PHOKSUNDO SULIGAAD WATERSHED HEALTH REPORT

Vision Statement: “A healthy watershed with sustainable management of natural resources and aquatic biodiversity, eco- tourism, and Inclusive economic opportunities creation”

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What is a watershed?

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

A watershed should be understood in its entirety – upstream and downstream – rather than by looking only at one element of the watershed. Water flows connect various aspects of a watershed, and what happens upstream has an impact on what happens downstream. For example, landslides and soil erosion upstream can increase sedimentation for downstream residents. Similarly, water diversions upstream for irrigation reduce water available downstream for people and aquatic species.

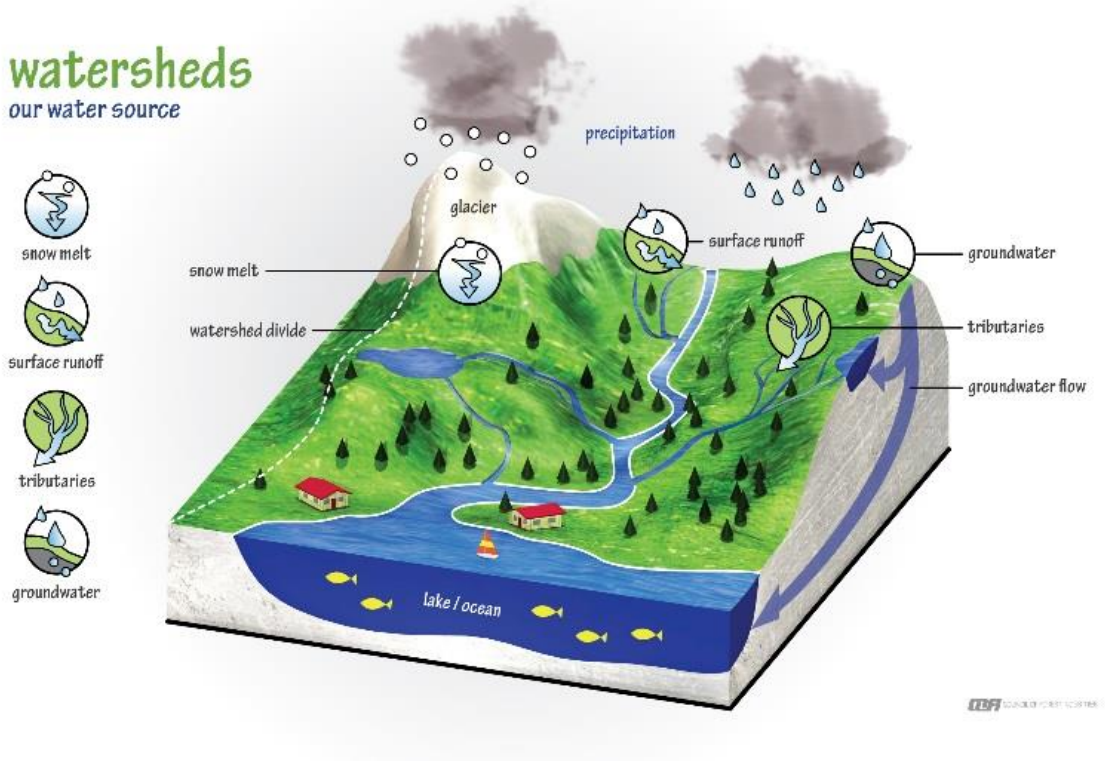

Figure 1: Diagram of a typical watershed

This watershed health report is one of several being written for watersheds across Nepal to inform development visions and processes. The goal of this watershed health assessment is to help people living in the Phoksundo Suligaad Watershed make better decisions, protect and restore the watershed, reduce risks, and create sustainable economic opportunities.

This watershed health 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. A full profile of the Phoksundo Suligaad Watershed has also been prepared.

