PHOKSUNDO-SULIGAAD WATERSHED PROFILE

STATUS, CHALLANGES AND OPPORTUNITIES FOR IMPROVED WATERSHED MANAGEMENT

USAID
FROM THE AMERICAN PEOPLE

USAID PAANI PROGRAM

युएसएड पानी परियोजना

Cover photo: A scenic view of Phoksundo Lake located at Phoksundo-Suligaad watershed, Dolpa.

Photo credit: USAID Paani Program/Manoj Chaudhary

PHOKSUNDO SULIGAAD WATERSHED PROFILE: STATUS, CHALLENGES AND OPPORTUNITIES FOR IMPROVED WATER RESOURCE MANAGEMENT

Program Title:	**USAID Paani Program**
DAI Project Number:	**1002810**
Sponsoring USAID Office:	**USAID/Nepal**
IDIQ Number:	**AID-OAA-I-14-00014**
Task Order Number:	**AID-367-TO-16-00001**
Contractor:	**DAI Global LLC**
Date of Publication:	**February 27, 2019**

The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

TABLE OF CONTENTS

TABLE OF CONTENTS IV

TABLES VI

FIGURES VIII

ABBREVIATIONS IX

ACKNOWLEDGEMENTS 1

EXECUTIVE SUMMARY 2

1. PHOKSUNDO SULIGAAD WATERSHED: NATURE, WEALTH AND POWER 11

2. NATURE 12

2.1 PHOKSUNDO SULIGAAD WATERSHED 12

2.2 WATER AVAILABILITY AND QUALITY 15

2.3 LAND USE AND LAND COVER 17

2.4 BIODIVERSITY AND INVASIVE SPECIES 19

2.5 CLIMATE AND PHYSIOGRAPHY 21

2.5.1 Rainfall 21

2.5.2 Temperature 22

2.6 CLIMATE RESILIENCE AND DISASTER RISK REDUCTION 25

3. WEALTH 27

3.1 AGRICULTURE PRODUCTIVITY 28

3.1.1 Soil management and fertility 29

3.2 INFRASTRUCTURE 29

3.2.1 Hydropower 29

3.2.2 Gravel Mining 30

3.2.3 Roads 30

3.2.4 Irrigation 31

3.3 SOLID WASTE AND MANAGEMENT 31

4. POWER 32

4.1 ACCESS AND INCLUSION 32

4.1.1 Access to water for domestic and agricultural use 32

4.1.2 Access to early warning systems (EWS) and disaster risk reduction 33

4.1.3 Access and inclusion in local NRM planning 33

4.2 COMMUNITY ACTION AND RESPONSE 35

4.2.1 Climate change adaptation and disaster risk reduction 36
4.2.2 Natural resource management (NRM) groups and activities 36
4.2.3 Compliance with laws and policy provisions 36
4.3 GOVERNANCE 37
5. MAJOR ISSUES AND CHALLENGES 39
6. PRIORITIZING ENVIRONMENTAL THREATS AND OPPORTUNITIES ... 40
7. VISION AND MISSION OF PHOKSUNDO SULIGAAD WATERSHED 42
7.1 VISION STATEMENT FOR THE PHOKSUNDO SULIGAAD WATERSHED 42
7.2 COMMITMENTS TO CONSERVING THE PHOKSUNDO SULIGAAD WATERSHED 42
8. RECOMMENDATIONS 49
WORKS CONSULTED 52
ANNEXES 54

TABLES

Table 1: Priority issues and threats on aquatic biodiversity in Phoksundo Suligaad watershed 5

Table 2: Summary of trend of change of seasonal rainfall observed in the watershed 21

Table 3: Amount of reserve income by household in the Phoksundo Suligaad watershed 27

Table 4: Material extraction sites in the Phoksundo Suligaad watershed with annual extraction amount limits 30

Table 5: Key offices in Phoksundo Suligaad for addressing natural resource issues 34

Table 6: Threats to environmental health and management in the Phoksundo Suligaad watershed 41

Table 7: Action commitments for improved freshwater and biodiversity conservation in the Phoksundo Suligaad watershed 42

Table 8: Issues and recommendations in the Phoksundo Suligaad watershed 49

Table 9: Household (HH) surveys by topic and number conducted 56

Table 10: Major settlements in the Phoksundo Suligaad watershed, including numbers of households and primary ethnicity 57

Table 11: Population by municipality, sex, and caste/ethnicity 58

Table 12: Lakes, ponds and waterfalls in the Phoksundo Suligaad watershed 62

Table 13: Forest cover and type in the Phoksundo Suligaad watershed 63

Table 14: List of endemic plants identified in the Phoksundo Suligaad watershed 63

Table 15: List of important medicinal plants in the Phoksundo Suligaad watershed 64

Table 16: List of mammals found in the Shey Phoksundo watershed, including status and distribution range 66

Table 17: List of protected animals found in Shey Phoksundo National Park and surrounding buffer zones 68

Table 18: List of bird species found in the Phoksundo Suligaad watershed, including status and distribution range 69

Table 19: Key roads in the Phoksundo Suligaad watershed 80

Table 20: Micro-hydropower plants in the Phoksundo Suligaad watershed 81

Table 21: Irrigation projects in the Phoksundo Suligaad watershed 82

Table 22: Water quality parameters in the Phoksundo Suligaad watershed, dry and monsoon seasons 83

Table 23: Major pollution points in the Phoksundo Suligaad watershed 84

Table 24: Community user forest groups by location and representation 84
Table 25: Buffer zone community forest user groups in Shey Phoksundo National Park 85
Table 26: Buffer zone user committees around Shey Phoksundo National Park by location.....87
Table 27: Key organizations and offices relevant to watershed health 88

FIGURES

Figure 1: The Phoksundo Suligaad watershed and its administrative boundaries 4

Figure 2: Map of natural hazard "hotspots" in the Phoksundo Suligaad watershed 7

Figure 3: Map of Phoksundo Suligaad watershed and its river network 14

Figure 4: Water quality sampling points in the Phoksundo Suligaad watershed..... 16

Figure 5: Average monthly discharge of the Suligaad River at the outlet of the Phoksundo Suligaad watershed 17

Figure 6: Forest loss and gain in the Phoksundo Suligaad watershed from 2000-2016 18

Figure 7: Long-term average monthly rainfall (in mm) measured at Dunai 21

Figure 8: Maximum, minimum and average long-term monthly temperature (ºC) in the Phuksundo Suligaad watershed 22

Figure 9: Mean annual temperature (ºC) distribution in Phuksundo-Suligaad watershed 23

Figure 10: Annual mean temperature change trends in Phuksundo-Suligaad watershed 24

Figure 11: Long-term average monthly rainfall (in mm) measured at Dunai (312) rain gauge station 59

Figure 12: Seasonal temperature change trend (ºC/year) observed in Phuksundo Suligaad watershe 59

