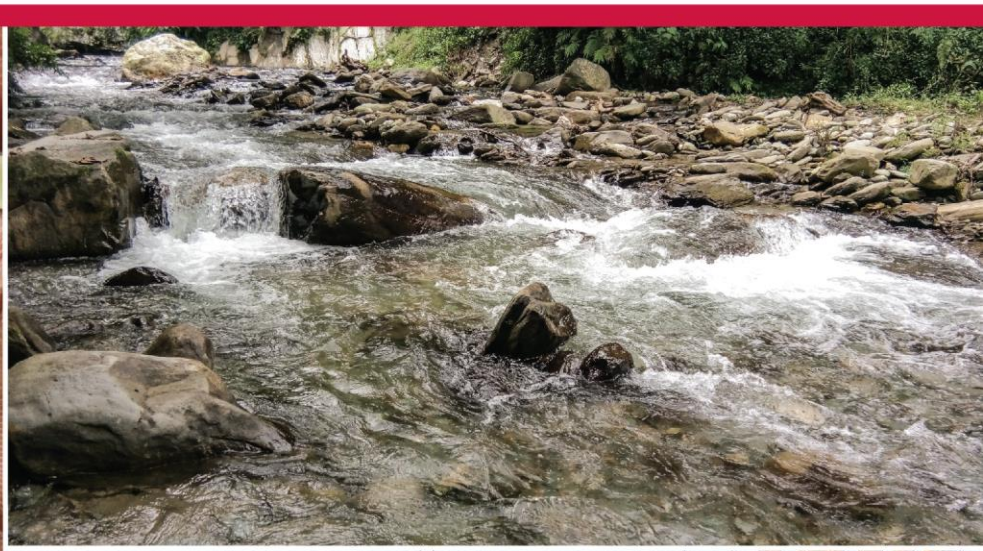
JHIMRUK KHOLA WATERSHED HEALTH REPORT



Community Vision - "A sustainable, inclusive, eco-friendly, multi-use and livelihood-oriented infrastructure, healthy and wealthy Jhimruk watershed for aquatic and terrestrial biodiversity conservation"

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What is a watershed?

A watershed is an area of land that contains a common set of streams and rivers that drain into a single larger body of water, such as a river (Figure 1). But watersheds include more than streams and rivers; they also consist of all the people, forests, wildlife, villages, infrastructure, terrain, climate, and agriculture within the landscape.

It is important to think about a watershed in its entirety – upstream and downstream – instead of only looking at one element of the watershed. This is because water flows and connects various aspects of a watershed. What happens upstream has an impact on what happens downstream. For example, gravel mining upstream can increase sedimentation for downstream residents. Similarly, water diversions upstream for irrigation can reduce the amount of water available downstream for people and aquatic species.

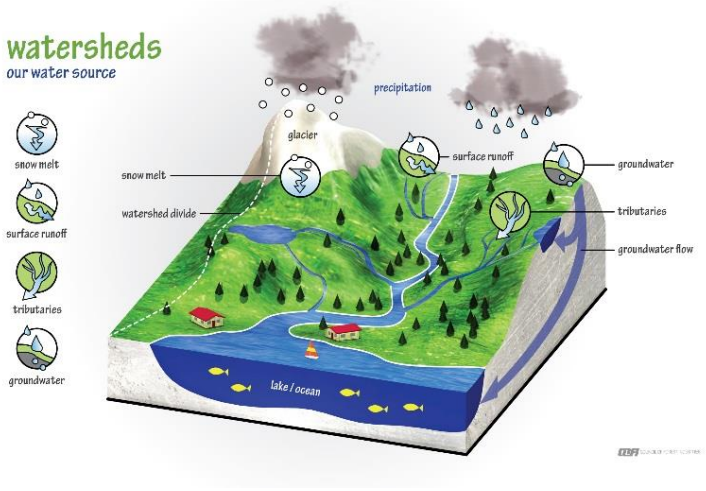


Figure 1: Diagram of a typical watershed

The goal of this watershed health assessment is to help people living in the Jhimruk watershed make better decisions, protect and restore the watershed, reduce risks, and create sustainable economic opportunities.