Watershed	Phoksundo Suligaad
Province	Karnali Pradesh (No. 6)
Total drainage area	964.3 km^2
Number of streams	34
Major rivers	Phoksundo Khola, Sagar Khola, Pugma Khola, Phaksu Khola, Aankhe Khola,
Lakes and wetlands	Phoksundo Lake, Chhonakyo, Chhokarpu, Chhononyo, Chholukhal Lake, Tangalanga Lake, Chhokarpu, Chhamkuni Lake, Gyalbara Lake, Majhban Bhimchaur, Mate Lake, Simeni Raithana, Rato Panera Dabuchaina, Parba Raman.
Land use	Snow/glacier (55%), grazing/pasture (34%), forest (6%), water (4%), agriculture (1%)
Municipalities	Shey Phoksundo Rural Municipality, Tripurasundari Municipality, Thulibheri Municipality, Kaile Rural Municipality.
Population	2,258 (51% male; 49% female)
Ethnic groups	Brahmin/Chhetri/Thakuri/Sanyasi (51%), Janajati (42%), Dalit (6%), Newar (1%)

Situated within Dolpa district in the northwestern section of Nepal, the Phoksundo Suligaad watershed (Figure 2) covers 984 square kilometers across two municipalities, or nagarpalika (Thulibheri and Tripurasundari), and two rural municipalities, or gaunpalika (Kaike and Shey Phoksundo). A sparsely populated area of just 2,258 people, the watershed is almost wholly contained (98%) within Shey Phoksundo National Park (SPNP) and its corresponding buffer zone. SPNP is protected area of mostly coniferous forest, and home to numerous animal species, including deer, musk deer, jharal, goral, naur, fox, hyenas and yak. The watershed also hosts a large crop of yarshagumba, a prized fungus that fetches high prices in foreign markets, and thus draws many people to the region each year for harvesting. Yarshagumba is the main source of revenue for the national park and residents in the watershed.

The Phoksundo Suligaad watershed sits in a high mountain region that offers little plains area for settlement. Most households are built into spaces available in the hillsides. There are few services (e.g., hospitals, schools) and little infrastructure in the area (e.g., roads, irrigation).

The watershed extends from 6,572 meters at the top of Phoksundo Lake and down to 2,047 meters at Suligaad. Correspondingly, the watershed features large variations in climate from the Himalaya down to the high valleys of Suligaad. Fertile alluvial soil in the valleys make it conducive to potato, bean, maize, rice, and buckwheat cultivation. However, the higher elevations sit in a rain shadow and endure prolonged dry periods that make rice plantation impossible.

In the southwest area of SPNP, the Sagar and Ghyampo Kapuwa rivers from the Tibetan Autonomous Region meet and create Phoksundo Lake, which has significant cultural importance for local residents. At

Rigmo, the lake releases water southward into the Phoksundo River and merges with the Maduwa, Pugma, and Ankhe rivers before its confluence with the Thulibheri River at Suligaad.

The Phoksundo Suligaad watershed includes 34 streams that provide irrigation, drinking water, and ecosystem services for the region. Two micro-hydropower schemes also operate on these streams at Shangta (52 kW) and Pugmo (16 kW), serving a total of 47 households.

As the population of the watershed is low, the range of ethnicities is also small. In addition to the Brahmin/Chhetri/Thakuri castes (BCT), only small numbers of Dalit and Janajati (Magar, Sherpa, Tamang) live in the area. A few Newari households were noted in the watershed, and no traditional fishing communities reside here.

In terms of fish and other aquatic life, the high elevation means the water is too cold to sustain large populations. In the study, only three fish species were recorded in the lower stretches of the Phoksundo River. Local residents could not provide the names of these species. This finding speaks to the need for more aquatic research in the region.

The land cover pattern in the watershed also indicates the degree to which life in Phoksundo Suligaad is challenging and harsh. Fifty-five percent of the land cover is barren, covered by rock, snow, and glacier. Thirty-four percent is used for grazing, 6% is forest, and only 1% is under cultivation.