Figure 13: Long-term annual mean rainfall trend (mm/year) observed in Phuksundo Suligaad watershed 60

Figure 14: Mean annual temperature (ºC) distribution in Phuksundo Suligaad watershed 61

Figure 15: Vision building framework 90

ABBREVIATIONS

BCTS	:	Brahmin/Chhetri/Thakuri/Sanyasi castes
BZFC	:	Buffer Zone Community Forest
BZMC	:	Buffer Zone Management Committee
BZUG	:	Buffer Zone User Group
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
CMDN	:	Center for Molecular Dynamics in Nepal
CSOs	:	Community Service Organizations
DADO	:	District Agriculture Development Office
DCC	:	District Coordination Committee
DDC	:	District Development Committee
DFO	:	District Forest Office
DDRC	:	District Disaster Risk Reduction Committee
DWSS	:	District Drinking Water and Sewerage Development Office
DEECC	:	District Environment and Energy Coordination Committee
DFO	:	District Forest Office/Officer
DFRS	:	Department of Forest Research and Survey
DLO	:	District Livestock Office
DSCO	:	District Soil Conservation Office/Officer
DSCWM	:	Department of Soil Conservation and Watershed Management
EAP	:	Emergency Action Plan

EIA	:	Environmental Impact Assessment
FECOFUN	:	Federation of Community Forestry Users
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
NeKSAP	:	Nepal Khadya Suraksh Anugaman Pranali

NFIWUAN	:	National Federation of Irrigation and Water Users' Association
NLCDC	:	National Lake Conservation Development Committee
NP	:	*Nagar palika* (new federal administrative unit; district level)
NPC	:	National Planning Commission
NRM	:	Natural resource management
PAANI	:	Program for Aquatic Natural Resources Improvement
PLMC	:	Phoksundo Lake Management Committee
Sec.	:	Second
SLCC	:	Snow Leopard Conservation Committee
SPNP	:	Shey Phoksundo National Park
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 buffer zone user groups (BZUCs), cooperatives, water user groups, and, especially, the communities dependent on aquatic biodiversity and local water management. Leaders from Shey Phoksundo gaunpalika (GP), Thulibheri nagarpalika (NP), Tripurasundari NP, Kaike GP, Shey Phoksundo National Park and local government bodies 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 (Paani) —युएसएड पानी परियोजना—is grateful for the privilege of having been invited to support the above efforts. Paani is a consortium of DAI, WWF, SNV, SILT, and NESS that works closely with Nepal's Water and Energy Commission Secretariat (WECS) and draws on support from the WECS' member agencies. Paani enriched the watershed profile by compiling and reviewing secondary data and by collaborating with the Federation of Community Forestry Users (FECOFUN) 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 FECOFUN, the District Agriculture Office (DAO), the District Coordination Committee (DCC), Nepal Red Cross, Shey Phoksundo National Park, and other government agencies who gave their full cooperation and support at the national, district and local levels. Any errors in this discussion document are those of the Paani team.

EXECUTIVE SUMMARY

The Phoksundo Suligaad watershed profile assesses the status, major challenges and opportunities for water resource management for the multiple users within Phoksundo Suligaad watershed in Province No. 6.

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

This watershed profile provides critical baseline information for local governments, communities, civil society, and private sector stakeholders within the Phoksundo Suligaad watershed to strengthen water resource management in a way that benefits human development and protects 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.[1]

Situated within Dolpa district in the northwestern section of Nepal, the Phoksundo Suligaad watershed (Figure 1) covers 984 square kilometers across two nagarpalika (Thulibheri and Tripurasundari) and two 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

[1] 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), will be gradually 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 as assigned by the new federal system.

Watersheds occasionally sit within a single province, but more commonly extend across two provinces, 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 in watershed, so does this area provide a unique record of environmental and socio-economic change.

to the region each year for harvesting. Yarshagumba is the main source of revenue to 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, school) and little infrastructure in the area (e.g., roads, irrigation)

The Phoksundo Suligaad 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 variation 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 provde 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.