This watershed report uses indicators to measure different aspects of a watershed to determine if the landscape is healthy and able to provide ecosystem services to people living in that watershed. The indicators in this report were determined through a combination of local stakeholder use priorities and watershed health as defined in the literature.

The health indicators in this report are grouped under larger categories of 1) nature, 2) wealth, and 3) power, each of which explores related aspects of the watershed from that particular viewpoint.

Watershed	Jhimruk
Province	Number 5
Total drainage area	916 km^2
Number of streams	169
Major rivers	Jhimruk, Lung, Gartang, Chhape, Jumri, Jhakrithan, Chundari Khola
Lakes and wetlands	Jamune Daha, Barah Lake, Bijuwar wetland (Bhauka but now disappeared)
Land use	Forest, 68%; shrub-forest mix, 23%: agricultural land, 15%; grazing land, 12%
Municipalities	Airawati, Gaumukhi, Jhimruk, Mallarani, Naubahini, Pyuthan and part of Mandabi and Saruma Rani
Population	191,150 (44% male; 56% female)
Ethnic groups	Brahmin/Chhetri/Thakuri (65%), Janajati (17%), Dalit (17%), Others (1%)

The Jhimruk watershed is located in Province 5 (formerly known as Pyuthan district) in southwestern Nepal (Figure 2). This watershed falls primarily within the mid hills along the Jhimruk River. The alluvial soils of the valley are highly fertile, which accounts for the basin's nickname, the "Rice Bowl" of Nepal. The upper portion of the watershed contains the Gaumukhi protection forest, an important habitat for musk deer and red panda. Pine forest covers much of the middle and upper portions of the watershed while Sal mixed forest predominates in the lower reaches.

Water availability varies by season and location, and is needed for drinking, irrigation and domestic use. Locally-established micro-hydropower plants generate more than 110MW of electricity for the area.

The largest of these power plants, Jhimruk, generates 12MW.

Figure 2: Map of the Jhimruk watershed

Priority issues identified as affecting watershed health negatively are: construction of improperly planned rural roads, climate induced hazards particularly flooding, landslides and wildfires resulting decreased fish population, conflicts on water uses with decreasing availability of water due to drying water sources.

Nature

Health indicators in this section include various aspects of the watershed ecosystem, including water, biodiversity and land use.

Water

The condition of water resources within a watershed depends on a large number of factors that affect the water cycle. In Jhimruk watershed, these include rainfall, minimal snow melt, infiltration, and withdrawals for irrigation, among other factors.

Rainfall

Only one meteorological station (Bijuwar) is currently operating in the Jhimruk watershed. However, another station at Bobang (10 km upstream) can be used to estimate rainfall patterns. This data shows that during the wet season, the watershed receives higher rainfall in the northern reaches. Looking at rainfall and temperature trends from 1976-2005 reflects an overall increase in both. The average dry season rainfall (Nov to Apr) is 24 mm compared to the monsoon season rainfall (June to Sept) of 311 mm. The average annual rainfall for the watershed is 1,516 mm.

Water availability and accessibility

In the watershed, the Jhimruk River and its tributaries are the main sources of water while groundwater provides some support. Several areas are water-scarce, including Dharampani, Narikot, Bijuli, Raspurkot, and Baraula. 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 spending more than 30 minutes per day fetching water by caste and ethnicity, the data show that Brahmin/Chhetri/Thakuri are 65%, Janajati 17%, Dalit 17% and Others 1%.

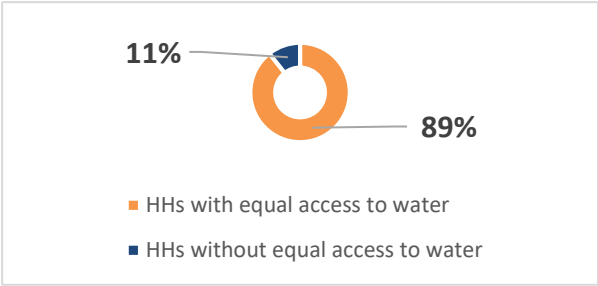
The decrease and disappearance of water sources has been attributed to changing rainfall patterns. Downstream communities encounter the greatest challenges in securing sufficient water, as upstream channel diversions to serve irrigation and hydropower diminish the amount of water flowing southward.

Water accessibility, on the other hand, 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. 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.

