49 kms are gravel and just 4 kms black-topped. The rest is earthen road (annex 10). The main strategic road runs from west to east, linking 17 kms of road between Chakchake to Khalanga Pyuthan.

Household surveys and observation revealed that most roads had been constructed without proper environmental assessment prior to building. This type of road construction causes severe environmental degradation by intensifying the conditions conducive to landslides and/or flooding. Heavy load excavators are increasing the amount of sedimentation that fall into the rivers. For example, after construction of the Khalanga-Bukeni-Chuja road, 15 water springs were reported as dry or severely reduced. In Phopli, where hillsides are generally steeper, local residents have blamed road construction for increasing landslide risk through deforestation. In July 2016, a landslide along this road claimed 28 lives.

Interviews with DOLIDAR staff revealed that guidelines for proper road construction exist and that IEEs and EIAs are required prior to construction. However, these guidelines are not followed nor are associated penalties for infractions enforced.

The map below illustrates the road network in the Jhimruk watershed (figure 12). The red line demarcates the watershed, while the blue lines indicate river and stream locations. The yellow lines are all current existing rural roads. Most of these roads run along ridges above waterways or along the course of these rivers. The proximity of the yellow and blue lines provides some idea of where improper road construction impacts or can impact the environmental quality of rivers and streams.

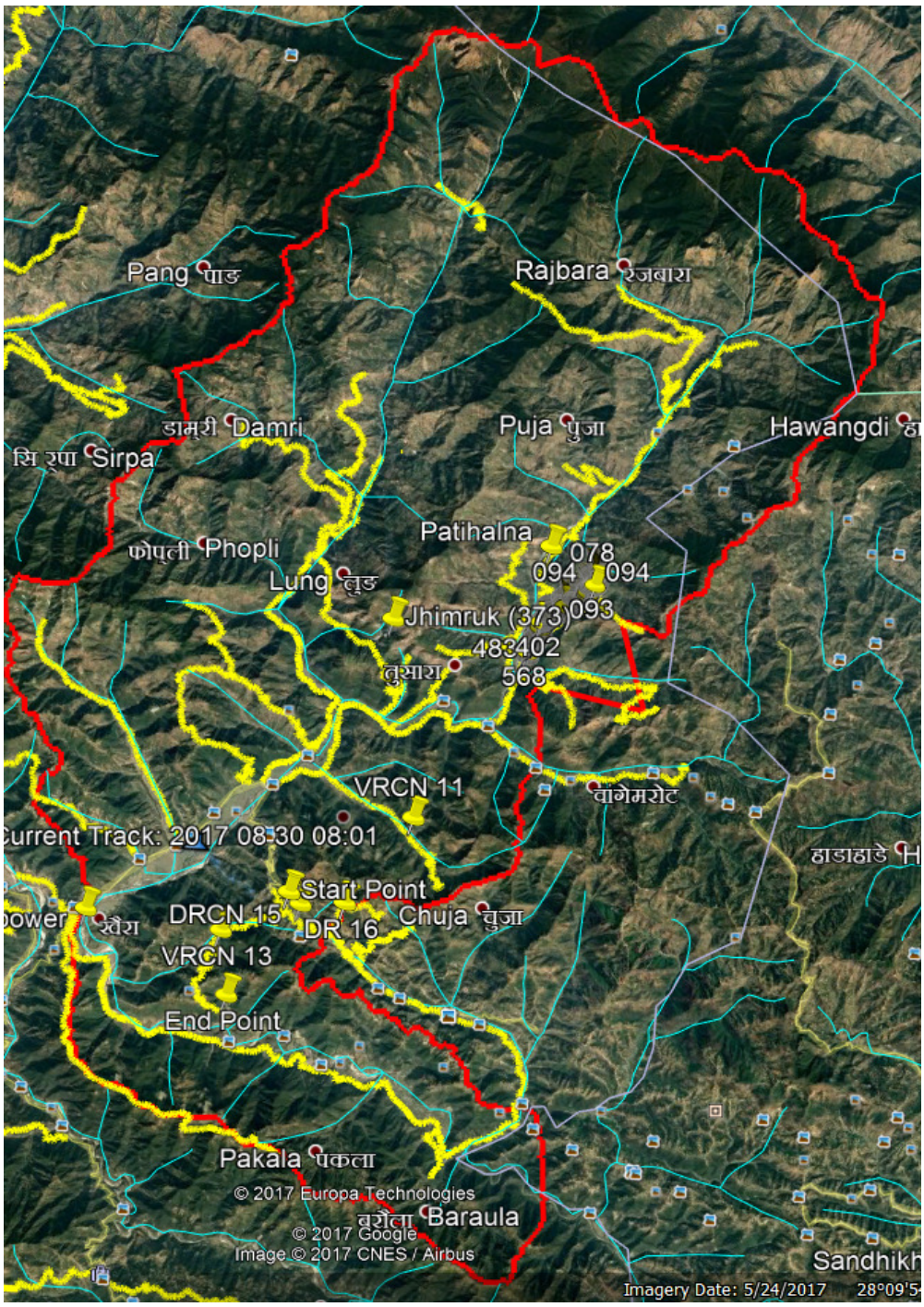

Figure 12: Rural roads in the Jhimruk watershed

Related Annexes

Annex 10: Road networks in the Jhimruk watershed

3.3.4 IRRIGATION

While irrigation is necessary to improve livelihoods and economic development in the watershed, the amount of water diverted directly affects aquatic life. Keeping minimum flows intact is crucial to maintain watershed health. GON requires environmental assessments for medium and large projects (>300 ha) but not for smaller schemes.

There are 25 irrigation schemes in the Jhimruk watershed (annex 12) built with support from GoN, USAID, and the ADB (for the CIP project). Collectively they provide water to 660 km^2 of cultivated land.

Of these systems, 22% are year-round irrigation, while 78% is only seasonal. Households draw water for irrigation from the river (24%), ponds (13%), lakes (4%), rainwater harvesting (31%), and groundwater extraction (4%). Five percent of respondents are landless.

Flooding and landslides also put irrigation at risk through direct damage and sedimentation. In Bagdula and Bijuwar, sedimentation from landslides has temporarily closed irrigation schemes in the past. In Baraula, a recent flood damaged 21 of 22 irrigation canals. At Thapa Khola, south of the Jhimruk hydropower plant, the irrigation channel has dried out.

Related Annexes

Annex 12: Irrigation projects

3.4 SOLID WASTE AND MANAGEMENT

Solid waste (e.g., garbage, plastics) in the watershed emanates from a number of sources, and the lack of personal and village-wide sanitation systems threatens water quality and aquatic life. In the Jhimruk watershed, rural markets and settlements at Bijuwar, Bagdula, Jumri, Bijaynagar, Khalanga, Machchhi, Thulobeshi and Bahane are becoming increasingly polluted due to some unregulated sewage disposal from households and local businesses.

However, local governments are working to manage waste better in some areas. Khalanga manages waste in the northeastern forest areas, while Bijuwar is regulating waste disposal in Rithi Khola, below Khalanga. All 31 VDCs in the watershed have been declared open defection free.

Surveys found a range of disposal methods that shed light on the waste concerns in the watershed. Twenty-six percent of respondents said they dispose solid waste into a compost pit, while 36% incinerate, 18% use a landfill site, 5% dump directly into nearby river and streams, and 11% said they do not treat soild waste before dumping. Field observations noted that dumping pits are close to water sources, as in Jumri. In Pyuthan, the landfill site drains into nearby streams that run toward Bijuwar. In Khalanga, market vendors have been found dumping waste in nearby community forests.

Regarding wastewater, 67% of respondents said they re-used such water in their kitchen gardens, 16% drained theirs into a sewage system, 12% disposed water into nearby rivers and lakes, and 5% use a septic tank.

Non-point source pollution, such as the rising use of agro-chemicals, is another concern for waste management. Interviews and observations revealed that farmers occasionally clean their spray tanks in the river after using them to spread pesticides. Other respondents noted that dead animals and plastics are also often dumped into nearby rivers, degrading water quality and impacting aquatic habitats.

Relevant annexes

Annex 14: Major pollution points in the Jhimruk watershed

4. POWER

In this section of the report, we detail and analyze the social, institutional, and regulatory structures through which water resources management, aquatic biodiversity management, and adaptation to climate change are planned and operationalized within the Jhimruk watershed. Analysis indicates there is a need to better understand how the current institutional arrangements are related to fisheries and gravel mining and whether they improve resource sustainability and benefit sharing with local populations, or not.

Prior to the government's constitutionally mandated switch to a federal structure, the District Coordination Committee (DCC) oversaw the leasing of ponds, lakes, and river stretches to private contractors for fishing and gravel mining. Today, that authority will rest with the local government, although how they will exercise that authority and through which office is yet to be determined.

Licensing promotes economic development but often affects indigenous communities who pursue traditional occupations (e.g., fishing). Accordingly, this section explores issues of access, inclusion, and compliance with laws as they relate to natural resource management.

4.1 ACCESS AND INCLUSION

In this section, we review issues of access and inclusion in regard to natural resource use and management in the Jhimruk watershed.

4.1.1 ACCESS TO WATER FOR DOMESTIC AND AGRICULTURAL USE

Drying water sources are a major cause for concern in the Jhimruk watershed. While the issue of drying springs is still not perfectly understood, many water sources have been swept away by soil erosion, landslides, and improperly constructed roads.

Water accessibility indicates the degree of ease for users to obtain water. Obstacles to water accessibility can be physical (e.g., distance to water points) or cultural (e.g., water sources available only to certain castes), or both. Again, due to drying water sources, many communities reported varying degrees of access to springs and community spouts. In the Jhimruk watershed, 4% of Janajati, 14% of Brahmin/Chhetri/Thakuri (BCT), and 9% of Dalits said they did not have equal access to available water.

Access to water issues also creates conflict, particularly caused by caste-based discrimination, which forbids lower castes from taking water from taps and sources used by higher caste families. These differences in access violate article (24) (1) of the Constitution of Nepal, which states that no person shall be subjected to discrimination based on his or her origin, caste, tribe, community, profession, occupation or physical condition.

The Constitution of Nepal stipulates that the federal, state, and local levels of government exercise the power of the State of Nepal pursuant to article 56(2). Certain legislative and executive powers have been vested in local level government (*nagarpalika* [NP] and *gaunpalika* [GP]), such as environmental conservation, local roads, agriculture, irrigation, drinking water supply, small hydropower, disaster risk reduction, and conservation of watersheds and wildlife (Schedule 8). At the same time, the federal, state, and local levels of government hold concurrent power on a range of other issues, including forest and

jungle management, water use, ecology and biodiversity (Schedule 9). The willingness and ability of government entities to exercise these powers within the cooperative model of federalism have significant implications for the conversation of freshwater biodiversity and community resilience.

These new governance responsibilities suggest the time is appropriate to work closely with local authorities to develop plans to promote improved watershed health. The following agencies are the main agencies responsible in the Jhimruk watershed for water resource management:

- District Coordination Committee
- Irrigation Development Division
- District Soil and Water Management Office
- Division Forest Office
- Agriculture Services Center
- District Administration Office
- Five rural municipalities (gaunpalika, GP): Airawati, Gaumukhi, Jhimruk, Mallarani, and Naubahini
- One municipality (nagarpalika, NP): Pyuthan

Related annexes

Annex 18: Water and sanitation user groups

4.1.2 ACCESS TO EARLY WARNING SYSTEMS (EWS) AND DISASTER RISK REDUCTION

As noted in section 2.6, there are no early warning systems (e.g., siren) in place in the Jhimruk watershed. Hazard information is distributed through SMS, radio, and newspapers when disaster-conducive conditions occur. In Jhimruk, households noted, marginalized communities tend to have greater vulnerability to natural disasters. An early warning system could greatly assist these families and others to use precious time to move to safer ground.

Regarding hazard information, 76% of respondents said they have access to disaster risk reducation (DRR) information, but 65% said they were not aware of DRR services and facilities such as rescue, first aid, shelter homes, and emergency food.

On the topic of access to hazard information, 88% of those who had access to information also believed their access was equal to others in the population.