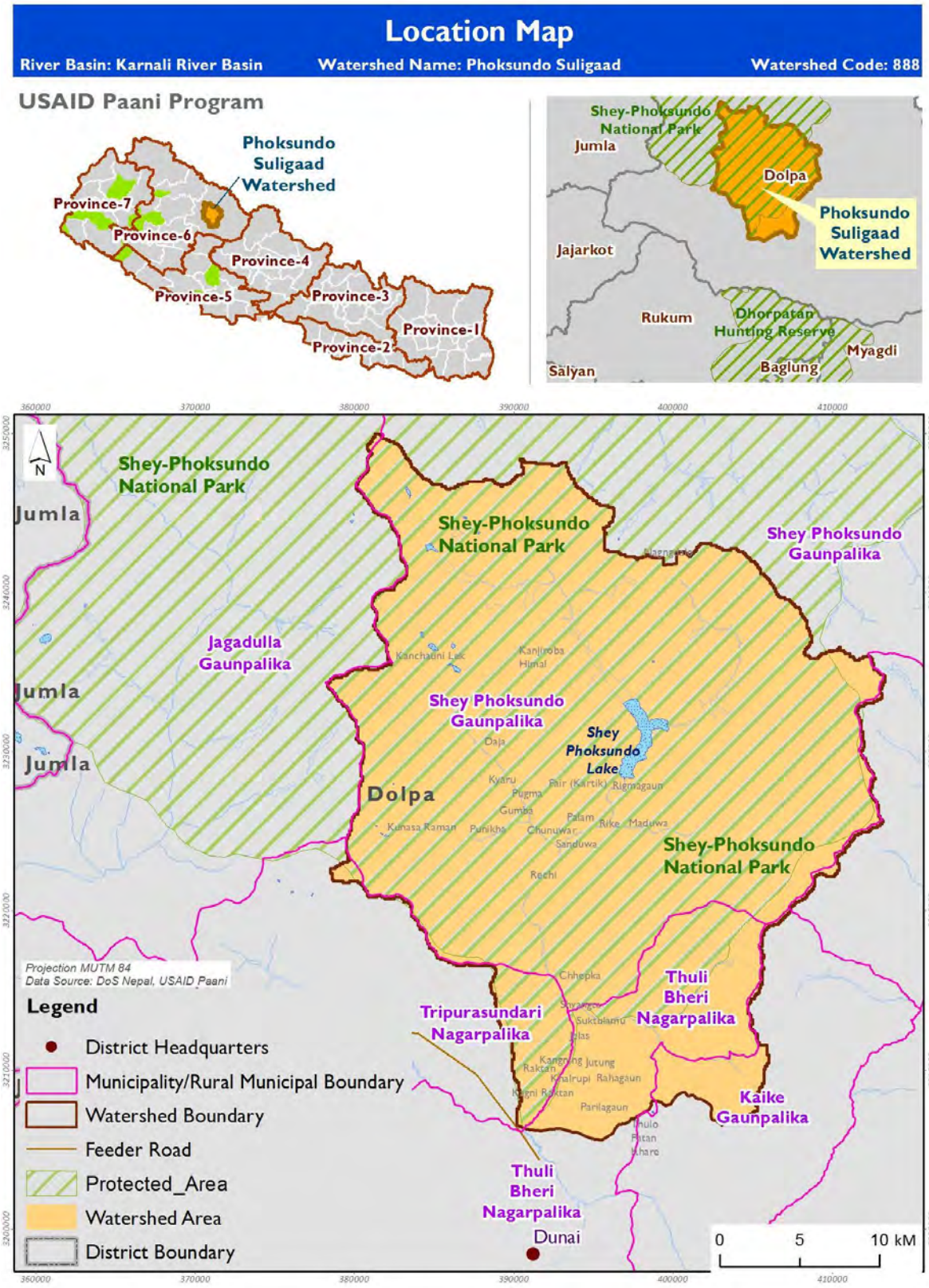

Figure 1: The Phoksundo Suligaad watershed and its administrative boundaries

Priority Issues for the Phoksundo Suligaad watershed

The following priority challenges in the Phoksundo Suligaad watershed were identified through a series of data collecting methods, including a multi-stakeholder workshop, household surveys and field observations. The challenges are summarized in Table 1 and described below with recommendations for addressing each challenge.

Table 1: Priority issues and threats on aquatic biodiversity in Phoksundo Suligaad watershed

SN	Issue	Impacts
I	**Low knowledge of conservation-related laws and policies among local organizations**	Local organizations (governmental and non-governmental) exhibit low knowledge of relevant policies and regulations related to conservation. This reality could produce sub-optimal results in terms of promoting freshwater conservation and biodiversity.
II	**Floods and landslides**	Increased incidence of floods and landslides damages local infrastructure (e.g., roads, bridges, and irrigation canals) and affects aquatic numbers and biodiversity through amplified sedimentation. Furthermore, a lack of local adaptation plans (e.g. early warning systems) and poor coordination between upstream and downstream communities does not allow for suitable and effective response. There are currently no community level adaptation plans in place.
III	**Low levels of evidence-based research available related to local biodiversity**	Given the watershed's remote location and the apparent lack of biodiversity (compared to other areas in Nepal), scientific research on the area is lacking. Therefore, local residents and organizations do not have a strong foundation of knowledge from which to develop adaptation and conservation plans. There is no basic information related to freshwater biodiversity available at the SPNP office and many respondents informed our team that Phoksundo Lake is a 'dead lake.'
IV	**Low coordination and planning integration between National Park and Natural Resource Management organizations (e.g., user groups)**	SPNP officials and local user groups in the watershed tend to work in parallel on issues that affect them similarly. While both groups share an interest in, for example, proper forest management, coordinated programs are few. This lack of cooperation is exacerbated by confusion about who holds what authority in which area. For example, some communities located within the National Park fall under

		buffer zone regulations and not national park regulations. The lack of clarity on this issue and others discourage more proactive responses to conservation challenges.
V	**Waste management**	Increasing tourism in the watershed and a lack of sanitation planning has led to a rise in pollution and untreated waste.
VI	**Decreasing fish numbers**	Rising tourism in the area is raising the demand for fish by local hotel entrepreneurs. SPNP oversees fishing through the issuance of coupons to approved guests, but respondents say that much illegal fishing still takes place in the Phoksundo River.
VII	**Drying water sources**	Residents reported fewer water sources available to meet their daily household needs. The shrinking snow cap in the Himalaya is one factor here, but improved management of springs could help lessen the immediate impacts. Improved forest management and more careful monitoring of non-timber forest products (NTFPs) would also be beneficial.

I. Low knowledge of conservation-related laws and policies among local organizations

Local organizations (governmental and non-governmental) exhibit low knowledge of relevant policies and regulations related to conservation. This reality could produce sub-optimal results in terms of promoting freshwater conservation and biodiversity. These organizations include buffer zone user committees (BZUC), buffer zone community forest groups (BZCFUG), snow leopard conservation committees (SLCC), community-based anti-poaching units (CBAPU), irrigation groups, and drinking water groups, among others. During field visits, the Paani research team discovered that organizational understanding of conservation-related policy was low and few organizations knew where to obtain more information.

Recommendations

- Assess the knowledge levels of each group individual;
- Design and implement trainings on conservation-related policy;
- Assess local livelihood options, provide support for sustainable livelihood promotion, and link this work with local and regional market places;
- Promote cooperatives to improve financial management of local conservation groups and all residents; and
- Encourage formation of conservation groups to build local response to environmental challenges.

II. Floods and landslides

Surveys revealed that 65% of households said flooding had increased, and 93% reported that landslides had become more common over the same period. Similarly, 88% of households said that natural hazards generally had increased. Floods and landslides not only damage infrastructure and personal property but also degrade aquatic habitats through increased sedimentation and by altering river flows. Figure 2 provides a map of natural hazard "hotspots" in the watershed as identified by stakeholders.