60%

Households needing <30 minutes to bring water



River and lake water quality

Solid waste from communities – primarily Bijuwar, Bagdula, Machchhi and Bahane – comprise the largest single pollution source in the Jhimruk watershed. Several non-source point pollutants such as plastics, raw sewage, agro-chemicals, and dead animal disposal were also reported. People stated that shared use of the river was contributing to a rise in allergies, livestock disease, and declining biodiversity.

Rivers and streams are perennial in the northern part of the watershed, but only seasonal in the south, occasionally with low water levels.

67%

Households perceive the quality of water they drink is good

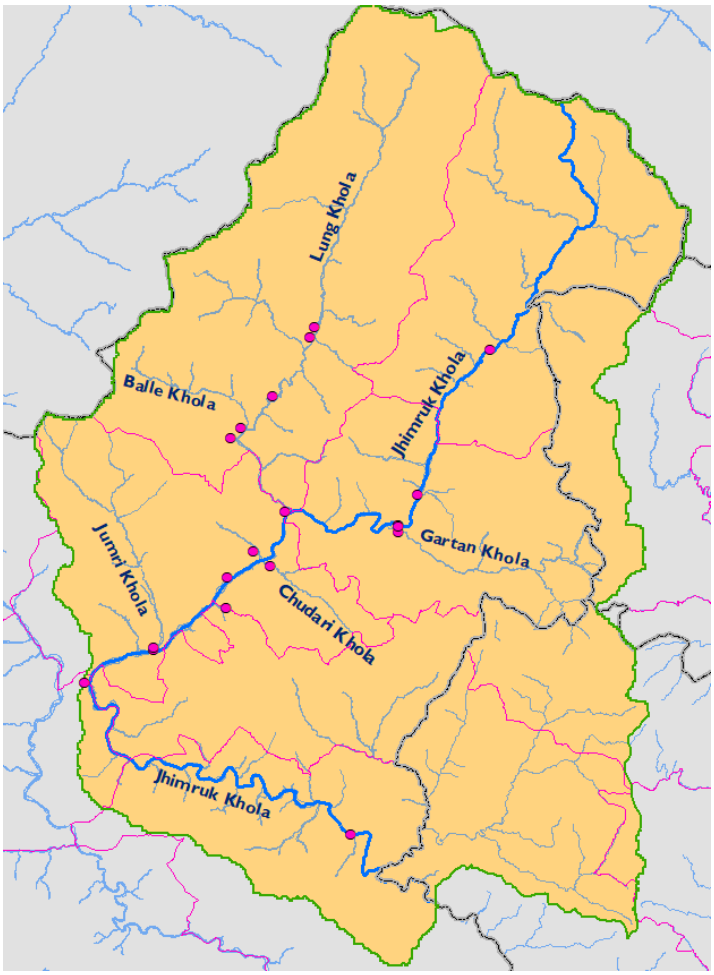


Figure 3: Water sampling points in the Jhimruk watershed

Eighteen points in the watershed were selected and measurements taken during dry and wet seasons from seasonal and perennial streams. Water samples were collected and tested for pH, iron, nitrite-nitrogen, ammonium, phosphate, and temperature. The 18 water measurement sites are illustrated in Figure 3. Generally, water quality in Jhimruk falls within accepted ranges for drinking, agriculture and irrigation. Iron and ammonium levels appear to be slightly elevated.

Biodiversity and habitat

Biodiversity and habitat speak to the overall environmental strength of an area to support a wide range of animal and plant species and also human uses, such as fishing or agriculture.

Land use and land cover

Nearly 61% of land cover in the Jhimruk watershed is covered by forest (557 sq. km), followed by agriculture (21%), grazing lands (13%), and shrub-forest (3%).

Areas considered shrub-forest may increase in coming years as rates of deforestation continue to rise and climatic patterns continue to change.

Fish diversity

Residents in the watershed reported 18 different species of fish in the Jhimruk River and its tributaries, including some rare and endangered aquatic species such as the *Rim Machha* (*Anguilla benfalensis*,) *Bai Machha* (*Botia* species) *Jhinge Machha* (*Penaeus monodon*) and fresh water mussels. Otters and the Ruddy Shelduck are two non-fish species also found in the watershed.