4.1.3 ACCESS AND INCLUSION IN LOCAL NRM PLANNING

The land, water, flora and gravel of the Jhimruk watershed comprise the major natural resources of the area. In addition, each of these resources faces numerous threats from deforestation, habitat degradation, unsustainable agricultural practices, and non-point source pollution, among others. The watershed's topography and soil erosion-related exacerbated these challenges.

Many environment and agriculture groups (e.g., farmers, drinking water and sanitation, water consumer, community forestry and DRR groups) are active in the Jhimruk watershed. For example, user groups for water and community forests help manage sustainable use practices while working to insure equitable access to these resources for all members. There are 321 water user groups in the Jhimruk watershed and 243 community forest user groups (CFUG).

However, in spite of these numerous groups, participation in local NRM planning remains low: only 54% of respondents are engaged in local planning processes, and only 15.7% of women claim membership (despite national mandates for women to comprise 33% of user group populations).

Looking at leadership in NRM groups, only 9% of these spots are held by women. Therefore, even though most women have equal engagement in natural resource issues by virtue of their daily household responsibilities, few are given positions of authority when it comes to managing these resources.

The issue of NRM planning is not only related to affiliation. Awareness of these user groups and VDC-level planning is also quite low in the Jhimruk watershed. Eighty percent of respondents in our survey said they were not aware of NRM planning processes at the VDC level, and 51% said they did not know about the various user groups for addressing natural resource matters.

Perhaps due to community forestry's positive contribution to access and beneit sharing, 39% of respondents say they have equal access to group services, such as forest product distribution and drinking water facilities. However, some respondents (10 women, 9 men) said access to these services was not equaly, and that women and persons from marginalized communities bore a disproportionate amount of the discrimination.

Related annexes
Annex 16: Community user forest groups
Annex 17: Water and sanitation user groups

4.2 COMMUNITY ACTION AND RESPONSE

This section provides detail on community planning and response to climate change and disaster risk, how communities collaborate for improved natural resource management, and the status of local compliance with existing environmental policies and regulations. Taken together, these aspects of community action reveal significant information about a watershed population's ability to adapt to future challenges.

4.2.1 CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

As a majority of the population in the Jhimruk watershed is dependent on climate-sensitive agriculture, variations in temperature and precipitation are causing serious livelihood distress to communities in the watershed. To adapt to these changes, many farmers have adopted climate-smart technologies to strengthen their crops and livestock and to promote resilient food systems. Some of these technologies include rainwater harvesting (20% of households), Gabion box installation (9%), and replantation in barren areas (29%).

At the government level, Local Adaptation Plans of Action (LAPAs) and Community Adaptation Plans of Action (CAPAs) are intended to prepare delivery of adaptation services to the most climate vulnerable areas and people of Nepal. Presently there are 12 CAPAs and 6 LAPAs implemented in the Jhimruk watershed (figures 13 and 14). The plans of action focus specifically on building resilience into hazard-prone areas through projects designed to protect water sources, minimize soil erosion, and reduce flood and landslide risk. Though initially designed with support from the national government, it is expected that local communities gradually assume ownership of LAPAs and CAPAs for the long-term.

Similarly, a Local Disaster Risk Management Plan (LDRMP) was developed for the Pyuthan district in 2016, inspired by floods and landslides that claimed 28 lives in Pholpli. The LDRMP lays out procedures

and protocols for mitigating natural hazard risks and protecting lives and key assets in the case of floods, landslides, and other disasters. In the Jhimruk watershed, the LDRMP is collaborating with Phulbari Gramin Bikash Samaj Nepal as an implementing partner to construct safe-buildings to replace those lost or damaged in Phopli.

Figure 13: Areas with prepared Local Adaptation Plans of Action (LAPAs) in the Jhimruk watershed

Figure 14: Areas with prepared Community Adaptation Plans of Action (CAPAs) in the Jhimruk watershed

4.2.2 NATURAL RESOURCE MANAGEMENT (NRM) GROUPS AND ACTIVITIES

Forest and water resources are a shared resource, the formation of user groups to collectively manage these resources has become common in Jhimruk. These user groups serve under various government authorities (e.g., DDC, DFO, DADO) and seek to improve sustainable use of water, timber, and non-timber forest products.

Community forest user groups (CFUG) are the major NRM groups working in the watershed. In Jhimruk there are 243 CFUGs representing 33,893 households and managing 25,057 ha of forest. Women comprise 49% of the total membership (98,819 of 201,883). The Forest Office in Pyuthan coordinates the CFUGs for effective implementation of natural resources.

Water user groups have two forms: irrigation users and drinking water and sanitation users (annex 18).

All NRM user groups face a variety of challenges to optimizing their effectiveness. These challenges include lack of funding, insufficient capacity in members and leadership, and lack of proper representation (e.g., women, marginalized groups) in leadership.

Some user groups can address these challenges through collaboration with local NRM organizations to provide support where needed (a full list in annex 19).

Related annexes
Annex 16: Community user forest groups
Annex 17: Water and sanitation user groups
Annex 18: Key stakeholders – organizations and offices

4.2.3 COMPLIANCE WITH LAWS AND POLICY PROVISIONS

Surveys and FGDs revealed a generally low knowledge of existing environmental policies and provisions, and an equally low compliance with these regulations where they were known. The primary reason for this is the remote location of many communities in the Jhimruk watershed, where they have limited interaction with government officials and representatives. Furthermore, coordination between government units appears to be limited. During one interview with a DSCO official about sand and gravel mining, he referred us to the DFO for that information, suggesting that those persons responsible for soil conservation may not have relevant knowledge of mining operations in the watershed.

Therefore, creating a culture of environmental conservation and a shared interest in promoting watershed health will require significant outreach to equip citizens with relevant information. For example, Aurawati Municipality, in consultation with the USAID Paani program, has been successful in generating consensus to ban fishing during the breeding season, from mid-June to mid-August, to protect fish numbers.

However, focus groups and interviews revealed that the public is keenly aware of lack of compliance with regard to fishing and dumping solid waste. Several respondents said they were aware that the use of poison and electric current violated the Aquatic Animals Protection Act, which prohibits such destructive practices. Other respondents spoke about unregulated wasted dumping (e.g., solid waste, pesticides, fertilizer) in rural settlements, such as Bijuwar, Jumri, and Bagdula, among others. These actions violate the Solid Waste Management Act and violations call for fines up to NPR 50,000. However, no respondents were able to recall instances where the DFO or DSCO had imposed such penalties.

4.3 GOVERNANCE

Governance and its responsiveness to community needs and aspirations provides a key focal point for managing natural resources sustainably, strengthening community resilience, and conserving freshwater biodiversity.

Through FGDs and KIIs, respondents expressed their growing awareness of the need to develop stronger relations between upstream and downstream communities. In spite of the many regulations providing vision on issues related to watershed health, there was a general consensus that the lack of implementation would lead to conflict between communities on issues of fish, forests, and water. Moreover, the growing amount of infrastructure development in the form of roads and micro hydro has raised general concern about e-flows and maintaining sustainable agricultural production.

Surveys responses and information provided by the DAO indicate that coordination between VDCs, municipalities, districts and provinces is quite low. Many government respondents said upstream/downstream water use coordination was especially poor because no formal platform exists on which to address these issues. Similarly, village and municipality level governments need to make their planning and budgeting processes (e.g., LAPA, CAPA, WUMP) transparent and participatory. Building consensus and ownership between government and citizens will improve the potential to create conditions favorable to conserving aquatic biodiversity and promoting community resilience.

5. PRIORITIZING MAJOR ISSUES AND CHALLENGES

Stakeholders in the Jhimruk watershed were asked to list their environmental concerns, particularly in relation to associated anxieties related to sustainability and livelihoods. As many rural Nepalis depend more closely than most on natural resources to support their households, stakeholders cited the loss of labor (to migration) and advancing degradation of water, forests, and aquatic habitats as major concerns. The full summary of environmental priorities is presented in Table 3.

Table 3: Environmental issues by priority

SN	Issue	Total	Rating
1	Unplanned rural road building	13	High
2	Decreasing water sources	11	High
3	Flooding and river cutting	11	High
4	Declining water quality and rising pollution	10	High
5	Decreasing fish numbers	10	High

6	Gravel mining	10	High
7	Water use conflict	9	Medium
8	Landslides	7	Medium

This table presents issues identified by 50 participants in a community survey, whose responses were later validated during the multi-stakeholder consultation (MSC) exit workshop. The participants were selected from a wide range of backgrounds representing local residents, civil society groups, and government agencies.

After creating a full list of environmental challenges, including issues related to scope and local interest, participants were asked to discuss and assign points to these issues based on the urgency with which they should be addressed. From these discussions, the environmental challenges were ranked and prioritized.

6. TURNING THREATS INTO OPPORTUNITIES

During the MSC exit workshop, participants also listed the major threats, challenges, and opportunities for watershed health in Jhimruk. Their comments are summarized in Table 4.

Table 4: Threats, challenges and opportunities for improved watershed health

Threats or challenges	Opportunities
Decreasing water sources	• Improve water source protection • Build recharge ponds • Promote rainwater harvesting techniques • Improve soil erosion control methods • Encourage environmentally-sustainable road construction
Decreasing fish numbers	• Promote regulatory gravel mining • Promote public awareness on native fish conservation • Study native fish populations • Promote aquatic-habitat friendly infrastructure • Reduce use of destructive fishing methods • Promote alternative income sources for traditional fishing communities including aquaculture
Water use conflicts	• Facilitate dialogue for water accounting • Develop local facilitators for conflict management

	• Raise awareness on water conflict issues through water user groups • Train local users on water source registration procedures
Unplanned rural road building	• Conduct trainings for relevant local government staff on sustainable road building • Promote green road construction • Promote the use of bio-engineering techniques to minimize soil erosion
Flooding and river cutting	• Establish an early warning system • Improve sustainability of rural road construction • Promote forest restoration and conservation • Promote improved gulley erosion control
Declining water quality and rising pollution	• Promote waste management awareness • Construct drinking water tanks with purification systems • Check water quality on a periodic basis • Sensitize local government agencies for improved health and sanitation
Gravel mining	• Make EIA and IEE assessments compulsory • Develop gravel mining policies and guidelines at local level
Landslides	• Use bio-engineering techniques to improved land cover • Promote awareness about landslide dangers and methods for minimizing risks • Promote improved spring source protection • Improve monitoring of unmanaged settlements and road construction

7. VISION AND MISSION OF JHIMRUK WATERSHED

This Jhimruk watershed profile has been prepared through various consultative processes, actively engaging with stakeholders from media, civil society organizations, government agencies, government offices, and environmental research institutions (e.g., universities).

7.1 VISION STATEMENT FOR THE JHIMRUK WATERSHED

A two-day vision-building session was organized during which the participants were divided into five groups to draft their own watershed vision statement. The groups were asked to draft the statements based on what they hoped to see in the watershed 20 years from now. The five drafts were shared with the entire group and they collectively created the following vision statement:

"To create a sustainable, inclusive, eco-friendly, multi-useful, and livelihood-oriented infrastructure in the Jhimruk watershed to promote biodiversity conservation and the overall health of the environment."

7.2 COMMITMENT FOR CONSERVATION OF JHIMRUK WATERSHED

Using the threats, challenges, and opportunities to watershed health (Table 5), participants at the exit workshop described what they intended to do within their capacity to act (i.e., as resident, government official, or NGO representative) and the outcomes expected from this activity. These ideas have been organized by watershed health theme in Table 5.