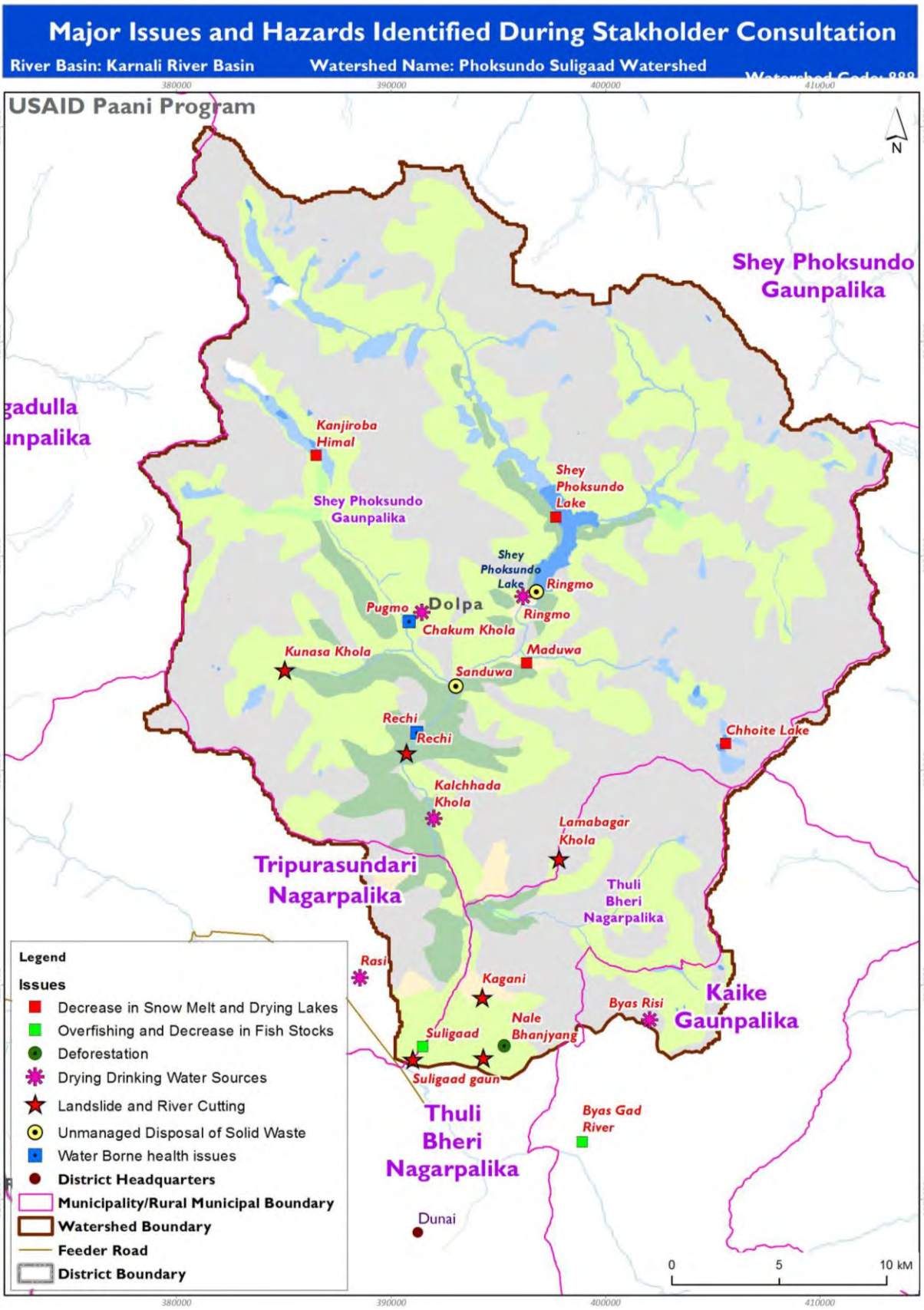

Figure 2: Map of natural hazard "hotspots" in the Phoksundo Suligaad watershed

Recommendations

- Provide training and support for low-cost slope stabilization techniques (e.g., gabion boxes);
- Provide improved support to control water runoff;
- Raise awareness about forest fires and open grazing, and how these phenomena relate to other natural hazards;
- Strengthen the early warning system of the watershed to allow increased response time to impending disaster;
- Disseminate information through print and radio about best practices for watershed management;
- Improve the implementation of Disaster Preparedness and Response Plans (DPRP); and
- Promote cooperative maintenance of foot trails in the watershed.

III. Low levels of evidence-based research available related to local biodiversity

Phoksundo Lake was declared a RAMSAR site in 2007, and the National Park is considered an IUCN category 2: A "[l]arge natural or near natural area set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities."[2] As such, SPNP has drawn increasing numbers of tourists interested in the natural beauty of the area.

In spite of this recognition and attention, little research has been conducted in the watershed in relation to the rivers and wildlife. For example, many respondents claimed Phoksundo Lake to be 650 meters deep, but that number has not been documented. The Chief Warden of SPNP, on the other hand, gives the lake depth at 145 meters, a number that has been verified by the national Department of Hydrology and Meteorology. This discrepancy points to the fact that local knowledge about the lake and other facets of the watershed is quite uneven. On the topic of fish diversity, local residents could not identify the species available in the lake and rivers – a sharp contrast with other watersheds involved in the Paani project where local knowledge of species was broad and encompassing.

These examples point to the fact that local residents and organizations are ill-equipped with proper information related to natural resources, and thus adaptation and conservation planning efforts could be hampered.

Recommendations

- Increase biodiversity research for the watershed and bathymetry of Phoksundo Lake, and encourage local participation in these efforts;
- Build management capacity in the Phoksundo Lake Management Committee; and
- Prepare a Phoksundo Lake Management Plan.

[2] https://www.iucn.org/theme/protected-areas/about/protected-areas-categories/category-ii-national-park

IV. Low coordination and planning integration between National Park and Natural Resource Management organizations (e.g., user groups)

A general tension pervades the relationship between SPNP and the BZMCs and BZUCs that operate on the National Park's periphery. The BZMCs and BZUCs say the park does not allocate enough financial support to the committees to fulfill their work objectives. SPNP officials say that buffer zone organizations demonstrate weak governance in the areas for which they are responsible, such as poor record keeping and uneven policy enforcement. This situation indicates that standardized and inclusive conservation planning for the watershed may be difficult.

Recommendations

- Establish regular coordination meetings between SPNP management, BZMCs and BZUCs;
- Build capacity of buffer zone organizations on SPNP rules and regulations;
- Provide trainings to buffer zone organizations on proper book keeping;
- Promote team building exercises for SPNP, BZMCs and BZUCs; and
- Provide trainings for all groups on report writing.

V. Waste management

Field research and focus group discussions revealed that most hotels and shops in the watershed do not follow guidelines for proper solid waste disposal. Respondents gave numerous examples of bottles, plastics, and other household trash being disposed directly into rivers and streams. Improper waste disposal is particularly intense in tourist areas such as Raha, Parela and Rassi. Furthermore, elderly members of the population still practice open defecation, in spite of the availability of toilets. Compounding this issue has been the rise in demand for yarshagumba, which has intensified the number of people arriving during harvest season. Villages and consumer outposts in the watershed are not equipped with sufficient infrastructure to accommodate this annual influx of people.

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;
- Increase water quality monitoring of the Phoksundo River and tributaries.
- Promote improved waste management programs specifically for hotel and restaurant managers; and;
- Develop waste management plan tailored to the unique context where yarshagumba is harvested.

VI. Decreasing fish numbers

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.

Recommendation

- Promote research on fish diversity and fish population dynamics;
- Promote local awareness on the importance of aquatic biodiversity conservation; and
- Encourage natural fish farming as an alternative livelihood option.

VII. Drying water sources

More than 89% of households surveyed said that rainfall amounts had decreased over the past decade, and rainfall is the primary source for rejuvenating local springs that provide water for daily needs. Similarly, nearly 83% of households said that water availability had declined over the past ten years. The shrinking snow cap in the Himalaya is one factor here, but improved management of springs could help lessen the immediate impacts. Improved forest management and more careful monitoring of non-timber forest products (NTFPs) would also be beneficial.

On a related note, as yarshagumba is a crucial source of livelihood support in the watershed, declining water could mean a corresponding decline in this important crop.

Recommendation

- Promote re-forestation on barren land for water retention;
- Construct water recharge ponds;
- Promote rainwater harvesting by household;
- Coordinate workshops to educate local residents about the value of soil erosion control and means for avoiding water conflict;
- Implement climate-smart agricultural practices where appropriate;
- Prepare local adaptation plans (CAPA and LAPA) to support adaptation measure throughout the watershed.