33% of respondents say native fish populations have decreased

Wealth

Indicators in this category refer to the current economic conditions within the watershed as well as future prospects. In this section, we focus on the most prominent forms of industry and livelihood in the Lower Mahakali area.

Infrastructure and extractives

The design and construction of infrastructure, such as roads and hydropower plants, has an impact on the health of the watershed. For example, poorly designed rural roads on steep slopes can greatly increase soil erosion and landslides. Similarly, hydropower plants 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. As demonstrated by these examples, it is important that the design, construction and operation of infrastructure projects account for the full range of social, economic, and environmental factors within the watershed. Sustainable infrastructure should provide equitable distribution of benefits with minimal long-term, environmental impacts.

Large hydropower

The Jhimruk hydropower project is the only medium hydropower plant at 12MW. It was constructed in 1994 and feeds water to 22 irrigation canals.

Because of lower water levels in the dry season, the plant does not generate maximum power for nearly eight months a year. Farmers in Dhuwang, Khaira, and Barula downstream frequently have less water than needed for irrigation due to the water diverted for the power plant. This competition for adequate water has generated some conflicts between downstream farmers and the power plant's operator, Butwal Power Company (BPC).

BPC complains that it cannot produce enough electricity to be profitable, while area residents accuse the power plant of polluting the river and withholding too much water that could be used for farming. The low river flows also allow waste and pollutants to build up in the river.

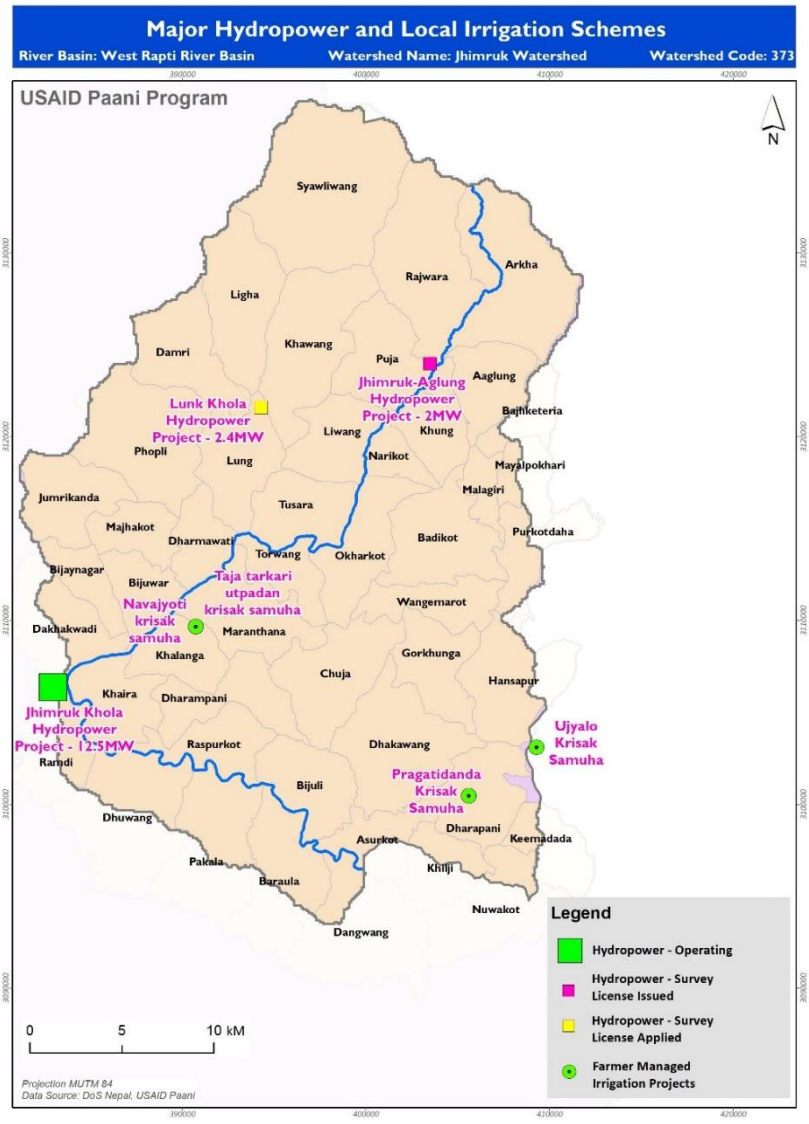


Figure 1: Hydropower Projects and Local Irrigation Schemes

Low water flows and altered environmental flows also negatively affect fish populations. The Jhimruk power plant maintains a fish ladder to allow free movement but residents in Baraula and Arkha claim the ladder does not fulfill its purpose: fish from the Rapti River cannot move upstream. Hydropower project and local irrigation schemes in the watershed can be seen in Figure 4.