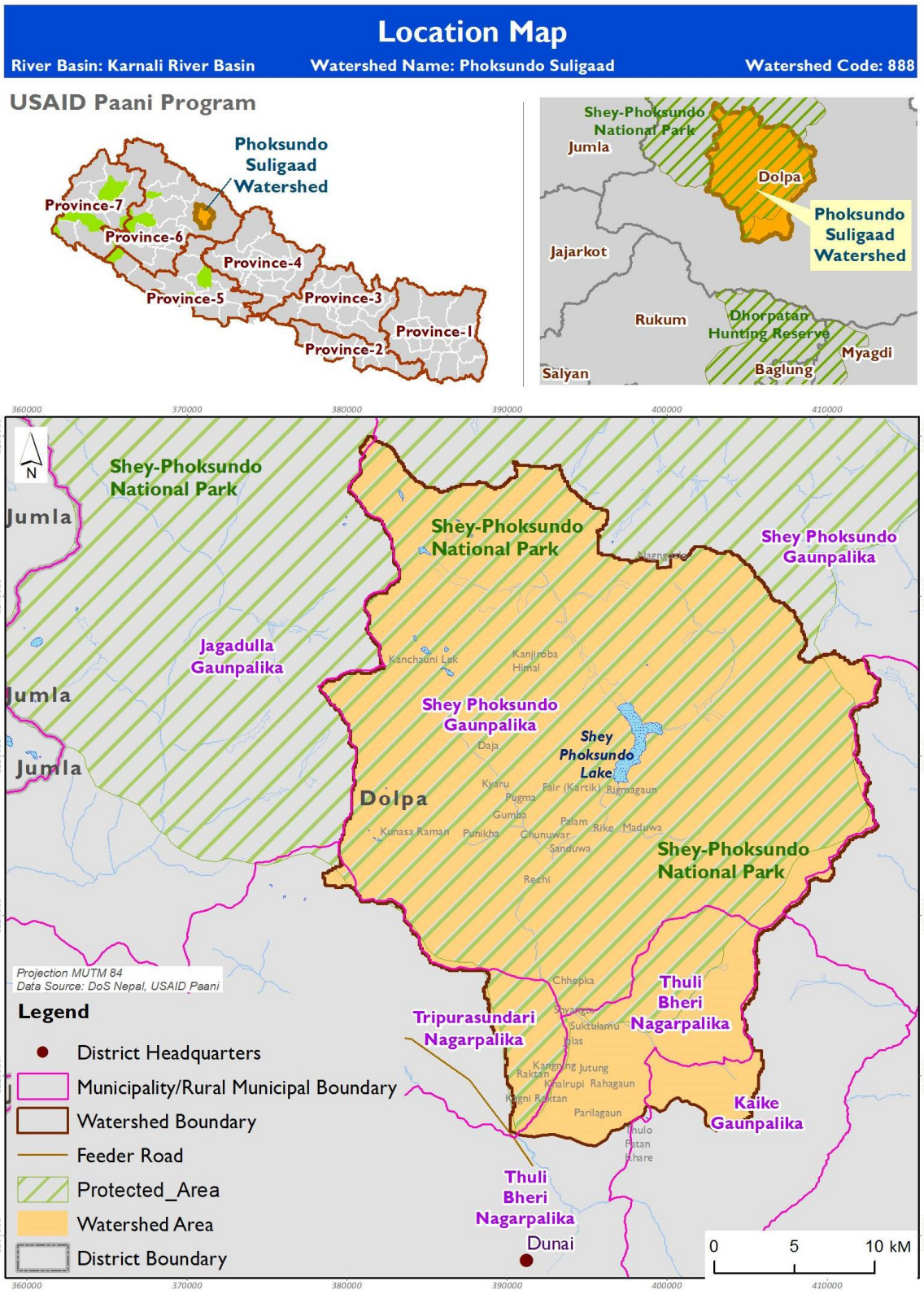

Figure 2: The Phoksundo Suligaad Watershed and its administrative boundaries

Nature

This section examines the environmental and natural resource dimensions of the watershed, including climate and weather, hydrology, biodiversity, and land use within the Phoksundo Suligaad watershed, paying special note to trends and changes that may threaten the health and sustainability of these assets.

Water

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

Rainfall

Long-term rainfall data records are not available in Phuksundo-Suligaad watershed. However, rainfall recordings are available at Dunai station, which is located 4 km from the southern boundary of the watershed. The long-term average monthly precipitation recorded at Dunai station is shown in Figure 3.