1. PHOKSUNDO SULIGAAD WATERSHED: NATURE, WEALTH AND POWER

This Phoksundo Suligaad 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. Then we examine how climate change and other drivers threaten and impact local livelihoods and biodiversity.

In 2018, the 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 priority issues and environmental assets were identified by location and impact groups. During the exit workshop, the Paani team also identified champions among stakeholders and local government agencies for leveraging funds; expertise to support water resources management initiatives; and agencies for leveraging funds and expertise to support water resources management initiatives.

Paani took critical feedback and suggestions to identify priority issues and actions (Section 8), and with the participants, developed a 20-year vison for improving watershed management. The representatives of newly-elected 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 Phoksundo Suligaad watershed, paying special note to trends and changes that may threaten the health and sustainability of these assets.

2.1 PHOKSUNDO SULIGAAD WATERSHED

The Phoksundo Suligaad watershed covers 964 km^2 in Dolpa district in northwestern Nepal. Parts of the watershed extend into two nagarpalika – Thulibheri (24%) and Tripurasundari (34%) – and two gaunpalika – Shey Phoksundo (33%) and Kaike (5%). The Phoksundo River is the primary waterway running south from Phoksundo Lake in Shey Phoksundo National Park (SPNP) down to Suligaad where it merges with the Thulibheri River.

Given the watershed's location near the northern border of Nepal, the changes in elevation are dramatic, from 6,572m at its highest point to 2,047m at its lowest. Ninety percent of the watershed falls within SPNP, a protected area that provides habitats to endangered species such as the snow leopard, musk deer, and Tibetan wolf. SPNP is the only trans-Himalayan national park in Nepal and one of only two districts that extend beyond the Himalayan range.

The Phoksundo River, which originates in Phoksundo Lake, is also fed by 34 major tributaries, which all feed the Middle and Lower Karnali watersheds further south (figure 3). Twenty-one of those streams originate in the northeastern section of the watershed and flow northwest into the Phoksundo. The other 11 tributaries originate to the west of the Phoksundo and flow southeast toward confluence. The surrounding Himalayan snow cap is the primary source of water for the area.

Apart from Phoksundo Lake, the forests are the other major natural resource in the watershed, covering 58 km^2 and providing timber and numerous non-timber forest products (NTFP) to local residents. Common tree species include leklali, bhij patra, thigure, kande, and dhupi (Juniperus indica Bertol), among others. Major NTFPs include yarshagumba (Cordiceps), wild mushrooms, kutki (Neopicrorhiza scrophulariiflora), guchchi chyau (Morchella), and kurilo (Asparagus)[4]. NTFP are the major sources of community income and livelihood. In the grass land areas of the watershed, residents harvest susi (Cymbopogon ambiguous), which can be processed for essential oils.

Local flatlands and pastures – referred to as patans – are used for primarily for grazing; the watershed contains 16 patans. Raising livestock, however, is a secondary livelihood compared to agriculture, which is the primary source of income in the watershed. Households raise beans, potatoes, barley, maize, and Chinu rice, the surplus of which can be sold in nearby markets. On the high plains, in the northern reaches of the watershed, residents harvest yarshagumba.

[4] See annex 5 for complete list of tree and NTFP species in the Phoksundo Suligaad watershed.

Tourism has steadily increased in Phoksundo Suligaad over the past decade, inspiring a rise in hotels and restaurants to accommodate the influx of travelers. The increasing number of tourists has created a corresponding rise in demand for the goods needed for accommodation. Many households earn additional income transporting goods to and from the watershed pulled by horses.

The population of the watershed is only 2,258, giving the area an extremely low population density. Most housholds also engage in yarshagumba harvesting in Dolpa district above 4,000 m. This crop demands high prices in Asia, especially in China, and the high profit margins mean overharvesting is a serious concern. SPNP officials say the three-year average recorded total harvest is 361kg. However, officials add 15% "unavoidable loss" to that figure under the assumption that weak monitoring of harvesting allows some illegal collection of yarshagumba that is not recorded. Thus, they provide an annual three-year harvest figure of 415 kg.