Table 5: Action commitments to address environmental challenges in the Jhimruk watershed

Issue	Activities	Expected outcomes
Decreasing water sources	• Improve water source protection • Replant barren lands • Build recharge ponds • Improve soil erosion control methods • Encourage environmentally sustainable road construction • Promote rainwater harvesting techniques • Promote resilience design among smallholding farmers	• Rehabilitated water sources • Water scarcity issues eliminated
Decreasing fish numbers	• Monitor and control gravel mining • Promote public awareness of issue • Study native fish populations • Promote aquatic-habitat friendly infrastructure	• Increase fish populations by 20% • Increased use of sustainable fishing through aquatic-

	• Reduce use of destructive fishing methods • Promote alternative income sources for traditional fishing communities • Promote support for aquaculture	habitat friendly infrastructure
Water use conflicts	• Enhance water cooperation through dialogue • Develop local facilitators for conflict management • Raise awareness on water conflict issues through water user groups • Collect data through LRP mobilization • Train local users on water source registration procedures	• Water conflict policy formulated and implemented • Increased capacity of water users to manage conflicts • Reduce water conflicts by 50%
Unplanned rural road building	• Conduct training for relevant local government staff on sustainable road building • Promote green road construction • Prioritize rural roads at local levels of government before construction • Improve drainage management during road construction • Improve debris management during road construction • Promote the use of bio-engineering techniques in road building to minimize soil erosion	• Improved commitment from all levels of government to establishing a master road plan • All road building according to environmentally-responsible standards
Flooding and river cutting	• Establish an early warning system for the watershed • Replant soil eroded areas • Improve sustainability of rural road construction • Promote forest restoration and conservation • Promote improved gulley erosion control	• Improved forest cover and river bank protection • Increased public awareness of flood risks and mitigation efforts
Gravel mining	• Make EIA and IEE compulsory • Develop gravel mining policy at local level • Promote use of Gabion boxes at mining sites	• EIAs and IEEs followed properly at all mining sites
Landslides	• Use bio-engineering techniques to replant and restore hillsides • Promote awareness about landslide dangers and methods for minimizing risk • Promote improved spring protection • Improve monitoring of unmanaged settlements and road construction	• Decrease sedimentation in Jhimruk River by 35-40% • Reduce asset damage by 40-50%

8. RECOMMENDATIONS

This Jhimruk watershed profile assesses the status, major challenges and opportunities facing water resources management for the multiple users located within the region. Based on the discussions at the exit workshop, the stakeholders proposed the following recommendations to improve climate change adaptation and freshwater biodiversity in the watershed:

- Conduct training for government staff and laborers on green road construction;
- Advocate for stronger enforcement of environmental guidelines related to road construction;
- Apply bio-engineering technology in road construction where possible;
- Prioritize the needs for rural roads prior to construction;
- Upgrade poorly built roads to meet higher environmental standards;
- Improve drainage and debris management during road construction;
- Estabilsh an early warning system for the watershed;
- Improve regulation of rural road construction;
- Educate forest users about the needs and methods for better forest conservation.
- Improve monitoring of gravel mining operations;
- Increase public awareness about the threats to fish populations;
- Focus future studies on native fish and their habitats;
- Build infrastructure friendly to aquatic species;
- Increase enforcement of the Aquatic Animals Protection Act 1961 that outlaw destructive fishing practices;
- Promote alternative livelihood options for traditional fishing communities;
- Plant trees and shrubs on barren land to retain water;
- Create water recharge ponds in communities;
- Improve soil erosion control;
- Promote rainwater harvesting;
- Facilitate workshops to discuss water conflicts and conflict management;
- Conduct awareness programs on water use policies;
- Improve waste management at local levels;
- Promote awareness about dangers of waste dumping in rivers;
- Construct drinking water tanks equipped with water purification technology;
- Train government representatives in health and sanitation standards; and
- Increase water quality monitoring of the Jhimruk River and tributaries.

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ANNEXES

Annex 1: Profile methodology

The overall objective of the watershed profiling process is to develop and enrich a shared understanding among key stakeholders about the major issues that affect local watershed health and water resource management. This watershed profile reflects the collective understanding and aspirations of people in the Jhimruk watershed and concerned institutions so they can provide baseline information to help identify priorities for project design and implementation. Moreover, the profile can support the development of tools for watershed planning and approaches for collaborative management moving forward. The profile serves as a foundation for:

- Building consensus and common understanding among the Jhimruk watershed's stakeholders on the current situation and future;
- Establishing a benchmark for activities targeting human and ecological communities in the watershed by describing the existing interaction between people and nature;
- Identifying potential priority areas for stakeholders to plan and work together on local-level activities to improve watershed management of the Jhimruk area where PANI and other projects can provide support; and
- Providing a platform for consultation and advocacy for Jhimruk watershed stakeholders through which they can participate in decision-making at the river basin and policy levels.

The watershed area was delineated using GIS tools during the watershed prioritization stage. This profile was prepared by drawing on a range of data sources including,

1. Secondary literature and information related to biophysical conditions, socio-economic characteristics, infrastructure, vulnerability and disaster risk, and freshwater biodiversity of the watershed;

2. An entry multi-stakeholders consultation [MSC] conducted to

    a) Share preliminary results of watershed conditions,

    b) Identify priority threats, vulnerabilities, and biodiversity values by location and impact groups

    c) Prepare detailed plans for the key informant interviews (KII), focus group discussions (FGD), and water quality and water discharge measurements;

3. Household (HH) surveys to assess the differential impacts of various environmental issues;

4. FGDs to assess the severity of environmental threats and biodiversity value associated with Paani focal interests; and

5. KIIs to explore the causes and intensity of the particular environmental issues in the watershed. Different guiding checklists designed around Paani focal interest areas, cross cutting areas, were used while conducting surveys including governance, gender and social inclusion and policy (Figure 9, below).

The HH survey data (Table 6) were organized into four broad categories: a) climate change and biodiversity; b) livelihoods and well-being; c) water sources; and d) water quality. The surveys were conducted in locations that were selected during the entry MSC as participants indicated specific issues and challenges appropriate to their respective areas.

Table 6: Household (HH) surveys by topic and number conducted

Subject of HH survey	Number conducted
Biodiversity and climate change	852
Livelihoods and well-being	888
Water sources	829
Water quality	910
Total	**3,479**

To complement the surveys, we conducted 10 FGDs and 14 KIIs to investigate the key issues identified by households. Water quality and discharge were measured by Paani staff using the Akvo Flow Mobile App.[8]

The consolidated data collected through these methods were presented to group leaders at the exit MSC workshop to provide the participants with a share foundation for identifying and prioritizing watershed health issues in Jhimruk. We also used this information to identify possible solutions and champions for leveraging knowledge and support through partnerships with local agencies and organizations.

To prioritize the collected issues, we held an exit MSC in which we presented preliminary findings and asked the participants to rank these issues in order of importance as well as potential actions and outcomes for addressing these issues. The participants were divided into groups to generate potential mission statements for the watershed. We brought the various statements together and synthesized the ideas into the mission statement located at the front of this profile.

[8] Akvo Foundation: https://akvo.org/products/akvoflow/#overview

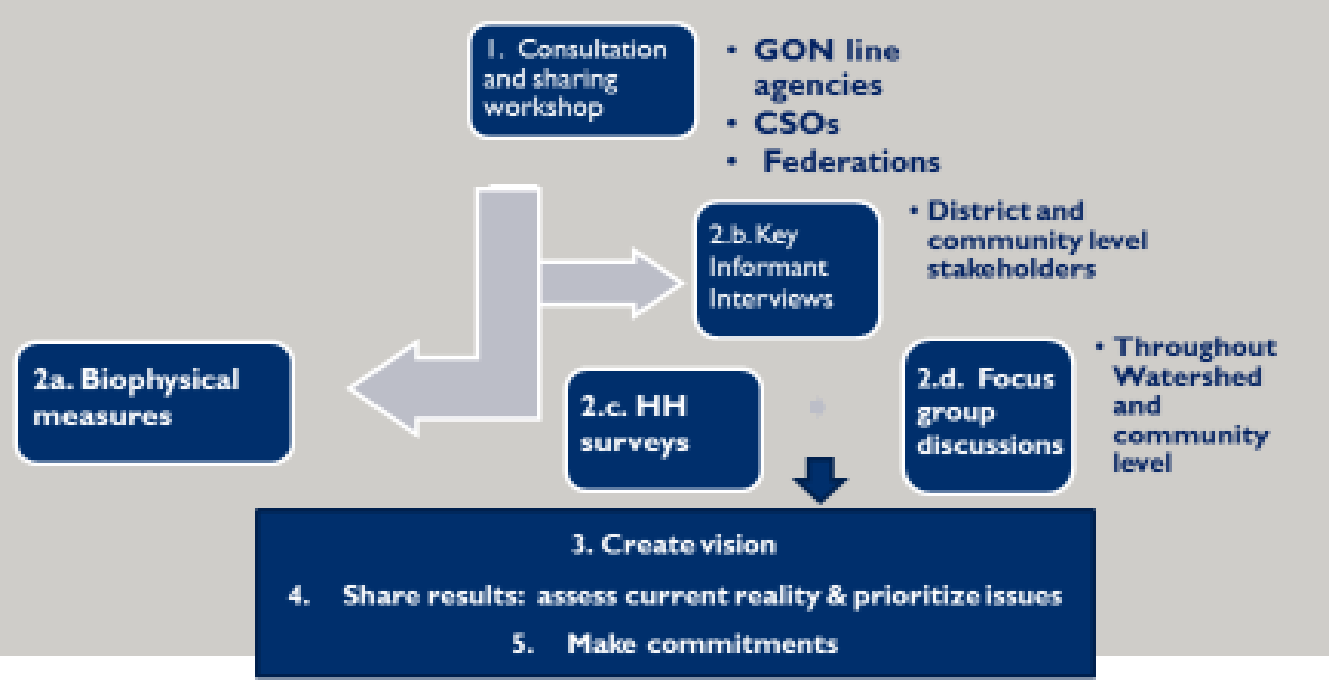

Figure 15: Methodological approach illustrated

Annex 2: Land use and land cover

Table 7: Land use and land cover by coverage and percentage

SN	Land use	Area (sq. km)	Percentage
1	Forest	462.69	68.04
2	Cultivation	103.06	15.16
3	Grazing	81.92	12.05
4	Shrub forest	17.70	2.60
5	River/streams	12.77	1.88
6	Rock	1.28	0.19
7	Barren land	0.59	0.09
8	Pond/lake/reservoir	0.01	0.00
	Total	**680.02**	**100.00**

Annex 3: Population

Table 8: Population by VDC, municipality, sex, and caste/ethncity

SN	VDC/Municipality	GP or NP	Estimate / Total Population								
			Population by sex			Population by caste/ ethnicity					
			Male	Female	Total	Brahmin, Chhetri and Thakuri	Janajati	Dalit	Madheshi	Others	Total
1	Arkha	Gaumukhi GP	2581	3070	5651	41	4008	1353	0	249	5651
2	Baraula	Airawati GP	1767	2438	4205	1338	1779	1003	18	67	4205
3	Bijaya Nagar	Pyuthan NP	1706	2287	3993	1613	1456	892	0	32	3993
4	Bijubar	Pyuthan NP	3376	3975	7351	2722	2086	2301	27	215	7351
5	Bijuli	Airawati GP	1675	2300	3975	2008	927	997	0	43	3975
6	Dakhakwadi	Pyuthan NP	2514	3563	6077	3522	804	1474	0	277	6077
7	Damri	Naubahini GP	2166	2591	4757	1388	1584	1455	0	330	4757
8	Dharampani	Malla Rani GP	1268	1815	3083	1110	1337	619	0	17	3083
9	Dharmawati	Pyuthan NP	2234	2649	4883	2476	910	1156	19	322	4883
10	Dhuwang	Airawati GP	1580	2043	3623	275	2918	419	0	11	3623
11	Jumrikanda	Pyuthan NP	1889	2412	4301	1575	2164	557	0	5	4301
12	Khaira	Malla Rani GP	1685	2402	4087	1672	1449	820	0	146	4087