Microhydro

Altogether, there are nine microhydro power plants in the watershed: three in Akha and Swauliwang, two in Khung, and one in Rajwara. Total power production comes 114MW for 1,284 households. Residents said the smaller plants do not affect aquatic life, and they expressed concern that these microhydro plants were endangered by impending floods and landslides, as two have already been damaged.

Capture fishery practices

Fishing in the watershed is characterized by traditional and non-traditional practices. Commonly-used traditional methods include net casting, gill nets, fishing hooks, draining water, and trapping fish in rice paddies.

In recent years, however, non-traditional methods are becoming more popular, many of them environmentally harmful. Some of these methods include poison, electric currents, and gelatin explosives.

Irrigation and sustainability

Irrigation facilities in the watershed are plentiful and robust; however, due to river cutting and drying water sources, water availability has been decreasing, particularly in the downstream communities. Agricultural terracing is not common in Jhimruk except in a few places (e.g., Liwang and Khung) and thus many smallholder farmers are becoming more vulnerable to the impacts of decreasing water.

Gravel mining

In the Jhimruk watershed, some settlements are developing into small cities (e.g., Baraula, Jumri, Bijuwar, Bagdula, Bahane, Maranthana, Macchi, Thulabeshi), demanding more sand, stone and gravel for construction of public roads, bridges, buildings, irrigation canals and water supply schemes. As in other watersheds, gravel mining has become a main source of revenue for the local government.

Local residents reported that gravel mining was disturbing fish habitats and decreasing fish populations in the Jhimruk and its tributaries by increasing sediment deposits that slow river flows. Local governments (district development committees, or DDCs) allocate budget from mining each year for various projects such as ecotourism, drinking water, sanitation and irrigation projects, income generation-skill trainings, and natural resource conservation.

Regulation of mining can benefit people by establishing secure revenue streams, and by imposing restrictions that protect public infrastructure and aquatic life. The Pyuthan DDC issues licenses for gravel mining in a number of tributaries of the Jhimruk River, including the Lung and Khaparang *kholas*. Extraction methods are primarily manual labor with small household equipment, but some small trucks and tractors are also used. Gravel mining runs nine months per year (stopping for monsoon) and some estimates indicate 200-300 cubic meters are extracted per day, or 70,000 cubic meters per year (DCC, 2017). According to government officials, extractors may not take gravel from within 50 meters of critical places such as culverts, irrigation canals, and drinking water sources. Similarly, mining operations are forbidden within 500 meters of bridges.

Roads

In the watershed, poorly designed roads and climate-induced hazards have increased the intensity of landslides, soil erosion, deforestation, and loss of water sources. Landslides and soil erosion upstream lead to river cutting, sedimentation, and inundation downstream – all of which degrades the habitats for aquatic life.

The Khalanga-Bukeni-Chuja and Dharampani to Girichaur roads were constructed without proper planning in 2013. After the construction, communities reported that 15 water springs had decreased an estimated 30% in terms of water supplied. As a result, people in Raspurkot-6 and Dharampani-1 faced acute shortages of water.