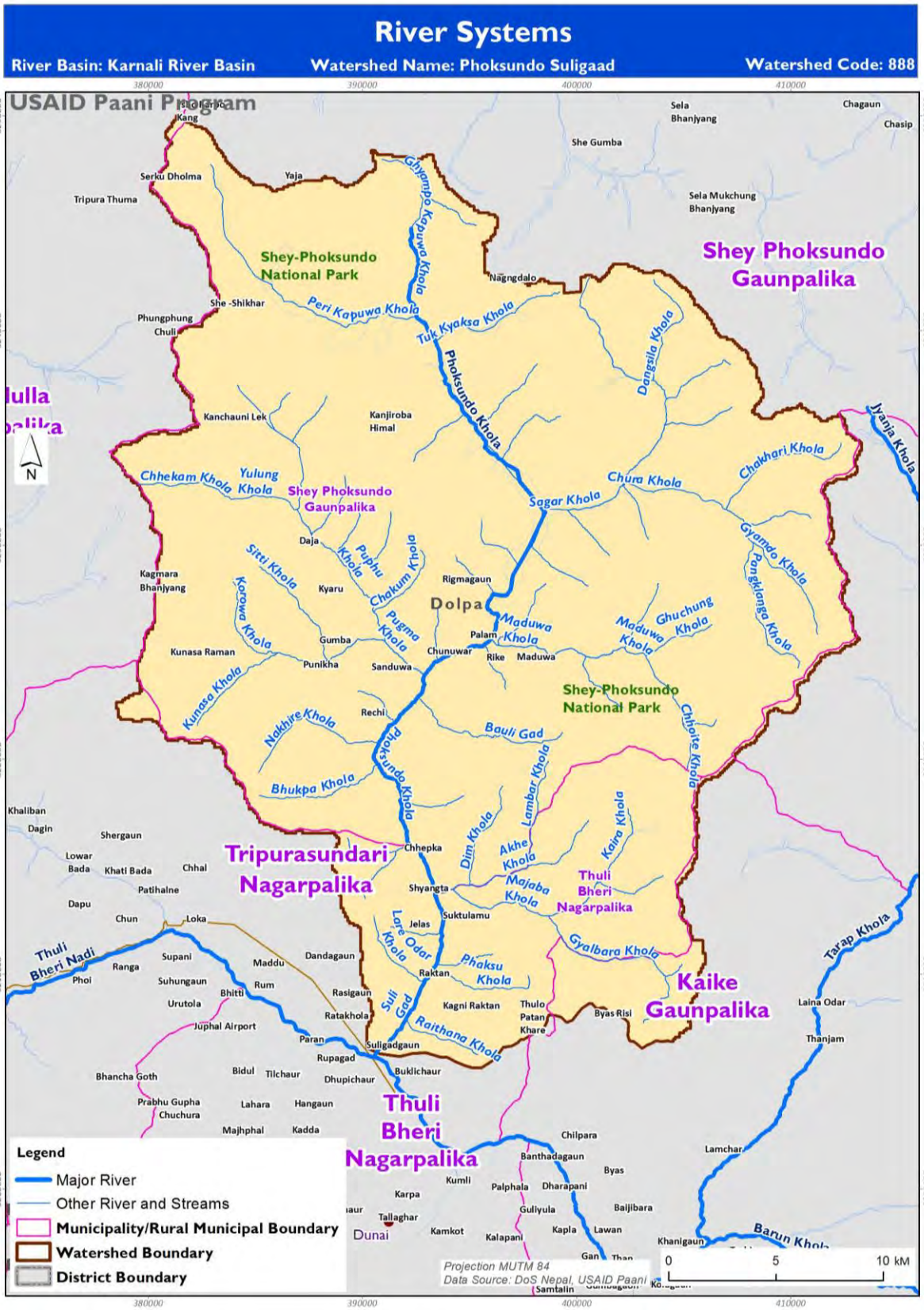

Figure 3: Map of Phoksundo Suligaad watershed and its river network

Related annexes
Annex 2: Land use and land cover
Annex 3: Population

2.2 WATER AVAILABILITY AND QUALITY

As noted above, the Phoksundo Suligaad watershed contains 34 waterways, and the Phoksundo River, which flows southward into the confluence with the Thulibheri River. Drinking water and agriculture constitute the two primary forms of water use. 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% have access to drinking water within 30 minutes of home, while 4% need to travel 30-60 minutes, and 14% need to 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 to be unequal. Of this 22%, 31% were Dalit, 20% BCTS, and 23% Janajati. The reasons given for unequal access were distance to water (55%) and water scarcity (53%)[5]. 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).

These concerns about water access could foresee a future of increasing conflicts among villages between upstream and downstream communities. Field research uncovered reports of severe water scarcity in Byasgadh, Ruma, Rassi, Parela, Rigmo, Chhepka, and Pugmo due to drying springs.

Water scarcity also has an important gender dimension that cannot be overlooked. In 86% of households, girls and women are responsible for water collection. This number could rise even higher as more and more men begin migrating outside the watershed for work. As water availability continues to diminish, girls and women are not only having to spend more time each day collecting water, but this burden is added to an already-rising workload in the absence of male household members. Therefore, promoting sustainable water use and equal access will also enable girls and women to devote more time to studies, income-generating work, and other activities to promote skill development.

Water quality in the watershed was determined by testing a range of parameters, including pH, nitrate nitrogen, ammonium, and phosphate. All 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 aquatic habitats if that those factors persist. The water was sampled at several locations in the watershed using an Akvo Caddisfly kit (Figure 4).

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

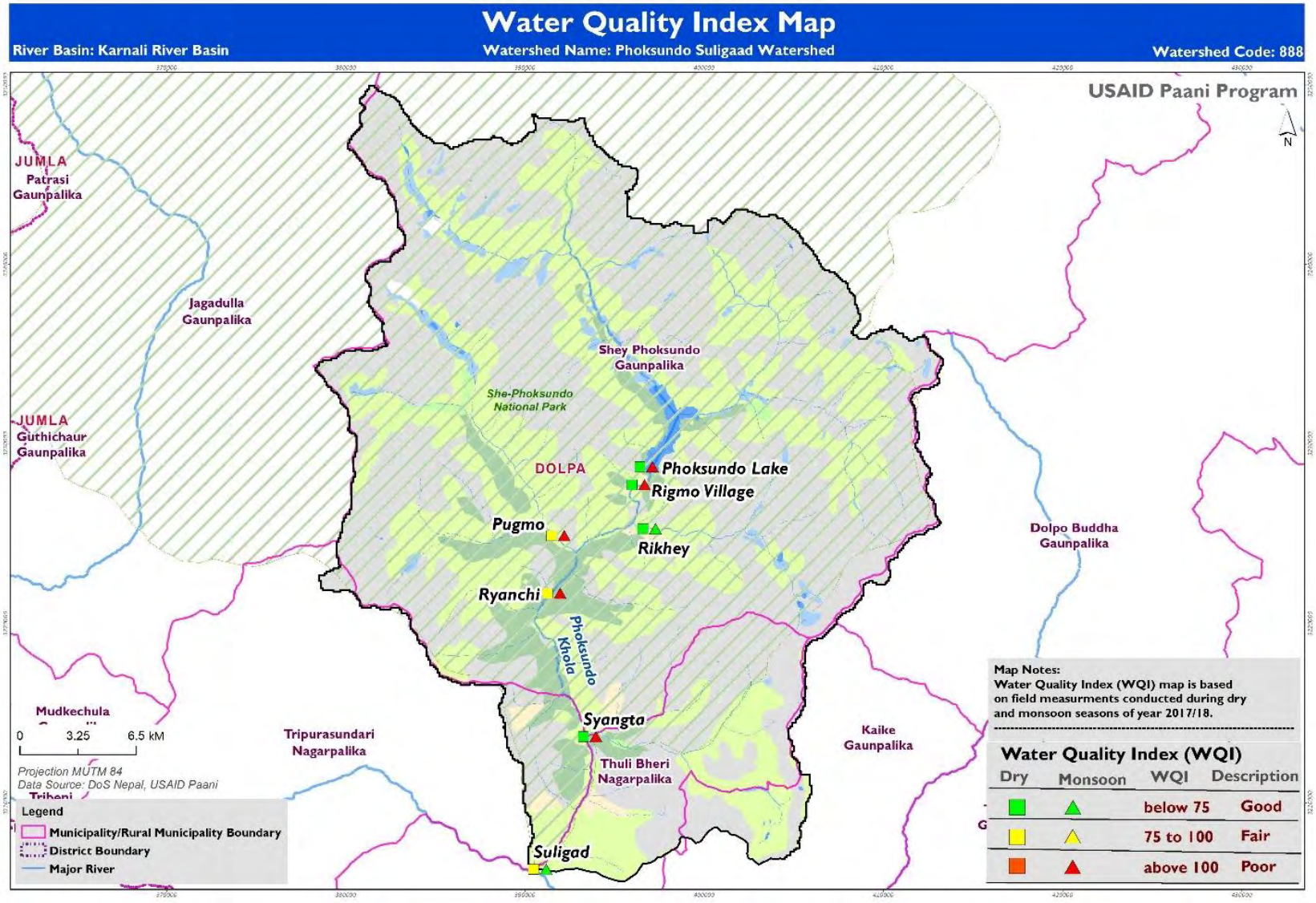

Figure 4: Water quality sampling points in the Phoksundo Suligaad watershed

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 in February for an annual average discharge of 11.10 m^3/s (Figure 5).