13	Khawang	Naubahini GP	2672	3305	5977	209	3797	1271	0	700	5977
14	Khung	Gaumukhi GP	1483	1773	3256	1628	171	886	0	571	3256
15	Ligha	Naubahini Gaunpalika	1646	1899	3545	525	2528	353	0	139	3545
16	Liwang	Gaumukhi & Jhimrukh GP	2290	2724	5014	1899	1036	1554	0	525	5014
17	Lung	Naubahini GP	2019	2650	4669	2927	864	651	183	44	4669
18	Majhakot	Pyuthan NP	1451	1779	3230	742	2200	273	0	15	3230
19	Maranthana	Pyuthan NP	2687	3598	6285	2855	1777	1355	0	298	6285
20	Narikot	Gaumukhi GP	1423	1933	3356	871	514	1042	0	929	3356
21	Okharkot	Jhimruk GP	2584	3148	5732	4049	482	1097	30	74	5732
22	Pakala	Airawati GP	1995	2627	4622	1526	2197	889	0	10	4622
23	Phopli	Naubahini GP	3503	4257	7760	2716	2947	1889	0	208	7760
24	Puja	Gaumukhi GP	2293	2842	5135	2585	171	1950	0	429	5135
25	Pyuthan Khalanga	Malla Rani GP	2601	3259	5860	2520	2033	1200	33	74	5860
26	Rajbara	Gaumukhi GP	2282	2811	5093	849	3168	1068	0	8	5093
27	Ramdi	Mandabi GP	1079	1355	2434	933	1105	309	22	65	2434
28	Ruspur Kot	Airawati and	1382	1991	3373	1892	566	800	0	115	3373

		Malla Rani GP									
29	Syauliwang	Naubahini GP	1614	1970	3584	380	2308	883	0	13	3584
30	Torwang	Jhimruk GP	1843	2480	4323	1442	1644	777	0	460	4323
31	Tusara	Jhimruk GP	2455	3316	5771	3587	232	1277	0	675	5771
	Total		**63743**	**81262**	**145005**	**53875**	**51162**	**32570**	**332**	**7066**	**145005**

Annex 4: Temperature and precipitation

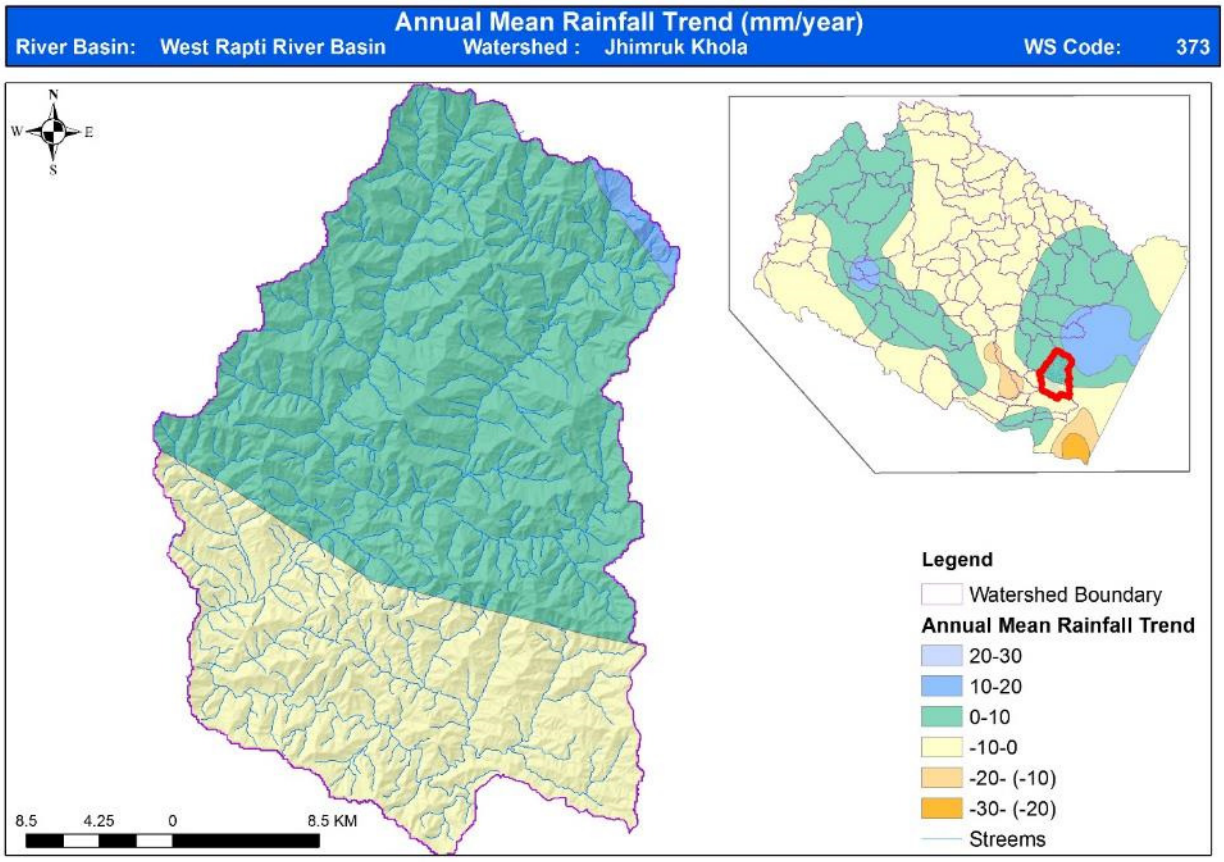

Figure 16: Long-term annual mean rainfall trend (mm/year) observed in Jhimruk watershed

Table 9: Rainfall and temperature averages by month in the Jhimruk watershed

Month	Rainfall (mm)	Temperature (C°)
Jan	28.9	8.3
Feb	28.2	9.8
Mar	29.7	13.1
Apr	38.5	16.1
May	81.0	17.5
Jun	266.4	18.3
Jul	401.6	17.9
Aug	368.9	17.9
Sep	206.9	17.3
Oct	49.1	15.0
Nov	6.6	12.0
Dec	10.9	9.3
Annual	**1516.6**	**14.4**

Figure 17: Locations of hydro-meteorological stations used to estimate rainfall and temperature for the Jhimruk watershed

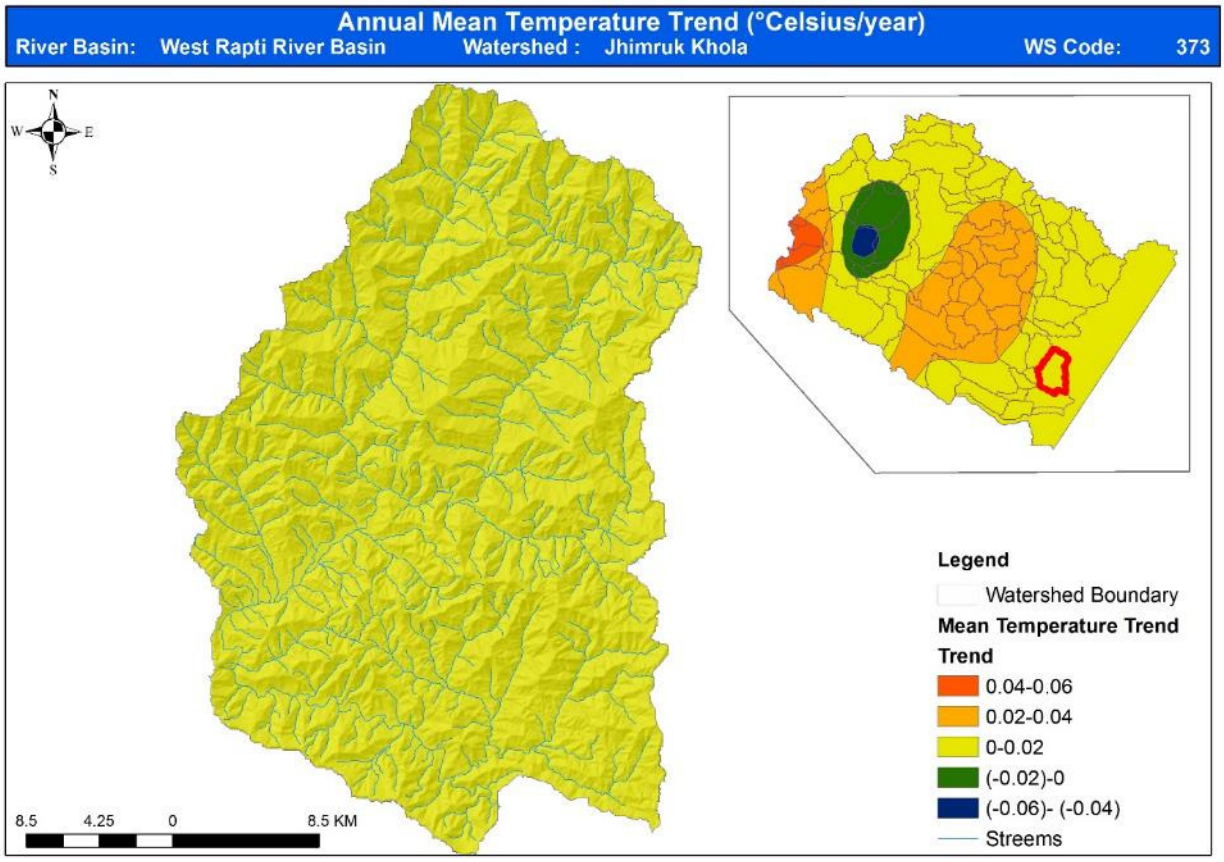

Figure 18: Annual mean temperature change trend in the Jhimruk watershed

Annex 5: Lakes, streams, rivers, and sub-watersheds

Table 10: Rivers, streams and tributaries in the Jhimruk watershed

Name	Length (m)	Tributaries
Khar	19,854	Tammu Khola, Mujakot Khola, Menra Khola, Daha Khola, Bhagre Khola, Banjari Khola,
Arkha	1,883	Besi Khola, Rangjung Khola, Hapajdhung Khola, Harja Khola, Sokh Khola, Gunchhyang Khola, Bhitte Khola, Baismul Khola
Andheri	10,544	
Korban	6,218	
Ghaderi	6,576	
Aglun	2,530	

Shyaulibang	4,394	Sim Khola, Bhuija Khola, Pahara Khola, Khar Khola, Uttise Khola, Panera Khola, Moja Khola, Hastung Khola, Damar Khola, Bhagni Khola, Gadera Khola, Thoklang Khola, Tare Khola
Dodre	3,178	
Kurtibang	6,678	Majh Khola
Kaiya	7,295	
Ek Tare Kho	7,279	
Gabdi	5,087	Khari Khola, Kate Khola, Patale Khola, Khalbang Khola
Jhundi	3,680	
Thula	3,304	
Kauche	2,770	
Balle	10,322	
Dha	2,805	
Andheri	10,544	
Dwar	2,627	Trinja Khola
Harsabang	5,279	
Jim	4,180	
Khun	4,057	
Khani	7,933	
Gau	5,021	
Libang	4,442	
Dhobi	4,145	
Ikhana	4,046	
Gobdi	5,087	
Kapre	2,265	
Hungadh	6,893	Bhaishi Khola, Hung Khola, Duda Khola,
Badi	2,931	
Gartang	8,271	Newar Khola, Kurle Khola, Kuchhne Khola, Airi Khola, Pairi Khola, Bange Khola, Dami khola, Othreni Khola, Aru Khola, Andheri Khola,

		Panjing Khola, Kabhre Khola, Baluwa Khola, Koya Khola, Betene Khola, Ripure Khola, Bhalu Khola
Lakuri	1,753	
Jim	4,180	
Kuta	3,370	
Chundari	6,098	Bhaswang Khola, Bhulke Khola, Churbung Khola, Shri Khola, Daha Khola,
Khapreng	8,691	
Saribang	3,535	Rakse Khola
Ritthe	2,547	
Bas	2,382	
Jumri	7,539	Jang Khola, Mangra Khola, Lame Khola, Kodar Khola, Dhobeni Khola, Klike Khola, Baya Khola, Tara Khola, Suwa Khola, Bismure Khola
Hari	3,279	
Sirse	6,471	
Bhakti	2,614	
Biribang	3,999	
Hariya	5,414	
Jhibang	2,471	
Beteni	4,034	
Kiran	3,137	
Dhubang	3,701	
Tigra	2,764	
Khakre	2,336	
Kanera	6,915	Huwa Khola
Khanidanda	2,727	
Gothibang	3,055	
AP	2,246	
Khagbesi	11,560	Lamchi Khola, Liuse Khola, Khillu Khola, Deurali Khola, Duware Khola, Lamdi Khola, Dhara Khola