Irrigation

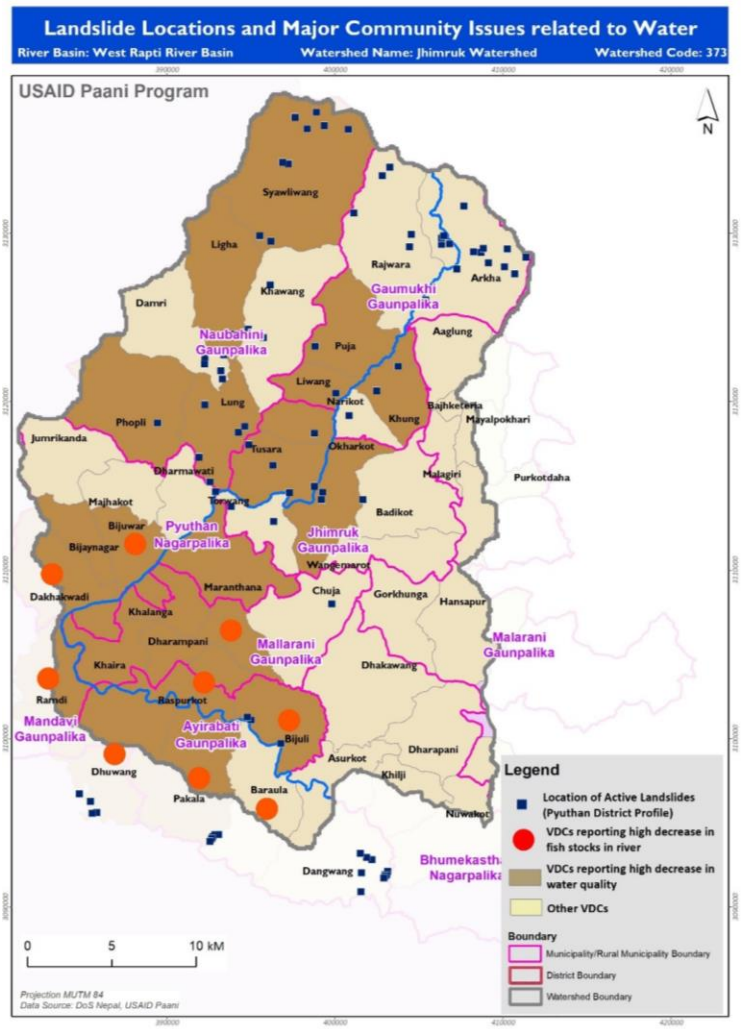
Several projects have been undertaken to provide smallholder farmers with access to irrigation. Altogether 24 irrigation schemes have been implemented, however, this expansion is still insufficient to meet all farmer needs. See Table 2 for more information on agricultural water sources.

Irrigation Water Source	Respondents from 2017 HH Survey (%)
Canal water	24
Irrigation canal	3
Underground source (boring, hand pump, well)	4
Ponds	13
Solar pump	3
Rain water collection	6
Rain water harvesting	25
Other sources	18
No land to cultivate crops	5

Table 2: Agricultural water sources in the Jhimruk watershed

Climate resilience and disaster risk reduction

Increased human activity combined with climate change impacts is intensifying environmental degradation in many parts of the Jhimruk watershed in some cases, increasing the likelihood and effects of natural hazards such as floods and landslides. For this reason, a focus on building climate resilience and disaster risk reduction in the area are warranted. See Figure 6 for a map of landslide risk locations in the Jhimruk watershed.



Early warning systems

Alert messages for impending natural disasters are disseminated by district administrative offices through SMS, radio, telephone, and newspapers. There is no available siren system. The district offices can also mobilize local security forces for rescue response when needed.

Residents in Phopli reported that an early warning system saved untold lives and property in July 2016 when a flood ravaged through their village. Given a few hours preparation for the impending flood waters, most vulnerable households were able to shift their families and key belongings to higher ground away from the disaster.

Figure 6: Landslide risk locations in the Jhimruk watershed

In spite of these safeguards and some early success, many residents are still unaware of early warning systems and less than half of area residents are covered by these systems. Thirty-six percent said they were not familiar with early warning systems in the watershed while 58% said they did not have access to early warning systems.

Looking more closely at perception of equal access to early warning system information, 76% said they did have equal access. Disaggregating the data by caste and ethnicity, 66% of Dalit, 80% of Brahmin/Chettri/Thakuri, and 59% of Janajati believed they had equal access to early warning system information.

To counteract climate change impacts, residents are adopting a wide range of adaptation activities to strengthen their livelihoods. Twenty-nine percent are doing reforestation, 20% said the conserve water, 9% have installed Gabion boxes to minimize erosion, and 7% have resettled their families in safe locations. Other activities reported include increased use of organic plant nutrients and pesticides, and enhanced forest fire management.