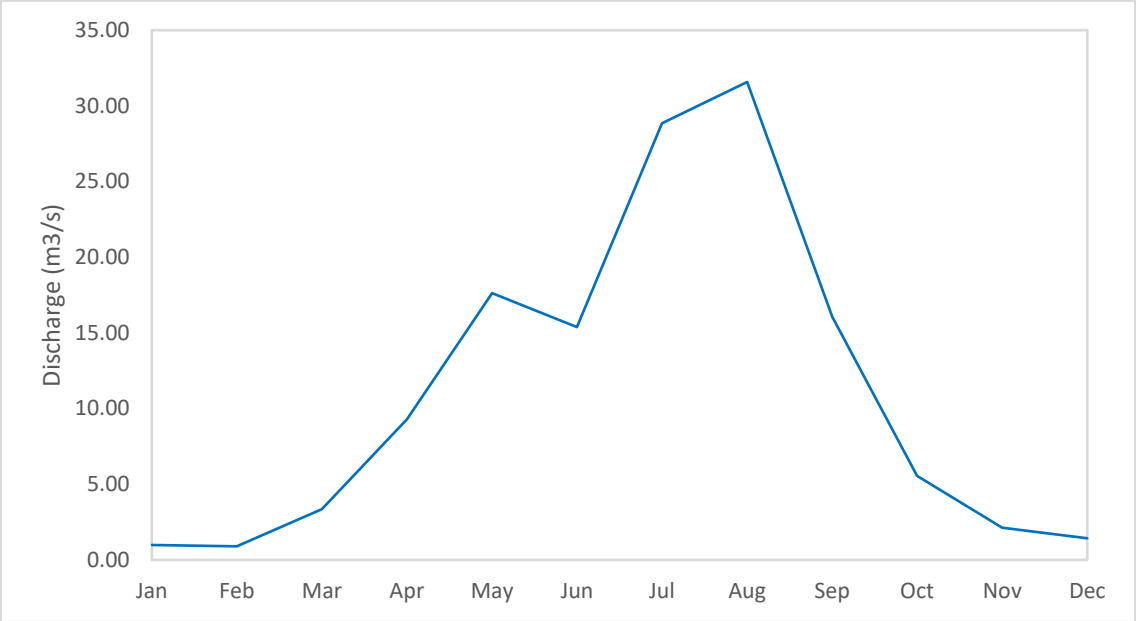

Figure 5: Average monthly discharge of the Suligaad River at the outlet of the Phoksundo Suligaad watershed

Related annexes

Annex 4: Lakes, streams, rivers, and sub-watersheds
Annex 9: Micro hydropower projects in the Phoksundo Suligaad5 watershed
Annex 11: Water quality

2.3 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 composed primarily of Nepalese alder or Utis (53%), followed by mixed hardwoods (22%) and pine (15%).[6]

From 2000-2016, forest cover has remained stable (Figure 6). According to data from Global Forest Watch, the watershed has lost one hectare of forest while gaining one hectare in other areas. Open

[6] See annex 6 for full listing of tree species in the watershed.

grazing and excessive firewood collection are the most significant concerns about local forests, while increasing dryness in the region also suggests that forest fire awareness is warranted in the future.

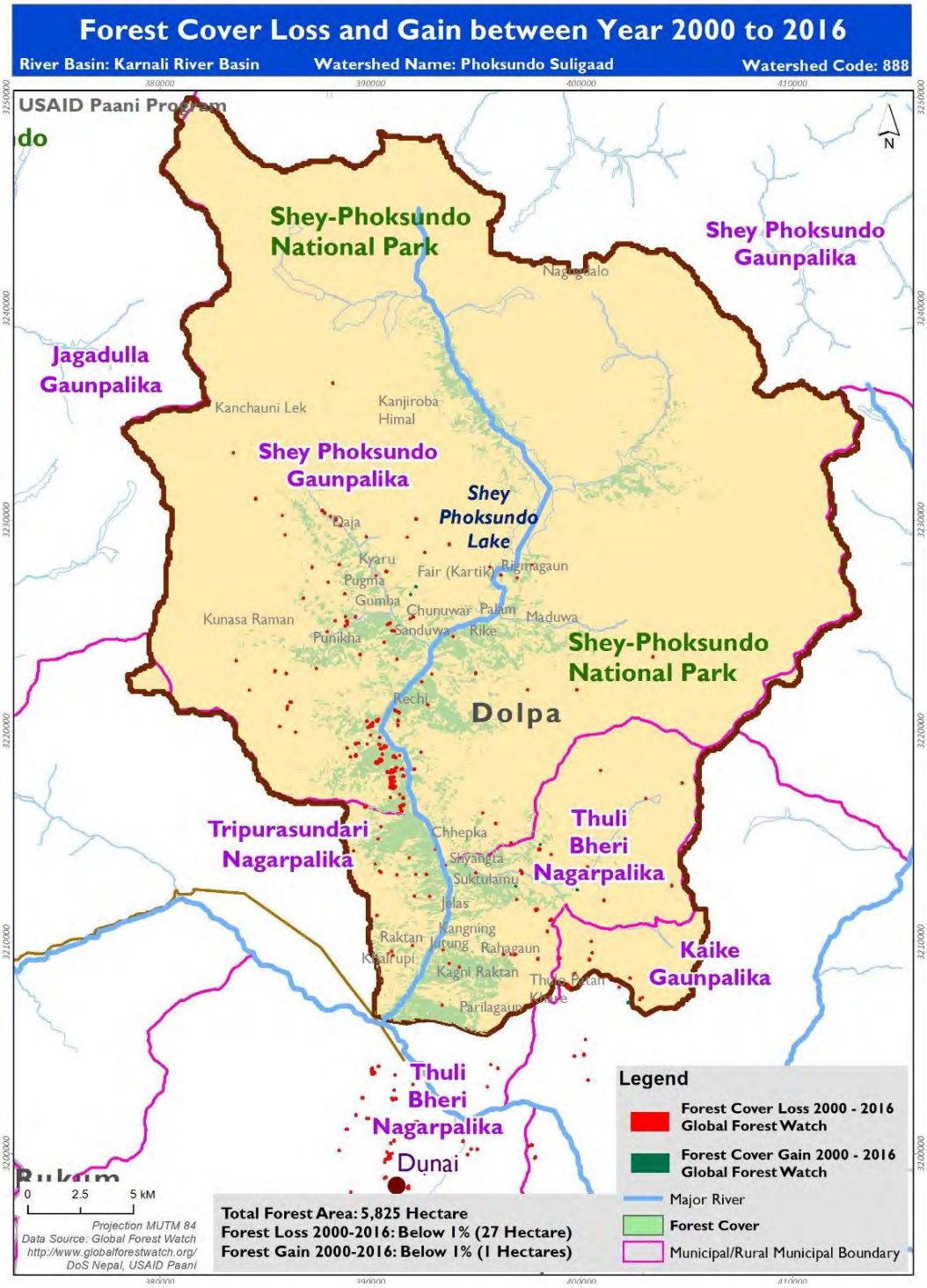

Figure 6: Forest loss and gain in the Phoksundo Suligaad watershed from 2000-2016