Chhape	16,559	Raijanpani Khola, Chuja Khola, Mud Khola, Samme Khola, Parphe Khola, Berte Khola, SukKkha Khola

Table 11: Identified sub-watersheds in the Jhimruk watershed

Name	VDCs and wards covered	Area (ha)
Mathillo Jhimruk 1	Arkha 3, 7, 8, 9 Puja 1, 2 Rajwara 1, 2, 3, 4, 6, 7	19.21
Majhillo Jhimruk 1	Dharmawati 4, 6, 7 Lung 9 Maranthana 1 Okharkot 1, 6, 7, 8 Torwang 3, 4, 5, 6, 7, 8, 9 Tusara 1, 2, 4, 5, 6, 7, 8, 9	25.38
Majhillo Jhimruk 2	Bijuwar 1, 2, 3, 4, 5, 6, 7 Dharmawati 1, 2, 3, 6, 7, 8, 9 Khaira 1 Khalanga 1, 3, 4, 5, 6, 7, 8, 9 Majhakot 1, 2, 3, 4, 5, 6, 7, 9 Maranthana 1, 6, 7, 8, 9 Phopli 2	37.12
Mathillo Jhimruk 2	Badikot 7 Khawang 1, 7 Khung (all wards) Liwang (all wards) Lung 8 Narikot (all wards) Okharkot 6 Puja (all wards) Rajwara 4, 6, 7 Tusara 1, 2, 3, 4, 5, 6	69.91
Tallo Jhimruk 1	Bijaynagar 1, 2, 3, 8, 9 Bijuwar 7 Dakhakwadi 1, 2, 3, 4, 5, 6, 7, 9 Khaira 3, 4, 5, 6, 7, 8, 9 Khalanga 9 Ramdi 4,5	21.91
Tallo Jhimruk 2	Baraula 1, 2, 5, 6, 7, 8, 9 Bijuli 1, 2, 3, 4, 5, 6	80.39

	Dharampani 1 Dhuwang 1, 2, 3, 4, 5, 6, 9 Khaira 2, 5 Pakala 1, 2, 3, 4, 5, 6, 8, 9 Ramdi 1, 2, 3, 4 Raspurkot (all wards)	
Chudari Khola	Chuja 1, 2, 3 Maranthana 1, 2, 3, 4, 5, 6, 7, 8 Okharkot 8, 9 Torwang 1, 2, 3, 4, 8, 9	26.33
Kachar Khola Jaladhar	Dharampani 1, 2, 4 Khaira 1, 2, 3, 4, 5 Khalanga 1, 2, 3, 4, 5, 9 Ramdi 4	16.79
Jhimruk Khola Jaladhar	Bijaynagar (all wards) Bijuwar 3, 4, 5, 6, 7, 8, 9 Dakhakwadi 3, 4, 5, 6, 7, 8, 9 Jumrikanda (all wards) Majhkot 4, 7, 8, 9 Phopli 2, 9	43.03
Gartang Khola	Badikot 2, 3, 4, 5, 6, 7, 8, 9 Chuja 3, 4 Okharkot 1, 2, 3, 4, 7, 8, 9 Tusara 2 Torwang 2,3	42.93
Chhap Khola	Bijuli 1, 2, 3, 4, 6, 7, 8, 9 Chuja (all wards) Dharampani (all wards) Khalanga 1, 5 Maranthana 4, 5, 8 Raspurkot 6, 7, 8, 9	50.04
Badikot Jaladhar	Badikot 1, 2, 3, 4, 5, 6, 7, 9 Narikot 8 Okharkot 1, 2, 3, 4, 5, 6	20.79
Lung Khola	Damri 7, 8 Dharmawati 4, 5, 7, 9 Khawang 1 Liwang 9 Ligha 7 Lung (all wards) Majhkot 5, 6	40.44

	Phopli 1, 2, 3, 4, 5, 6 Torwang 7 Tusara 6, 8, 9	
Boldi Khola	Damri 2, 3, 4, 9 Jumrikanda 3 Lung 6 Phopli 3, 4, 6, 7, 8, 9	29.11
Gabai Khola	Damri (all wards) Ligha 1, 5, 6, 7, 8, 9	29.86
Dangal Khola	Jumrikanda 6	24.88
Madi Khola 5	Dhuwang 9 Ramdi 2, 3, 6, 7, 8	40.1
Madi 6 & Tallo Madi	Baraula 3, 4, 5, 6 Dhuwang 5, 6, 7, 8, 9 Dangwang 3, 5 Pakala 4, 5, 6, 7, 8 Ramdi 2 Baraula 1, 6 Dhuwang (all wards)	88.69
Tallo Jhimruk Khola 3	Baraula 1, 6 Dhuwang (all wards)	37.41
Madi Khola 4	Bijaynagar 8 Dakhakwadi 3, 5, 7, 8, 9 Ramdi 3, 4, 5, 6, 8, 9	65.54
Syauliwang Khola	Khawang (all wards) Liwang 1, 9 Ligha (all wards) Lung 7 Puja 3, 9 Rajwara 6	72.89
Dandagaun Khola	Arkha 2, 3, 4, 5, 6, 7, 8	16.05
Rajwara Khola	Arkha 1, 3 Khawang 7 Rajwara (all wards) Syauliwang 5, 8	31.4
Thulachaur Khola	Arkha 1, 2, 3 Rajwara 5	18.53

Gadhira Khola	Khawang 7, 8 Rajwara 6 Syauliwang 5, 7, 8, 9	29.36
Panera Khola	Syauliwang 3, 4, 5, 6, 7	18.33

Annex 6: Forest types and composition

Table 12: Forest types by area and percentage

Type	Area (sq km)	Percentage
Mixed hardwood	237	51%
Sal Forest	18	4%
Pine Forest	143	31%
Sisau (sisam)	2	0%
Banjh Oak (Quercus)	57	12%
Himalayan Fir (Abies)	0.5	0%
Deodar Cedar	4	1%
Spruce	2	0%
Total Forest Cover	**463**	

Annex 7: Fish and aquatic life

Table 13: Species of fish commonly found in the Jhimruk watershed

SN	Local name	Scientific name	VDC	River location
1	Asala or Snow Trout	Schizothorax spp.	Dakhakwadi -1 Bangemaroth 3 Okharkot 4 Lung -6	Jhimruk, Gartang, Ahal Khola, Lung Khola
2	Bai, Baghi	Botia spp.	Chukaha 5	Jhimruk
3	Bam	Mastacymbelus spp	Khaira – 1 Sera Kwadi - 1, Chukaha -	Jhimruk

4	Buduna	Garra spp	Khaira – I Sera	Jhimruk
5	Charinga, Saura, Hile	Channa spp.	Kwadi,9 Hungad Khola 5 & 6	Hungadh Khola
6	Gadera, Gadyaulo	Nemacheilus spp.	Cherneta, Kapilpata, Hungadkhola, Pipaltari	Jhimruk, Gartang, Hungadh Khola, Lung Khola
7	Gaicha	Xenentodon spp.	Hungadh Khola	Hungadh Khola
8	Karanga	NA	Udik	Jhimruk
9	Katala	NA	Kapilpata	Gartang
10	Katle	Neolissocheilus hexagonolepis	Bahane	Lung Khola
11	Phakata, Phaketo	Barilius spp.	Sera 1, Piplari 9, Hungadh Khola 5, 6	Jhimruk, Hungadh Khola, Lung Khola
12	Ruti	NA	Chandre	Lung Khola
13	Sahar, Mahseer	Tor spp.	Sera	Jhimruk
14	Sidhra, Bhitte	Puntius spp.	Kwadi	Jhimruk
15	Tite	NA	Udik	Jhimruk
16	Yaki, Milki, Chokare	Labeo spp.	Sera, Chukaha, Kwadi, Cherneta	Jhimruk
17	Bhyaguta (Frog)	NA	Kwadi	Jhimruk
18	Dragon fly larvae	NA	Kwadi	Jhimruk
19	Gangata	NA	Kwadi, Ambapata, Hungadh Khola, Pipaltari	Jhimruk, Hungadh Khola, Lung Khola
20	Ghonghi (Snail)	NA	Kwadi	Jhimruk
21	Jhate Kira (Snail)	NA	Bahane	Lung Khola
22	Jhinge (Prawn)	NA	Kwadi	Jhimruk
23	Lamcho sankhekira	NA	Daredhunga	Chhapekhola

24	Sipikira, Mussels	NA	Kwadi, Garthal Khet	Jhimruk

Annex 8: Mammals and population trend

Table 14: Common mammals in the Jhimruk watershed

Nepali name	Common name	Scientific name
Bhalu	Sloth bear	Melursus ursinus
Kasturi	Siberian musk deer	Moschus moschiferus
Kharayo	Hispid hare	Caprolagus hispidus
Mirga	Spotted deer or chital	Axis axis
Goral	Himalayan goral	Naemorhedus goral
Chituwa	Leopard	Panthera pardus
Bandel	Wild boar	Sus scrofa
Dumsi	Old world porcupine	Hystricidae

Annex 9: Birds and population trend

Table 15: Common birds in the Jhimruk watershed

Nepali name	Common name	Scientific name
Danfe	Himalayan monal	Lophophorus impejanus
Munal	Crimson horned pheasant	Tragopan satyra
Kalij	Kalij pheasant	Lophura leucomelanos
Dhukur	Dove	Streptopelia spp
Luiche	Red junglefowl	Gallus gallus
Kholihans (Khoya Hans)	Bar-headed goose	Anser indicus
Titra	Crested partridge	Rollulus rouloul
Suga	Plum-headed parakeet	Psittacula cyanocephala

Annex 10: Road networks

Table 16: List of road networks in the Jhimruk watershed by type and length

Communities connected	Type of road	Length
Khalanga – Jharkisthan – Sarankot – Jorpokhari - Tikuri	Earthen	11.40
Okharkot - Pipalneta - Pipalrukh - Narikot - Gulmi	Earthen	8.65
Dhand - Hirapokhari - Okharkot - Badikot	Earthen	4.01
Majuwa - Judelikhola - Chuja - Chuja_Road	Earthen	8.62
Rajwara (1) - Shyaulibang_Road	Earthen	10.44
Baraula - Narsingneta – Dangbang Road	Earthen	2.50
Kutichar - Domai - Pipaltari – Tusara Road	Earthen	3.12
Dharampur - Chheda - Mundanda – Chuja Road	Earthen	4.42
Bahane - Lung - Tusara - Dhand - Road	Earthen	9.02
Kutichaur - Ratatari - Kuta - Tusara_Road	Earthen	5.05
Bahane - Damri_Road	Earthen	3.24
Rajwara (1) – Shyaulibang Road	Earthen	5.11
Aglung Phedi - Rajwara – Dhorpatan (Baglung) Road	Earthen	2.93
Dharmawati - Gejwang - Phopli - Mainamare – Rolpa Road	Earthen	2.66
Khalanga - Chijathanti - Jogitari	Earthen	19.49
Chisapani - Damri	Earthen	5.88
Dharmawati - Gejwang - Phopli - Mairamane	Earthen	11.63
Tikuri - Gurunggaon - Majhkot	Earthen	9.18
Bijuwar - Dhungethati - _Deurali	Earthen	9.20
Thulabeshi - Puja	Earthen	4.29
Bagdula - Machchi - Thulabeshi - Arkha - Bhimgithe	Earthen	21.80
Siring Khola - Rajwara - Dhorpatan	Earthen	7.61
Dhad - Tusara	Earthen	5.66
Machhi - Bangemarot - Sautamare	Earthen	9.11
Cherneta - Puranthati - Jogitari	Gravel	21.09