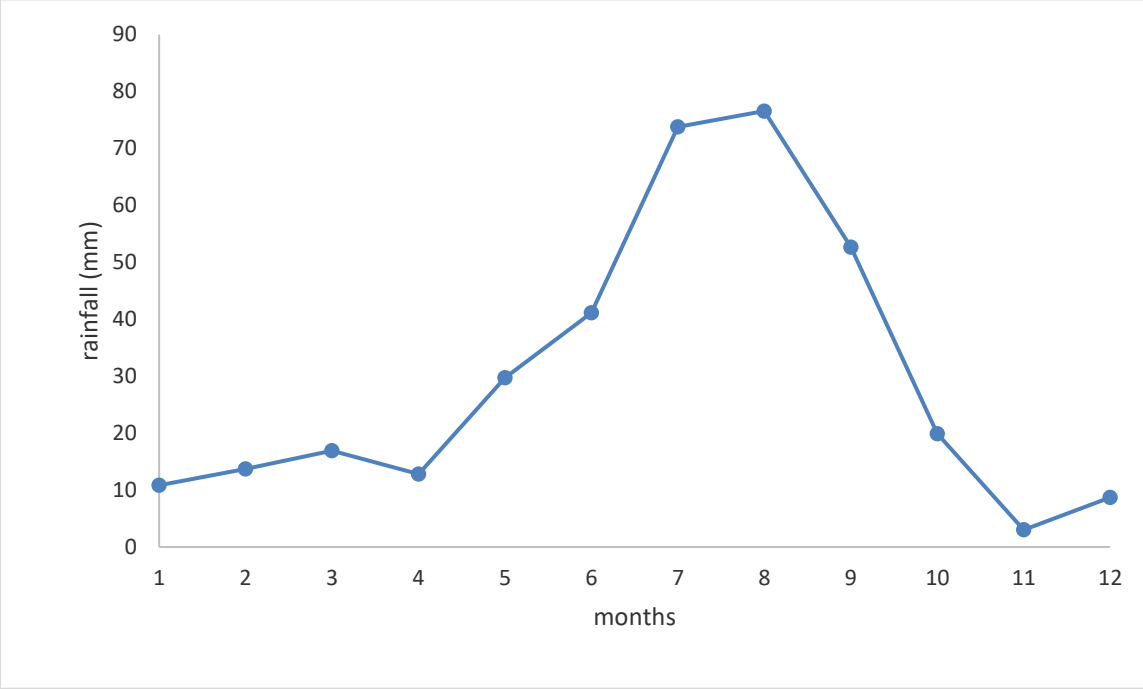

Figure 2: Long-term average monthly rainfall (in mm) measured at Dunai (312) rain gauge station

Water availability and accessibility

As noted above, the Phoksundo Suligaad watershed contains 34 waterways and the Phoksundo River, which flow southward into a confluence with the Thulibheri River. The two primary forms of water use are drinking water and agriculture. However, despite the numerous rivers and many lakes and ponds that dot the landscape, water access and availability are issues for future concern.

Household surveys (n=268) found that 80% of households have access to drinking water within 30 minutes of home, while 4% must travel 30-60 minutes, and 14% must travel more than an hour. Two percent of

households have water sources in their homes. Nearly all the needed water is drawn from the river (62%) or a piped system (37%). The sources of piped water are springs (77%), rivers (22%), and lakes (1%). Only 11.4% of households have private taps, while the rest rely on public sources.

On the question of access, 22% reported that they believed access to available water was unequal. Of this 22%, 31% were Dalit, 20% BCT, and 23% Janajati. The reasons given for unequal access were distance to water (55%) and water scarcity (53%)[1]. As many Dalit and Janajati settlements tend to be located on the periphery of villages, distance is likely a primary cause for those citing unequal access to water. However, water scarcity is related to a growing concern about drying water springs in the watershed (see Executive Summary, Issue 7).

80%

Households needing <30 minutes to bring water

27.20%

Households that perceive the quality of water they drink is good

River and lake water quality

Water quality in the watershed was determined by testing a range of parameters, including pH, nitrate nitrogen, ammonium, and phosphate. All locations tested were found to be in the normal range for drinking, domestic use, and irrigation. Low pH levels and slightly elevated ammonium (max 8 mg/l) levels were found in a few sites, which could be dangerous for the aquatic habitat, if that those factors persist. The water was sampled at several locations in the watershed using an Akvo Caddisfly kit.