Currently, local governments are developing Local Adaptation Plans of Action, or LAPAs. These plans document best practices for improving a community's ability to adapt to changing circumstances. A few examples of these best practices include ideas for improved waste disposal, creating open defecation-free zones, and enhancing catchment management plans.

Power

Indicators in this section refer to the strength and accessibility of governance institutions in the watershed, as well as the level of inclusiveness across gender, caste, and ethnicity in decision-making processes.

Local institutions and inclusiveness

There are different community-based organizations, federations and line agencies in the watershed who are responsible for various aspects of watershed management, including 243 community forest user groups (CFUG) who are important advocates for river basins through their work with forests. CFUGs support reforestation efforts in degraded areas, which helps to improve overall watershed health through restoration of soils and land cover, among other important elements.

Figure 7: Location of key stakeholder groups in the Jhimruk watershed

Regarding affiliation disaggregated by caste and ethnicity, 26% of Dalit, 45% of Brahmin/Chettri/Thakuri, and 26% of Janajati report they are actively involved with a local group or committee.

Policies, frameworks and institutions

The Constitution of Nepal 2015 guarantees the right of every person to live in a clean and healthy environment. Accordingly, the national government has ratified numerous policy provisions and programs for conserving natural resources and promoting environmental management. A few examples of these policies include the National Park and Wildlife Conservation Act - 2029 (1973); the Soil Conservation and Watershed Management Act – 2039 (1983); the Forest Act – 2049 (1993); and the Environmental Protection Act – 2053 (1997).

Importantly, the Local Self-Governance Act – 2051 (1999) allocates authority to local governments to manage a wide range of natural resource and water-related issues including agriculture, rural drinking water, irrigation, river control, soil conservation, and the development of tourism and cottage industries.

In the watershed, government line agencies – such as the soil conservation office, forest office, and drinking water and sanitation office – are positioned to assist with watershed health issues in Jhimruk. These institutions will also lend expertise for implementing programs to improve sustainable disaster management and climate change adaptation. Institutions also have a shared commitment to achieve 33% female participation in government work and decision making about natural resources.

However, despite these strengths, residents still expressed concerns about the lack of coordination, responsiveness, and human resources at local levels to insure consistent application and monitoring of watershed management practices.

Several governance opportunities may be capitalized upon in the next few years, as the recently-elected parliament means fresh local representation for watershed concerns. As well, a move toward a federalist structure could mean greater responsibility at local levels, which could improve responsiveness in regard to meeting pressing environmental challenges in the watershed, upstream and downstream. Concerns about adequate budgets for local level governance remain.

Responses on the inclusive participation in local planning

69% women say they participate in local level planning.

At the local level…
42% of Brahmins, Chettris, and Thakuri
18% of Dalit
35% of Janajati and
5% of Madhesi

Report that they are involved in local level planning

40% of respondents agree that people comply with local laws and policy provisions, including norms and standards

Watershed health assessment – Summary

The list health indicators presented in this section takes into account factors related to biophysical health, infrastructure, socio-economics and governance within the watershed. Each of these indicators was assessed through consultation with stakeholders in the Jhimruk watershed and assigned a score between 0-5 points.

We are concerned with assessment *and* monitoring, and employ the following rating system.

Color Symbol	Description	Treatment measures
[4-5 points]	Good health condition, no additional treatment required	Intervention required to keep condition intact
[2-4 points]	Fair condition, functioning at risk, be alert to maintain and improve condition of the watershed	Promotion of good practices needed to improve health condition; special attention if not additional treatment may be necessary.

[<2 points] 	Poor condition, impaired functioning, decreased quality and quantity of ecosystem services in the watershed	Special measures must be adopted to restore watershed health conditions and ecosystem services

Based on the designated indicators for assessment, we rate the health status of the Jhimruk watershed as ***moderately good*** (Table 1)**.** The water quality for domestic and agricultural purposes and the large forest cover for land use are among the most positive factors in the watershed. Areas of concern include low water availability and little activity in regard to climate change adaptation and resilience. The lack of coordination between levels of governance also hamper efforts to strengthen the outlook for long-term watershed health improvement.