Cherneta - Chin - Jamune - Dangwang - Juda	Earthen	7.26
Machhi - Dhad - Badikot	Earthen	10.70
Bagdula - Damti - Bahane - Khabang - Syaulibang	Gravel	8.57
Bahane - Chisapani - Ligha	Earthen	12.00
Dakhakwadi - Neta - Barjibang - Sotre - Sari	Earthen	5.32
Dharapani - Chineta - Mundanda - Chuja	Earthen	3.62
Dhad - Gobdi - Timurchaur - Libang	Earthen	7.11
Bijuwar - Dhungethati - Deurali	Gravel	2.52
Bagdula - Damti - Bahane - Khabang - Syaulibang	Black top	4.08
Bagdula - Machchi - Thulabeshi - Arkha - Bhimgithe	Gravel	13.60
Machhi - Dhad - Badikot	Gravel	0.72
Machhi - Bangemarot - Sautamare	Gravel	1.38
Cherneta - Puranthati - Jogitari	Earthen	5.77
Bagdula - Damti - Bahane - Khabang - Syaulibang	Earthen	5.48
	Total	**294.24**

Annex 11: Micro hydropower – potential rivers and streams

Table 24: Potential rivers for micro hydropower plants

Pradeep Gautam sir will provide this data

Annex 12: Irrigation projects

Table 17: List of irrigation projects by name, location, and area

SN	Name	Location	Area covered (sq km)
1	Kashikulo	Bijuwar - 7	35.00
2	Gartang Khola	Okharkot	35.00
3	Sirbari Pipaltari	Lung	55.00
4	Pidalne Phat	Tushara	45.00
5	Thulo Khola	Puja	80.00
6	Badahara Saribang	Maranthana	30.00

7	Upadre Kulo	Dwakhaquadi	74.00
8	Ghari Kulo	Vijayanagar	25.00
9	Lamasera	Okharkot	37.00
10	Baguwa Khola	Jumrikanda	15.00
11	Nabachaw	Dwakhaquadi	29.00
Irrigation schemes from CIP			
12	Ghaya Kholsi	Majhkot – 5, 6	16.00
13	Rat Tari	Tusara - 9	17.00
14	Kadheni Kulo	Tusara - 3	14.00
15	Kath Khola	Puja – 8	15.00
16	Agara	Khung – 7, 8	19.00
17	Gaun Khola	Puja - 8	24.00
18	Gaumukhi	Arkha - 1	18.00
19	Baichaur	Arkha - 4	11.00
20	Tuniboat	Khung	10.00
Irrigation schemes from KISAN I			
21	Canal, pipe and lift (4 schemes)	Ramdi	15.00
22	Canal, pipe and lift (5 schemes)	Maranthana	13.00
23	Pipe irrigation (2 schemes)	Torbang	3.25
24	Pipe and water harvest tanks	Majhkot	10.00
25	Canal, pipe and lift (4 schemes)	Ramdi	15.00
		Total	**660.25**

Source: Department of Irrigation (DOI)

Annex 13: Water quality

Table 18: Water quality by river/stream and tested aspect

	Name of the river/stream					Water quality standards		
	Balipuk Khola	Jhundi Khola	Lung Khola	Balle Khola	Andheri Khola	* Drinking	** Irrigation	** Aquaculture
Conductivity (µS/cm)	80.2	14	154.2	280.7	284	1,500		
Temp °C	12.2	10	13.9	15.1	15.2			4 to 30
Iron (mg/L)	0.0	0.0	0.0	0.0	0.0	0.3 (3)	5	0.01
pH	6.4	4.8	5.9	6	6.5	6.5-8.5	6.5-8.5	6.5-9.0
Nitrate Nitrogen (mg/L)	1.0	1.20	0.8	0	1.3	50		<300
Nitrite Nitrogen (mg/L)	0.02	0.02	0	0	0.02		<5	
Ammonium (mg/L)	0	0	1	0	0	1.5		0.025
Phosphate (mg/L)	6.5	3.0	2.1	0.9	1.8	0.4 EEC		

	Name of the river/stream					Water quality standards		
	Jhimruk dam site	Hareya Khola	Jhimruk Arlabang	Kandre Khola	Chhape Khola	* Drinking	** Irrigation	** Aquaculture
Conductivity (µS/cm)	250	502.8	412.3	435.35	410	1,500		
Temp °C	12.9	19.4	19	11.9	18			4 to 30
Iron (mg/L)	0.0	0.0	0.0	0.0	0.0	0.3 (3)	5	0.01
pH	6.5	7.4	6.5	7.2	7.4	6.5-8.5	6.5-8.5	6.5-9.0
Nitrate Nitrogen (mg/L)	0.0	0.0	0.0	0.8	0.0	50		<300
Nitrite Nitrogen (mg/L)	0.0	0.0	0.0	0.0	0.0		<5	
Ammonium (mg/L)	1.0	0	1.0	0	0	1.5		0.025
Phosphate (mg/L)	7.9	7.9	2.7	5.8	4.4	0.4 EEC		

	Name of the river/stream	Water quality standards

	Saribang Khola	Jhimruk near Thulabesi	Dhaute Khola	Hungadh Khola	Gartan Khola	* Drinking	** Irrigation	** Aquaculture
Conductivity (µS/cm)	511	19	82.7	113.2	288.1	1,500		
Temp °C	16.2	12.7	13.4	17.6	16.6			4 to 30
Iron (mg/L)	0.0	0.0	0.0	0.0	0.0	0.3 (3)	5	0.01
pH	7.1	6	6.3	6.4	7.2	6.5-8.5	6.5-8.5	6.5-9.0
Nitrate Nitrogen (mg/L)	0.0	0.0	0.0	0.0	0.0	50		<300
Nitrite Nitrogen (mg/L)	0.0	0.0	0.0	0.0	0.0		<5	
Ammonium (mg/L)	5	2	0	0	0	1.5		0.025
Phosphate (mg/L)	3.7	8.6	4.4	3.7	4.4	0.4 EEC		

	Water quality standards						
	Jhimruk Machhe	Chundari Khola	Gaumukhi Barah Tal	Gaumukhi	* Drinking	** Irrigation	** Aquaculture
Conductivity (µS/cm)	178.7	410	193.8	213.1	1,500		
Temp °C	12.1	13	17.5	11.4			4 to 30
Iron (mg/L)					0.3 (3)	5	0.01
pH	6.2	6.4	5.9	6.7	6.5-8.5	6.5-8.5	6.5-9.0
Nitrate Nitrogen (mg/L)	0	0	0	0	50		<300
Nitrite Nitrogen (mg/L)	0	0	0	0		<5	
Ammonium (mg/L)	3	0	1	0	1.5		0.025
Phosphate (mg/L)	7.9	5.1	5.1	1.8	0.4 EEC		

** Nepal's Drinking Water quality standards*

*** Nepal Water Quality Guidelines, Volume 1 (Irrigation) and Volume 2 (Aquaculture), Irrigation, Ground Water Resource Development Board, Ministry of Irrigation*

Annex 14: Major pollution points in the Jhimruk watershed

Table 19: Major pollution points in the Jhimruk watershed

SN	Pollution point	Type	VDC	Elevation (m)
1	Dakhakwadi	Small market	Dakhakwadi	793
2	Jumri Khola Bazar	Small market	Bijuwar	794
3	Bijuwar	Settlement, household sewage	Bijuwar	802
4	Khalanga	District headquaters and small market	Bijuwar	1333
5	Bagdula	Dumping site	Dharampani	813
6	Kwadi	Small market	Dakhakwadi	780
7	Thulobeshi	Settlement	Khung	1130
8	Baraula	Small market	Baraula	632
9	Machhi	Small market	Okharkot	948
10	Bahane	Small market	Lung	1,018

Annex 15: Locations of gravel mining operations

Table 20: Locations of gravel mining operations in the Jhimruk watershed

SN	Location	VDC	Latitude (N)	Longitude (E)
1	Macchi Danda	Okharkot/Tasara	28.1533	82.97
2	Bijuwar	Bijuwar	28.1056	82.8681
3	Kwadi	Dakhakwadi/Khaira	28.0881	82.0839
4	Gairebagar	Ramdi	28.04306	82.8103
5	Khaira	Dhubang	28.008	82.851
6	Chunabagar	Pakala	27.9936	82.898
7	Khoprang Khola	Dharmawoti	27.9936	82.8902
8	Kitaghat	Torbang	28.1282	82.9385
9	Bhainsebudhebagar	Narikot	28.1856	82.9978
10	Padkebar	Khung	28.1953	83.0193
11	Lung Khola	Lung	28.1953	82.8989

12	Gartang Khola	Bangemaroth	28.1322	82.9708

Source: DCC Pyuthan (EIA/EIA report 2017)

Annex 16: Community user forest groups

Table 21: Community user forest groups by location, area and representation

SN	VDC	GP/NP	#	Area (ha)	HHs	Female	Male	Total
1	Damri	Naubahini GP	5	538	1,023	2,760	2,921	5,681
2	Arha	Gaumukhi GP	9	1,513	1,717	4,639	4,873	9,512
3	Baraula	Airawati GP	4	133	675	2,039	1,928	3,967
4	Bijaynagar	Pyuthan NP	4	474	342	1,115	1,116	2,231
5	Bijuli	Airawati GP	8	1,164	1,697	4,840	4,820	9,660
6	Bijuwar	Pyuthan NP	4	673	593	1,942	2,027	3,969
7	Dahakwadi	Pyuthan NP	2	172	296	971	997	1,968
8	Dharampani	Malla Rani GP	5	190	413	1,185	1,305	2,490
9	Dharmawati	Pyuthan NP	6	239	1,027	2,984	3,056	6,040
10	Dhuwang	Airawati GP	8	349	934	2,754	2,835	5,589
11	Jumrikanda	Pyuthan NP	2	140	708	2,211	2,336	4,547
12	Khaira	Malla Rani GP	5	1,285	1,109	2,844	3,082	5,926
13	Khalanga	Malla Rani GP	11	1,025	2,187	6,775	6,797	13,572
14	Khawang	Naubahini GP	8	306	800	2,381	2,590	4,971
15	Khung	Gaumukhi GP	11	1,156	2,638	7,806	9,158	16,964
16	Ligha	Naubahini GP	10	457	1,211	3,299	3,349	6,648
17	Liwang	Gaumukhi & Jhimruk GP	11	431	1,256	3,534	3,440	6,974
18	Lung	Naubahini GP	5	751	626	1,728	1,828	3,556
19	Majhkot	Pyuthan NP	10	440	1,521	4,355	4,249	8,604
20	Maranthana	Pyuthan NP	2	172	120	340	369	709
21	Narikot	Gaumukhi GP	16	567	984	2,460	2,521	4,981
22	Okharkot	Jhimruk GP	7	1,100	743	2,344	2,430	4,774

23	Pakala	Airawati GP	11	557	923	2,667	2,742	5,409
24	Phopli	Naubahini GP	9	956	1,087	3,927	4,071	7,998
25	Puja	Gaumukhi GP	12	1,049	1,525	4,409	4,359	8,768
26	Rajwara	Gaumukhi GP	12	711	1,560	4,535	4,858	9,393
27	Ramdi	Mandabi GP	11	1,426	1,569	4,159	4,287	8,446
28	Raspurkot	Airawati and Malla Rani GP	9	990	1,295	3,701	4,142	7,843
29	Swauliwang	Naubahini GP	9	2,746	917	2,985	3,047	6,032
30	Torwang	Jhimruk GP	9	1,803	982	2,975	3,177	6,152
31	Tusara	Jhimruk GP	8	1,545	1,415	4,155	4,354	8,509
	Total		**243**	**25,057**	**33,893**	**98,819**	**103,064**	**201,883**

Source: DFO Pyuthan

Annex 17: Water and sanitation user groups

Table 22: Water supply and sanitation user groups by location

SN	Name	VDC	Ward Number
1	Chanyasim Khanepani	Dharmawati 1 Bijuwar 1,2	
2	Syauliwang 2, Khanepani Aayojana	Syauliwang	8
3	Syauliwang 3, Khanepani Aayojana	Syauliwang	1
4	Khalanga Khanepani Tatha Sarsafai Aayojana	Khalanga	3,4,5,6,9
5	Dhuwang 4, Khanepani Aayojana	Dhuwang	7
6	Kandrekhola 3, Khanepani Aayojana	Khaira	1
7	Syauliwang 5, Khanepani Aayojana	Syauliwang	4
8	Syauliwang 1	Syauliwang	3,5,6,7
9	Amildhara 3	Liwang	8
10	Goldhara 2	Jumrikanda	5
11	Liwang 6	Syauliwang	2,3
12	Jumrikanda 1 & 2	Jumrikanda	5