River discharge rates indicate the water flow in a watershed, which provides important insights into the overall health of the rivers and streams. Suligaad is the primary river that drains the watershed. Maximum discharge was found in August, and the lowest rates were found in February, for an annual average discharge of 11.10 m^3/s (Figure 4).

[1] Numbers here total more than 100 because respondents were allowed to provide more than one reason for unequal water access.

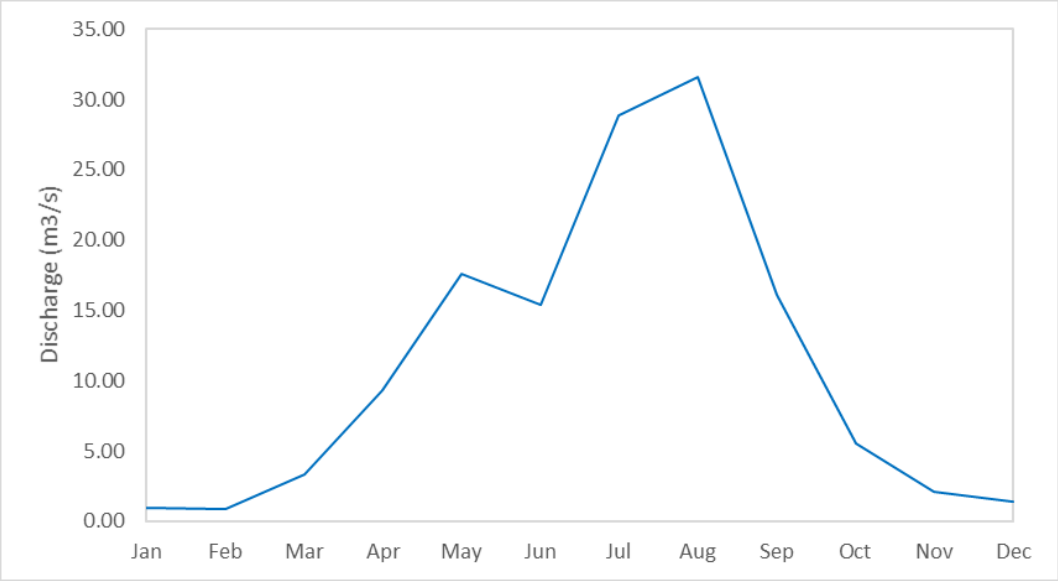

Figure 4: Average monthly discharge of the Suligaad River at the outlet of the Phoksundo Suligaad Watershed

Biodiversity and habitat

SPNP is a trans-Himalayan area, covering 91% of the Phoksundo Suligaad Watershed, and is most notable for its role in providing a habitat for rare animal and plant species. With its status as a national park, the area promotes conservation of several endangered animals: snow leopard, Tibetan wolf, red panda, Tibetan sheep, Tibetan antelope, lynx, wild yak, Chinese pangolin, and musk deer. Two hundred and fourteen birds live in the park from 33 different bird families, as well as 27 species of butterfly, of which 9 are considered rare. Additionally, important fungi grow in the area, particularly yarshagumba, which is a major source of income, and, in recent years has attracted large numbers of people to the area for its harvest.[2]

Land use and land cover

Given its location along the Himalayan range, the majority of the Phoksundo Suligaad watershed is barren land, seasonally covered with snow and ice (55%). Thirty-four percent of the land is used for grazing livestock, 6% is forest, and 4% is covered by water in the form of ponds, lakes and rivers. This combination of land covers makes the Phoksundo Suligaad watershed unique from many of its southern counterparts, which tend to be rich with forest.

Forest covers just over 58 km^2 of the watershed, and is comprised primarily of Nepalese alder or Utis (53%), followed by mixed hardwoods (22%) and pine (15%).[3]

[2] See annexes 6-11 for a full listing of flora and fauna in the Phoksundo Suligaad watershed.
[3] See annex 6 for full listing of tree species in the watershed.