Table 1: Summary of health indicators for the Jhimruk watershed

Theme	Watershed health indicators	Watershed indicator rating	Rationale for rating
WATER 	Water availability		- Significant loss of water in natural lakes and other water sources in the watershed - 91.9% of respondents report difficulties due to drying water sources.
	Water accessibility for community, agriculture		- 90.7% of households spend at least 30 minutes per day to obtain water - 89.8% of respondents say they have equal access to water - 20.1% of respondents who said that the water is enough to irrigate land throughout the year.
	Water quality for drinking, irrigation and energy generation		- 86.25% of respondents perceive the water quality is good - This perception is supported by our biophysical tests
BIODIVERSITY & HABITAT 	Household sanitation		- 99% of respondents use a toilet - 72.4% respondent do not report having contracted any water-borne diseases.
	Solid waste disposal		- 26% respondents dispose solid waste in kitchen garden - 36% incinerate solid waste - 18% use landfill site - 5% place solid waste in the river

	Land use land cover		- Very solid forest cover in the watershed (68%) against just 15% agricultural land
	Species diversity [Fresh water]		- 18 species of fish reported, along with other aquatic species: crab, snail and prawn - Some IUCN-listed fish species found here
	Invasive species [Aquatic]		- 4% of respondents say exotic fish species increased.
	Quantity of fish [Local]		- Due to habitat destruction and sedimentation, fish stock has decreased - 33% say fish stock decreased in the watershed
	Fishing practices		- Traditional fishing practices continue along with some destructive forms, such as electric current and explosives
SUSTAINABLE AGRICULTURE	Climate and physiography		- High incidence of landslides - Drying water sources, particularly in the southern reaches - Droughts have increased forest fire risk
	Soil management [conservation, fertility]		- 96% of respondents say soil fertility decreased.
	Agriculture productivity [Data]		- 84.5% report that agriculture production has decreased and this perception is supported by DADO report
	Sustainability of irrigation		- Irrigations canals require some repair annually, but damage is minimal
SUSTAINABLE INFRASTRUCTURE & MINING [e-friendly framework]	Sustainability of hydropower		- Hydropower production lags in dry season when water is low - Hydropower owners report that quartzite in the water has damaged turbines - Microhydro plants are occasionally damaged by flood and landslides

	Sustainability of gravel mining and construction materials		- Gravel mining is prevalent but not excessive due to low local demand for the material - Some gravel mining is required due to high sedimentation in the river. The excess sediment must be removed to maintain river flow
	Sustainability of rural roads		- Rural road construction have minimal relationship to incidence of landslides and sustainability of water sources
CLIMATE RESILIENCE AND DISASTER RISK REDUCTION	Climate induced threats – intensity & severity [landslides, floods and landslides]		- Frequent landslides with high human loss and economic impact
	Community response, measures to adapt to CC impacts		- Only 9.6% of respondents say they practice more than three climate smart adaptation activities
	Community access to Early Warning Systems		- Only 5.87% of respondents say they have an early warning system
	Adoption of good practices		- Some LAPAs have been prepared to encourage good practices
GOVERNANCE AND EQUALITY	Inclusive participation in local planning; Women, marginalized castes and ethnic groups hold key positions in NRM groups		- There is mandatory provision for inclusive participation in local planning - Women, marginalized castes and ethnic groups hold key positions in NRM groups, but only 6%
	Persistence of active NRM groups [Biodiversity, disaster, climate change, water, agriculture, forest, irrigation, farmers]		- 243 CFUGs in the watershed providing support to There are 243 CFUGs and so many other group active like irrigation, drinking water group etc.
	People comply with laws and policy provisions, including local norms and standards		- People comply with policy provisions including local norms and standards as required in some cases

	Mechanism placed to resolve outstanding issues, benefit sharing, sand mining, irrigation, hydropower		- Local benefit sharing mechanisms exist for hydropower and mining revenues
	Equitable access and benefit sharing arising from use of Natural resources (ecosystems services and products)		- 93% of respondents say they have equal access to group facilities and services
	Coordination between rural municipalities, municipalities, provinces and line agencies		- No coordination between these levels for ecosystem services and watershed health management
	Adoption of climate-smart, environment and watershed management friendly practices [across all thematic areas]		- Only 9.6% of respondents practice climate-smart adaptation activities

References

District Coordination Committee (DCC). *Initial Environment Evaluation Report*. Pyuthan, Nepal, 2017.