13	Syauliwang 4	Syauliwang	2,3
14	Dharampani 1	Dharampani	2,3
15	Kusunde 2	Dharampani	3
16	Kushum Pani 3	Dharampani	5,6
17	Liwang 2	Liwang	5
18	Badkhola 1	Lung	5
19	Jumrikanda Purna Gaun 1	Jumrikanda	5
20	Gabdi Khanepani Tatha Sarsafai	Tusara	
21	Gudgude Ledemela	Tusara	9
22	Bharatiya Gramin Khanepani	Khalanga	3,4,5,9
23	Barjibang 2	Barjiwang	9
24	Liwang 5	Liwang	1,7,9
25	Laldamar 2	Baraula	2
26	Tallo Banskot 1	Phopli	7
27	Upallo Banskot 1	Phopli	7
28	Jadi Scheme 1	Pakala	1
29	Kumal Takura 1	Baraula	4
30	Buki Chaur Gramin Khanepani	Liwang	1,8,9
31	Andheri 3	Pakala	9
32	Liwang 3	Liwang	2,3,4
33	Arjham 2	Pakala	9
34	Baraula 6	Baraula	7,8
35	Kattike 3	Baraula	3
36	Sisaini 5	Baraula	5,6
37	Neware Tole 2	Baraula	3
38	Arkha 15, 16 & 17	Arkha	7,8
39	Kolawang 4	Pakala	7
40	Gaire Pokhari 5	Pakala	7

41	Okharkot, Badikot	Okharkot	NA
42	Dhakuliwamg Scheme 2	Rajwara	6
43	Brihat Bijuwar Khanepani Aaayojana	Bijuwar	NA
44	Beorekhola Khanepani Tatha Sarsafai Upabhokta Samuha	Maranthana	4
45	Raspurkot 1 & 2	Raspurkot	6,7,8,9
46	Dhandhmangra 2	Bijuwar	5
47	Dakhakwadi Khanepani Tatha Swasthya Sikshya Sasafai Samiti	Dakhakwadi	2,3,4
48	Baskot Bahu Uddyeshyiya Gramin Bikash Bya.	Phopli	7
49	Ghuikateri Tusara	Tusara	1,2,3
50	Upallo Narokot Gramin Khanepani	Narikot	4,5,7
51	Kusunde Khanepani	Dharampani	3
52	Phopli 1	Phopli	3,4,5,6
53	Tighrekhola Khanepani	Ramdi	1,2
54	Sana Sim Bhalukhola	Bijaynagar	4,5,6
55	Juke Khola	Khaira	2,6,7,8,9
56	Talakhola Khanepani	Lung	8
57	Simsiyar Khanepani	Lung	6
58	Mithiaap Darbhan Khanepani	Bangesal	6
59	Sindure Pani Khanepani	Puja	7
60	Sepung Khanepani	Bijaynagar	9
61	Bhulke Pandhera Khola, Chuja Khanyu Khola	Chuja	8,9
62	Bhulke Chuja Deurali Khanepani	Chuja	1,8,9
63	Chuja Gaderi Khola Khanepani	Chuja	5
64	Maranthana Beore Khanepani	Maranthana	4
65	Luplung Khanepani	Phopli	1,2
66	Obang Khanepani	Jumrikanda	7
67	Purnagaun Khanepani	Jumrikanda	8
68	Phopli 1	Phopli	3,4,5,6

69	Susaunekhola Laghu Jalvidyut Aayojana	Arkha	1,2
70	Ghans Katne Khola Khanepani	Arkha	2
71	Bhati Khola Khanepani	Arkha	1
72	Damri Pokhara Khanepani	Damri	4,5
73	Purnagaun Khanepani	Lung	9
74	Sulabh Khanepani	Barjiwang	4,5,6,7
75	Sarangkot Khanepani	Khaira	2,5
76	Jukejaluke Khanepani	Dharampani Raspurkot	
77	Pakala Khanepani	Pakala	2
78	Jumrikanda Khanepani	Jumrikanda	7,9
79	Satmuni Khanepani	Khaira	7,8
80	Dharampani 6	Dharampani	9
81	Sariwang Khanepani	Maranthana	9
82	Chhahara Patal Kateri Khanepani	Badikot	5,6
83	Kutakhola Ratotari Khanepani	Tusara	8,9
84	Badkhola Kutaga Khanepani	Tusara	8,9
85	Sisneri Khola Khanepani	Pakala	1
86	Bhulke Masure Khanepani	Khalanga	8
87	Dhadmangra Khanepani	Bijuwar	4,5,6,8
88	Ramdi Khanepani	Ramdi	7
89	Bhorsepani Khanepani	Khalanga	8
90	Pipaltari Khanepani	Lung	9
91	Tiusara Tallo Bhalukate Khanepani	Tusara	2
92	Kajuwa Kasueri Khanepani	Khalanga	1
93	Turke Khola Khanepani	Rajwara	5
94	Kimichaur Khanepani	Lung	7
95	Simpani Khanepani	Tusara	2
96	Malle Odar Khanepani	Bijaynagar	5

97	Juke Mul Khanepani	Lung	1
98	Besi Ban Khanepani	Arkha	8
99	Gegra Pumping Khanepani	Bijuwar	4
100	Lamakhola Dumpani 1	Bijuwar	9
101	Bangemul Khanepani	Dharmawati	6
102	Torwang, Maranthana Dhage Khanepani	Torwang	2
103	Kharikhola Khatepani Khanepani	Dharam Pani	9
104	Rajudhara Khanepani	Khalanga	2
105	Gel Khola Khanepani	Dakhakwadi	5
106	Khanikhola Daderi Gramin Khanepani	Maranthana	3
107	Tarule Khola Khanepani	Dhuwang	7
108	Khor Chaur Khanepani	Khung	1
109	Purna Gaun Khanepani	Jumri Kanda	8
110	Ripakhola Khanepani	Dhuwang	5
111	Handi Gaura Khanepani	Maranthana	7
112	Pani Chuhine Serambot Khanepani	Narikot	1
113	Kot Pandhera Tusar Pani	Maranthana	7
114	Duhe Khola Khanepani	Dharampani	5
115	Dahare Khaola 4 Khanepani	Pakala	7
116	Tallo Tusare Khola Khanepani	Tusara	2
117	Karki Danda Khanepani	Khalanga	8
118	Gogan Pani Khanepani	Raspurkot	8
119	Mandre Chaur Okhar Bot Khanepani	Bijay Nagar	6,7
120	Narange Khanepani	Pakala	6
121	Karki Danda Khanepani	Khalanga	8
122	Ramkram Khanepani	Khawang	4
123	Goganpani Khanepani	Raspurkot	9
124	Dhungepani Khanepani	Bijuwar	2

125	Kuntepani Khanepani	Dharampani	8
126	Gothana Batase Khanepani	Phopli	2
127	Chor Mare Khanepani	Badikot	7
128	Hadepani Khanepani	Tusara	9
129	Lukka Khanepani	Maranthana	8
130	Maira Mare Khanepani	Phopli	9
131	Bhakunde Khanepani	Raspurkot	8, 9
132	Mulpani Khanepani	Dharampnai	7
133	Kundapani Khanepani	Dharampani	8
134	Jiunikhola Khanepani	Maranthana	
135	Dharapani Gaurapani Khanepani	Torwang	
136	Bokseni Mul Khanepani	Dharmawati	
137	Lamchhyang Khanepani	Majhkot	4
138	Budhepokhara Khanepani	Ligha	9
139	Chiurikhola Khanepani	Dharampani	6
140	Thanke Khanepani	Damri	5
141	Garbhe Khola Khanepani	Damri	3
142	Ghantikhola Khanepani	Khawang	3
143	Mauribhir Khanepani	Khawang	5
144	Bihitari Khanepani	Bijuli	9
145	Bukakhola Khanepani	Lung	3
146	Shrinagar Khanepani	Lung	3
147	Hiti Khanepani	Khalanga	5,6
148	Jaljalaghat Khanepani	Khawang	6
149	Balibisauna Pandhera Khanepani	Raspurkot	5
150	Lekhmatikhola Dhange Khanepani	Torwang	2
151	Kate Khanepani	Damri	6
152	Ladrung Khanepani	Ligha	7

153	Danda Kateri Khanepani	Ligha	8,9
154	Pyasi Pokhara Khanepani	Phopli	8
155	Bista Kharka Khanepani	Phopli	7
156	Balipuk Khanepani	Khawang	4
157	Deutrali Khanepani	Damri	8
158	Bihikhola Khanepani	Damri	1
159	Chiplepahara Khanepani	Damri	5
160	Maukhola Khanepani	Damri	5
161	Selakhola Khanepani	Khawang	1
162	Milijuli Khanepani	Khawang	2
163	Patchaur Khanepani	Phopli	8
164	Panimul Khanepani	Ligha	1
165	Bhumedhara Khanepani	Ligha	6
166	Siriwang Khanepani	Ligha	4
167	Ranikamla Khanepani	Dharmawati	1
168	Dhamche Khanepani	Khawang	6
169	Khaira Lift Khanepani	Khaira	8
170	Daringe Khanepani	Phopli	7
171	Bastuk Khanepani	Rajwara	2
172	Dhuwakhola Khanepani	Dharampani	2
173	Baireni Damar Khanepani	Bijuli	6
174	Kholakharka Khanepani	Arkha	5
175	Juke Khola Khanepani	Raspurkot	4
176	Airawati Khanepani	Puja	4
177	Tesrokhola Khanepani	Markawang	1
178	Khatrikhet Simsar Khanepani	Bangemarot	2
179	Chhahara Khola Khanepani	Tusara	1
180	AmdarKhola Khanepani	Ramdi	8

181	Suntalabari Khanepani	Liwang	8
182	Amile Bagar Khanepani	Arkha	1
183	Khaira Khanepani	Khaira	1
184	Ghauda Pandhera Khanepani	Bijuwar	4
185	Kalikhola Khanepani	Ramdi	7
186	Jhariwang Khanepani	Dakhakwadi	7
187	Kailash Daha Khanepani	Arkha	
188	Dakhakwadi Masuri Rajukot Khanepani	Dakhakwadi	7
189	Rajhakhola Gahatera Khanepani	Bijuli	7
190	Upallo Bhiotri Khola Sirubari Khanepani	Ramdi	6
191	Chaukuna Dhairechaur Khanepani	Dakhakwadi	7
192	Upallo Bahunpani Khanepani	Khalanga	1
193	Sirsekhola Khanepani	Dakhakwadi	6
194	Kusukot Khanepani	Dharampani	2
195	Maira Mare (Bastawik) Khanepani	Phopli	9
196	Regati Khanepani	Phopli	5
197	Bismure Khanepani	Dakhakwadi	
198	Dhaire Kharka Khanepani	Baraula	1
199	Dhareni Kholi Khanepani	Khawang	6
200	Bhingreli Danda Khanepani	Raspurkot	3
201	Argelibunighat Khanepani	Torwang	5
202	Chabekhola Chakchake Khanepani	Ramdi	7
203	Ninyu Kharka Khanepani	Torwang	7
204	Hariya Tari Khanepani	Baraula	9
205	Chidiyar Khanepani	Dhuwang	4
206	Chhapakhamchi Khanepani	Dhuwang	2
207	Umakhola Khanepani	Dhuwang	2
208	Chisapani Aanpchaur Khanepani	Ramdi	4