Fish diversity

Fish in the watershed are rare, found only in rivers between the Suligaad and Jelus Rivers. While numbers were generally good, as reported by local residents, no community members could identify the species of fish present, instead referring to all fish as "machchha" (fish).

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 Phoksundo Suligaad Watershed.

Infrastructure and extractives

The design and construction of infrastructure, such as roads and hydropower plants, have an impact on the health of the watershed if appropriate preventive, mitigated, and control measures are not adopted in time. For example, poorly designed rural roads on steep slopes can 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 farmers. 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 impacts within the watershed. Sustainable infrastructure should provide equitable distribution of benefits with minimal long-term, environmental impacts.

Hydropower

Given the low number of schemes and their relatively small stature, hydropower is not a significant concern in the watershed. Only two micro-hydropower plants operate in the watershed currently: Pugmo (in Shey Phoksundo NP) generates 16kW and Shangta (Thulibheri GP) generates 52kW.

A license has been issued for a third micro-hydro plant just south of Phoksundo Lake, providing electricity to Ringmo, Rikhe, and Sunduwa villages. It is expected to be operational by 2022.

Capture fishery practices

Water temperatures in the watershed are comparatively quite low (below 13°C in winter and below 19°C in summer); thus, few species of fish can thrive in these waters. Households overwhelmingly reported declining fish numbers, in spite of the fact that illegal fishing practices, which are employed in many parts of Nepal, were not reported in Phoksundo Suligaad. In addition to cold water, strong high-elevation currents inhibit fish migration in the streams above Jalas and Shangta. The Chief Warden of SPNP said no fish could be found above Palam. Like other biodiversity issues in the watershed, research on fish numbers and fish diversity is lacking.

Agriculture

Regional markets are available in Dunai and Juphal, outside the watershed, but the lack of motor-able roads makes it difficult for residents to participate. Handicrafts and surplus produce are more commonly sold to hotels in SPNP to accommodate rising numbers of tourists. Some households travel to Tibet (five days away) to exchange vegetables and medicinal herbs for salt, butter, and other goods. However, increasing government controls on this area are limiting the days available to make such exchanges.

Soil fertility is a major concern for farmers: 74% say that soil fertility has declined over the past decade, and 75% say their crop yields have also declined. They attribute these challenges to increasing soil erosion, declining water availability, and lack of access to organic fertilizer.

Agricultural run-off issues are minimal, at least in terms of chemical fertilizers. Due to the clay and sandy soil, famers prefer organic manure for their crops. Some farmers have begun using chemical pesticides, particularly in the southern half of the watershed, where farmers are experimenting with fruits and nuts.

Gravel mining

As there are few roads and no transportation facilities in the watershed, there are no private contractor gravel mining sites in operation. However, inside SPNP, local residents can extract materials for construction with approval from the Chief Warden, who designates the area for extraction and the maximum amount that can be withdrawn annually (Table 4). Residents pay a royalty to the District Coordination Committee (DCC) per cubic meter of sand and gravel taken. Per interviews, officials at SPNP contest this arrangement and suggest that royalties be paid to their administration.

While gravel mining is not a present concern in the watershed, the impending completion of a road from Surkhet to Dolpa is expected to increase the demand for extraction of sand, stone, and gravel from this area.

Roads

Phoksundo Suligaad is not connected to any national road system. Roads in the watershed are divided between foot trails (for trekking and transport) and facility roads. The foot trails are primarily for trekking and transport, and are not motor-able roads. There are 10 facility roads, 6 of which lie within the watershed and total 280 kms. These roads were constructed with support from the Swiss Development Cooperation (SDC), in accordance with strict environmental regulations that called for replantation of 25 trees for every one tree removed.

As development continues throughout Nepal, government plans include roads that will extend into or near the watershed. Proper monitoring will be required to ensure that construction follows proper guidelines for minimizing erosion and appropriate slope maintenance.

Irrigation

There are 10 irrigation schemes, all of which are contained in Shey Phoksundo GP and Thulibheri NP. Of those households with access to irrigation, only 6.5% report having water year-round. The remainder of households rely on seasonal irrigation or rain-fed agriculture. Water for irrigation comes from either rainfall (86%) or canals that bring water from the river (14%).