209	Jotre Khanepani	Ramdi	4
210	Kairan Khanepani	Dhuwang	3
211	Ramdibensi Khanepani	Ramdi	5
212	Thulokol Khanepani	Pakala	2
213	Dhudi Khanepani	Khaira	5
214	Jaruwakhola Khanepani	Raspurkot	1
215	Khakrekhola Khanepani	Ramdi	7
216	Salthanti Khanepani	Raspurkot	7
217	Arni Pakha Khanepani	Raspurkot	4
218	Chiuri Bisauna Khanepani	Baraula	4
219	Kot kattike Khanepani	Baraula	2
220	Aanpkhola Khanepani	Dakhakwadi	8
221	Gairi Khet Khanepani	Narikot	7
222	Satmuni Khairakhota Bhumigat Lift Khanepani	Khaira	1
223	Banstari Pipaltari Khanepani	Okharkot	9
224	Okharkot Basakhola Khanepani	Okharkot	1,2,3,4,5
225	Dhaapkhola Khanepani	Ramdi	7
226	Jadi Khanepani	Pakala	1
227	Sineta Khanepani	Bijuli	6
228	Namrikot Khanepani	Chuja	1
229	Lisne Khanepani	Phopli	9
230	Jabunekhola Mul Sanrakshan Khanepani	Dakhakwadi	7
231	Latajhakri Ghantisa Khanepani	Dakhakwadi	1
232	Maljhakri Khanepani	Dakhakwadi	9
233	Gothiwang Khanepani	Raspurkot	5
234	Dharapani Jhakridhunga Kamera Thapla Khanepani	Raspurkot	2
235	Kabhre Karmachaur Khanepani	Torwang	8
236	Tunikhola Khanepani	Torwang	4

237	Dhoje Gahira Khanepani	Phopli	9
238	Karange Khanepani	Phopli	9
239	Gamija Khanepani	Phopli	8
240	Timile Khanepani	Phopli	8
241	Jukekholi Khanepani	Tusara	5
242	Newjakhola Khanepani	Dakhakwadi	9
243	Simpani Pakhapani	Tusara	1
244	Upallo Kochre Khanepani	Majhkot	7
245	Meraya Khoriya Khanepani	Liwang	7
246	Mangrakhola Khanepani	Raspurkot	5
247	Dharapani Khanepani	Pyuthan NP	18
248	Larke Gaura Khanepani	Bijuli	1,2
249	Pargrar Tal Khanepani	Khawang	1
250	Masurat Gaudhari Gaiwang Khanepani	Damri	7,8
251	Raijanpani Khanepani	Dharampani	2
252	Badkholi Khanepani	Tusara	8,9
253	Ubhokhola Simpani Khanepani	Dharampani	1
254	Bohara Tal Khanepani	Pyuthan municipality	1
255	Tunika Rukh Dhadh amare Khanepani	Okharkot	1
256	Timile Khanepani	Khaira	1
257	Thulo Lunksur Tallo Syaule Khanepani	Phopli	8
258	Jaluke Keore Khanepani	Raspurkot	6
259	Byadkhola Meriya Khola Khanepani	Liwang	7
260	Bukeni Syani Lekh Khanepani	Dharampani chuja	
261	Ramdi Chin Pumping Khanepani	Ramdi	5
262	Simpani Pakhapani DWS and Sanitation Scheme	Tushara	1
263	Mereya Khoreya DWS and Sanitation Scheme	Liwang	7
264	Jukekhola utteshepani DWS and Sanitation Scheme	Tushara	5

265	Dharampani DWS and Sanitation Scheme	Dharampani	5
266	Kailash Daha DWS and Sanitation Scheme	Arkha	6
267	Mahurat Gaudahry Gathang DWS and Sanitation Scheme	Damri	7
268	Badarkheti DWS and Sanitation Scheme	Tushara	8
269	Dharampani DWS and Sanitation Scheme	Pyuthan municipality	18
270	Ubhokhola Simpani DWS and Sanitation Scheme	Dharampani	2
271	Thulolungkusur Tallo Saune DWS and Sanitation Scheme	Phopli	8
272	Bayadkhola Merepakhela DWS and Sanitation Scheme	Liwang	7
273	Ramdichin DWS and Sanitation Scheme	Ramdi	7
274	Bukene Sanilera Lift DWS and Sanitation Scheme	Dharampani	5
275	Panrangtal Thuloakhikhola DWS and Sanitation Scheme	Khabang	1
276	Mangra Khola DWS and Sanitation Scheme	Rashpurkot	5
277	Tuneko Rukh Dhahd Amare DWS and Sanitation Scheme	Okharkot	1
278	Dhahare Khola Uppalomul DWS and Sanitation Scheme	Pyuthan NP	8
279	Jalude silimchaur Halte Aamarai DWS and Sanitation Scheme	Badikot	1
280	Lukukhun DWS and Sanitation Scheme	Arkha	8
281	Daadar Thapatol DWS and Sanitation Scheme	Badikot	8
282	Boharatol DWS and Sanitation Scheme	Pyuthan NP	1
283	Yekpakhe DWS and Sanitation Scheme	Phopli	4
284	Mulkhola DWS and Sanitation Scheme	Dhuwang	2
285	Gauthale Pasabang DWS and Sanitation Scheme	Puja	6,7
286	Gauthale Arghale Kuda DWS and Sanitation Scheme	Puja	5
287	Lukukhun Sabang Galang DWS and Sanitation Scheme	Arkha	6
288	Larke Gaira Lift DWS and Sanitation Scheme	Bijuli	1,2
289	Dhubang Dabang Lift DWS and Sanitation Scheme	Rashpurkot	6
290	Panikhet Belaunaghare DWS and Sanitation Scheme	Pakala	1
291	Jadikhola DWS and Sanitation Scheme	Pakala	1
292	Torbang DWS and Sanitation Scheme	Torwang	1

293	Bagarkhola DWS and Sanitation Scheme	Liwang	4
294	Khashungpani DWS and Sanitation Scheme	Jumrikanda	3
295	Jaluke DWS and Sanitation Scheme	Maranthana	Pyuthan-16
296	Dharapani Neta chisabang DWS and Sanitation Scheme	Torbang	6,9
297	Masara DWS and Sanitation Scheme	Phopli	8
298	Letsim DWS and Sanitation Scheme	Puja	6
299	Satmuni Khairakot DWS and Sanitation Scheme	Khaira	19
300	Timele DWS and Sanitation Scheme	Pyuthan	18
301	Betanikhola Lift DWS and Sanitation Scheme	Dhubang	5
302	Rumkash Utteshe Jukekhola DWS and Sanitation Scheme	Puja	9
303	Dhungakhor Kharibata DWS and Sanitation Scheme	Badikot	8
304	Satmuli Khairakot Kaunata Lift DWS and Sanitation Scheme	Jumrikanda	1
305	Patal Katere DWS and Sanitation Scheme	Jumrikanda	1,6,8
306	Shak Khola DWS and Sanitation Scheme	Jumrikanda	1,2,3,5

Annex 18: Key stakeholders – organizations and offices

Table 23: Key organizations and offices relevant to watershed health

SN	Name of line agency	Phone
1	Jilla Prashasan Karyalaya	420048/420133/420033
2	Jilla Bikash Samiti	420046/420023/420024/420147
3	Jilla Prahari Karyalaya	420049
4	Jilla Krishi Bikash Karyalaya	420052/420187
5	Jilla Swasthya Karlaya	460010
6	Pyuthan Jilla Aspatal	460056
7	Jilla Shikshya Karyalaya	420069
8	Jilla Ban Karlaya	420007/420180
9	Khanepani Tatha Sarsafai Division Karyalaya	420189/460152
10	Mid West Irrigation Division Office	420191/460064

11	District Livestock Service Office	420014
12	District Soil and Water Conservation Office	420018
13	National Research District Office	420053
14	Nepal Vidyout Karyalaya	46151/420096
15	Mahila Tatha Balbalika Bikash Karyalaya	460036/420190
16	Shakha Tathyank Karyalaya	460247
17	Jilla Prabidhik Karyalaya	420114
18	Gharelu Tatha Sana Udyog Bikash Karyalaya	420077
19	Energy, Environment and Climate Change Unit	420135
20	Khanepani Tatha Sarsaphai Nagar Aayojana Karyalaya	460166
21	Jhimruk Jalvidyout Kendra	429041/429040
22	Jal Utpanna Prakop Sub Division Karyalaya, Dang	82540180
23	Paschim Nepal Khanepani Tatha Sarsafai Aayojana	
24	Mallarani Rural Development Concern Center	086420019
25	Kalika Development Center	9849468912
26	Fulvari Integrated Rural Development Organization	9801335606
27	FEDWASUN District Chapter	9847820755
28	NFIWUAN District Chapter	9857832513
29	Jhimruk Hydro Power	
30	FECOFUN District Chapter	
31	HIMAWANTI Nepal	

Annex 19: Natural hazard vulnerability ratings by VDC and gaunpalika

Table 24: Vulnerability ratings by VDC and gaunpalika (GP) for selected natural hazards

SN	VDC	GP	Earthquake	Wildfire	Landslides	Vulnerability
1	Damri	Naubahini	3	2	3	**Medium**
2	Phopli	Naubahini	3	2	3	**Medium**
3	Khawang	Naubahini	2	2	3	**Medium**
4	Ligha	Naubahini	3	2	3	**Medium**
5	Lung	Naubahini	2	2	2	**Low**

6	Swauliwang	Naubahini	3	3	3	**High**
7	Arkha	Gaumukhi	3	2	3	**Medium**
8	Khung	Gaumukhi	3	2	3	**Medium**
9	Liwang	Gaumukhi & Jhimruk	3	2	3	**Medium**
10	Narikot	Gaumukhi	3	2	3	**Medium**
11	Puja	Gaumukhi	3	2	3	**Medium**
12	Rajwara	Gaumukhi	3	3	3	**High**
13	Okharkot	Jhimruk	2	3	3	**High**
14	Torwang	Jhimruk	3	2	2	**Medium**
15	Tusara	Jhimruk	2	2	2	**Medium**
16	Bijaynagar	Pyuthan	3	2	3	**High**
17	Bijuwar	Pyuthan	3	2	3	**High**
18	Dahakwadi	Pyuthan	3	2	3	**High**
19	Dharmawati	Pyuthan	3	2	3	**High**
20	Jumrikanda	Pyuthan	3	2	3	**Medium**
21	Majhkot	Pyuthan	2	3	3	**Medium**
22	Ramdi	Mandabi	2	2	1	**Medium**
23	Dharampani	Malla Rani	2	2	1	**Low**
24	Khaira	Malla Rani	3	2	3	**High**
25	Khalanga	Malla Rani	3	2	3	**High**
26	Maranthana	Pyuthan	3	2	3	**High**
27	Baraula	Airawati	3	3	3	**High**
28	Bijuli	Airawati	3	2	2	**Medium**
29	Dhuwang	Airawati	2	2	2	**Medium**
30	Pakala	Airawati	3	2	3	**Medium**
31	Raspurkot	Airawati and Malla Rani	3	2	2	**Medium**

Table 25: Details of notable natural hazard events in the Jhimruk watershed since 2000

Year	Incident	VDCs affected	Recorded effects
2001	Flood and landslide	Syauliwang	School and health post damaged
2008	Flood and landslide	Syauliwang, Phopli, Chuja, Arkha, Damri, Bijuwar, Okharkot, Tusara, Gothiwang, Liwang, Khaira, Sari, Puja, Rajbara, Kochiwang, Dharampani and Tiram.	Five deaths, 18 injured
2009	Flood and landslide	Arkha	Three deaths
2010	Flood and landslide	Syauliwang, Phopli, Chuja, Arkha, Damri, Bijuwar, Okharkot, Tusara, Gothiwang, Liwang, Khaira, Sari, Puja, Rajbara, Kochwang, Dharampani and Tiram	Three deaths and 54 injured
2011	Flood and landslide	Khalanga, Maranthana, Puja, Swargadwari	Sixty-four houses damaged
2012	Flood and landslide	Bhingri, Dharmawati, Maranthana, Thulabeshi, Syauliwang, Arkha, Damri, Bijuwar, Okharkot, Tusara, Gothiwang, Liwang, Khaira, Sari, Rajbara, Kochiwang, Dharampani, Tiram	Sixty-three people injured
2013	Flood and landslide	Maranthana, Dakhakwadi, Puja, Arkha, Bhingri	544 people in 57 households affected
2014	Flood and landslide	Khung	Five people killed; one wounded. Three houses and 9 cattle damaged

Annex 20: Vision building framework employed for compiling the Jhimruk watershed profile