Group discussions revealed that the rising incidences of flash flooding and intensity of rainfall events had damaged irrigation canals near Raha and Kageni.

Climate resilience, disaster risk reduction and early warning systems

Collectively, adaptation practices seem few and far between in the Phoksundo Suligaad watershed, as more and more residents turn to yarshagumba to make up for shortfalls in agriculture and non-timber forest products (NTFPs). The increased pressure on yarshagumba could have a circular effect as less and less

produce is harvested for consumption. If yarshagumba numbers were to fall, area residents would not have a strong agricultural base to take up the slack.

Regarding avalanches and flash floods, there is no early warning system (EWS) currently available in the Phoksundo Suligaad Watershed. Given the number of anecdotes about land and property loss, a functional EWS could provide significant benefits.

To adapt to the impacts of climate change, residents are adopting a wide range of adaptation activities to strengthen their livelihoods. Fifty percent are doing reforestation, 68.8% said they conserve water sources, 50% have installed Gabion boxes to minimize erosion, and 12.7% have resettled their families in safer locations. Other reported activities include increased use of organic plant nutrients and pesticides, and enhanced forest fire management.

Local Adaptation Plans of Action, or LAPAs, developed for Raha Village Development Committee (VDC) identify best practices including ideas for improved waste disposal and enhancing catchment management plans.

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 Phoksundo Suligaad Watershed. 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

In the Phoksundo Suligaad Watershed, water availability is a pressing concern, as well as the many NTFPs and ecosystem services they provide. As the need for economic development continues to be addressed, many people living in the watershed have concerns for balancing livelihoods with sustainable livelihoods and biodiversity conservation.

Hopefully, the new government structure will improve participation in local-level planning processes, such as development of LAPAs, Community Adaptation Plans of Action (CAPAs), and Water Use Master Planning (WUMP). Surveys revealed that only 17.5% of households were aware of local-level planning opportunities such as these. Disaggregating those responses, we find that 23% were aware of CAPA, 13% were aware of LAPA, and only 9% were aware of WUMP. Along gender and ethnicity lines, 21% of men knew about these processes, compared to only 10% female, and no Dalit households claimed knowledge of any planning processes at all.

Buffer Zone User Committees (BZUC) and Buffer Zone Community Forest User Groups (BZCFUG) can play a key role in strengthening awareness and action for improved biodiversity conservation in the Phoksundo Suligaad Watershed. These groups number 17 and 25, respectively, and they work with national park officials to devise sustainable use plans for the forests and other natural resources in SPNP (for more on these groups, see section 4.2.2).

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).

The Local Government Operation Act 2017 (LGOA) provides municipalities and rural municipalities with powers, functions and duties to formulate, implement, and regulate local policies. LGOA also authorizes local governments to develop plans related to local level disaster preparedness and response planning, early warning systems, and distribution and coordination of relief materials. Observations and focus group discussions revealed that all nagarpalika and gaunpalika authorities have been executing these powers related to disaster management; however, local civil society organizations say that not enough energy has been devoted to conservation.

Surveys and focus groups revealed a generally satisfactory level of knowledge of and compliance with existing conservation policies and regulations of the national parks. Respondents attributed this fact to awareness raising activities conducted by SPNP and BZMCs.

However, as noted in the previous section, many NRM-related groups do not have adequate representation of women and marginalized person in leadership positions, despite national mandates for 50-50 splits between men and women in these roles. Furthermore, several respondents indicated that women's participation was often only to satisfy these requirements and lacking in meaningful participation. Overall, only 12.6% of women who belong to an NRM group held a leadership position.

Responses on inclusive participation in local planning

20% of women say they participate in local-level planning

At the local level…
9% of Brahmins, Chettris, and Thakuri,
0% of Dalit, and
91% of Janajati say they participate in local-level planning

Watershed health assessment – Summary

The list of health indicators presented in this section takes into account factors related to biophysical health, infrastructure, socio-economic standing, and governance within the watershed. Each of these indicators was assessed through consultation with stakeholders in the Phoksundo Suligaad 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 Phoksundo Suligaad Watershed as ***moderately good*** (Table 3)**.** The water quality for domestic and agricultural purposes and the large portion of national park and buffer zone with forest cover for land use are among the most positive factors in the watershed. Areas of concern include low water availability in community settlements for drinking purpose and little activity in regard to climate change adaptation and resilience. The lack of coordination between levels of governance also hampers efforts to strengthen the outlook for long-term watershed health improvement.

Table 1: Summary of health indicators for the Phoksundo Suligaad Watershed

Theme	Watershed health indicators	Watershed indicator rating	Rationale for rating
WATER	Water availability		- Rich in glaciers, lakes and springs
	Water accessibility for community, agriculture		- Good water availability but poor infrastructure for distributing water - 22% of respondents say water access is unequal - Only 6.4% have irrigation all year round
	Water quality for drinking, irrigation and energy generation		- 27% of respondents perceive water quality as good - All tested parameters for drinking water and irrigation in the normal range
BIODIVERSITY & HABITAT	Household sanitation		- 93% of households have toilets - 61% of respondents reported having a water-borne illness in the past year
	Solid waste disposal		- Only 33% use landfill for household solid waste; most families incinerate
	Land use land cover		- Forest cover to agricultural land ratio is strong: 6 to 1 - NTFP collection periods coincide with harvest season; more and more land is left fallow
	Species diversity [Fresh water]		- Three species of fish reported - SPNP regulations support protection and conservation
	Invasive species [Aquatic]		- No invasive species reported

	Quantity of fish [Local]		- Fish population appears stable, but lack of diversity in cold water raises concerns about climate change impacts on numbers
	Fishing practices		- Rising use of traps and casting nets
SUSTAINABLE AGRICULTURE	Climate and physiography		- Declining snowfall and rising glacial melt threatens water availability and increases the risk of glacial lake outburst floods
	Soil management [conservation, fertility]		- 74% of respondents say soil fertility has decreased - Low technical knowledge of soil issues
	Agriculture productivity [data]		- 75% say agricultural production has decreased - Rainfall patterns changing, making growing season less predictable
	Sustainability of irrigation		- Few irrigation schemes and available ones often run dry
SUSTAINABLE INFRASTRUCTURE & MINING [e-friendly framework]	Sustainability of hydropower		- Micro hydropower at Aankhe Khola and Pugmo, but erratic rainfall hampers operations
	Sustainability of gravel mining and construction materials		- Demand for infrastructure is raising concerns about over-extraction and environmentally-responsible extraction
	Sustainability of rural roads	NA	
CLIMATE RESILIENCE AND DISASTER RISK REDUCTION	Climate induced threats – intensity & severity [landslides, floods and landslides]		- Floods and landslides increasing, especially in rainy season - High loss of property and human life
	Community response, measures to adapt to CC impacts		- Only 3% of residents have adopted a climate-smart technology or practice

	Community access to early warning systems		- No formal early warning system available in the watershed
GOVERNANCE AND EQUALITY 	Inclusive participation in local NRM planning		- Women and people from marginalized groups hold only 5% of leadership positions in local NRM groups - Low meaningful participation from women and marginalized groups
	Persistence of active NRM groups [Biodiversity, disaster, climate change, water, agriculture, forest, irrigation, farmers]		- 10 BZCFUGs support conservation activities - Low regulation on NTFP collection
	People comply with laws and policy provisions, including local norms and standards		- Local customs and rules have not been incorporated in the regulations of local municipalities and SPNP
	Mechanism placed to resolve outstanding issues, benefit sharing, sand mining, irrigation, hydropower		- Lack of coordination among local municipalities, BZMC, and SPNP
	Equitable access and benefit sharing arising from use of natural resources (ecosystems services and products)		- 67% of respondents say they have equal access to group facilities and services - Benefit sharing for fodder and fuelwood is good but low coordination on broader conservation efforts
	Coordination between rural municipalities, municipalities, provinces and line agencies		- Coordination is low and confusion persists under the new federal system regarding responsibilities
	Adoption of climate-smart, environment and watershed management friendly practices [across all thematic areas]		- Only 20% (of 3% above) of respondents practice climate-smart adaptation activities