Related annexes

Annex 5: Forest types and composition

2.4 BIODIVERSITY AND INVASIVE SPECIES

SPNP is a trans-Himalayan area covering 91% of the Phoksundo Suligaad watershed and is most notable for its role in providing habitat to rare animal and plant species. With its status as a national park, the area promotes conservation of several endangered animals, including: 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 nine are rare. Additionally, important fungi grow in the area, particularly yarshagumba, which is a major source of income, and, in recent years, attracts large numbers of people to the area for its harvest.[7]

In terms of biodiversity, scientists and park officials organize SPNP and the watershed into four zones: lower (below 2,800m), middle (2,800-4,500m), upper (above 4,500m), and Dolphu, a village development committee that sits in the western reaches of the park. The middle zone is the highest in species diversity and richness.

Perhaps the most unique feature of the Phoksundo Suligaad watershed is the high level of endemic vegetation: 50 species of plants representing 46% of all the endemics in western Nepal. Of particular note are the approximately 407 medicinal plants as identified by the People and Plants Initiative in 1997. This situation has created some tension between local residents who graze livestock in these pastures and Tibetan healers who rely on these species for their occupations. Padamchal (Rheum australe or Himalayan rhubarb) is the most coveted of these species: 84% of residents said they had harvested this plant, known for treating a variety of maladies, including circulatory, digestive, endocrinic, and respiratory ailments.

In the southern part of the watershed, higher rainfall levels allow for temperate and sub-alpine vegetation to flourish. In the lower Suligaad valley, dense forests are composed of Himalayan blue pine (Pinus wallichiana), mixed with West Himalayan spruce (Picea smithiana), Deodar (Cedrus deodara), Hemock (Tsuga dumosa), and Silver fir (Abies spectabilis). In terms of shrubs and bushes, caragana and lonicera are common, along with bushes of rhododendron nivale, rhododendron lepidotum, and dwarf jumper.

Grass density generally thickens through the watershed moving from north to south, from upper Dolpa to lower Dolpa. Field research indicates that grass supply and grazing rates are presently sustainable. A few areas – Shey, Perikapuwa, and Pugmo – were marked for overgrazing during certain points of the year.

SPNP also features a cultural diversity that mirrors the biological diversity present. The park contains several Bhuddist monasteries, and the Bonpo (a rare sect of Buddhism) still flourishes in this area. Because of this combination of natural and cultural uniqueness, SPNP was listed as a UNESCO World Heritage Site in 1999. Phoksundo Lake was listed as a RAMSAR site in 2007 by the IUCN

[7] See annexes 6-11 for a full listing of flora and fauna in the Phoksundo Suligaad watershed.

SPNP falls under the Western Himalayan Alpine Shrubs and Meadows Ecoregion – one of 200 ecoregions cited by WWF for its biodiversity. In 2007, Phoksundo Lake was declared a Ramsar site for its critical importance to waterfowl in the region. In this regard, this watershed is a biodiversity rich area.

Fish in the watershed are rare, found only in rivers between Suligaad and the Jelus River. While numbers were generally good, as reported by local residents, no community members could identify the species of fish present, instead referring to all the fish as "machchha" (fish). Similarly, park officials hardly do any assessment to develop the inventory of the fish species. During a Paani reconnessance visit, the team noted a few fish fish species such as Snow trout (Bucche asala), *Schizothorax*, Dinnawah snow trout (*Schizothorax progastus*) and Flatfish as identified through community consultations. The warden informed the team that until recently research on aquatic biodiversity has not been conducted in the park areas.

"Dead" spots in the watershed's water bodies is an area needing more research. The Paani team did not observe fish in the Phoksundo River from Kageni in the south up to the Lake. However, some waterfowl and amphibians were noted and their presence confirmed by local residents. Local households also said there seemed to be no fish available in many parts of the river and Phoksundo Lake. Thus, Paani grantee the Center for Molecular Dynamics in Nepal (CMDN), is conducting conduct research at seven sites this year that appear suitable for fish habitation but are currently without.

Neither aquatic nor terrestrial invasive species were reported.

Related annexes

Annex 6: Mammals in the Phoksundo Suligaad watershed
Annex 8: Birds in the Phoksundo Suligaad watershed

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

Long-term rainfall data records are not available in Phoksundo-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 7.

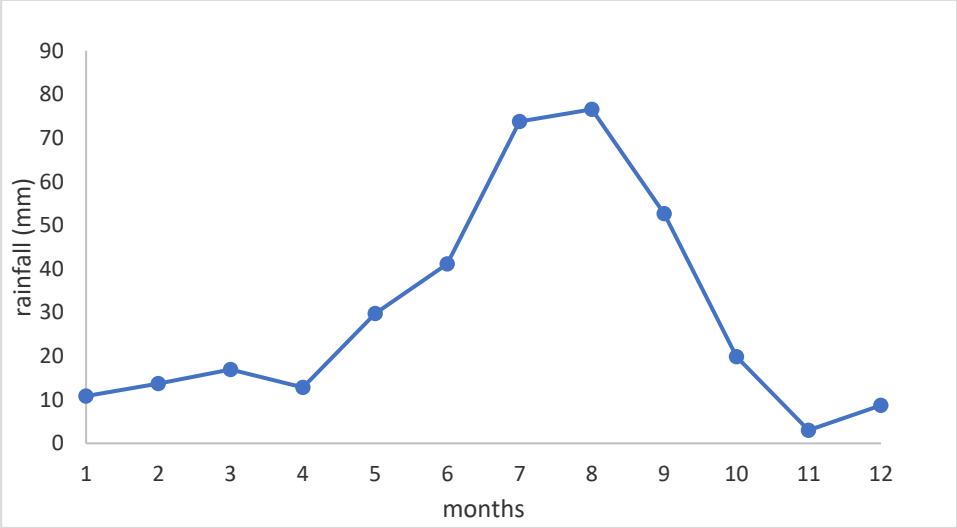

Figure 7: Long-term average monthly rainfall (in mm) measured at Dunai

Spatial and seasonal variations in rainfall trends were observed in the watershed (Table 2). The annual rainfall for the entire watershed is decreasing up to 10mm/year in the northwest but increasing 10mm/year in the southeast. However, these changing trends are not consistent across the watershed.

Table 2: Summary of trend of change of seasonal rainfall observed in the watershed

Season	Months	Rainfall change mm/year	Remarks
Winter	Dec-Feb	0 to 0.4	Northern part of watershed
		0.4 to 0.8	Southern part of watershed
Pre-monsoon	Mar-May	-1 to 0	Northwestern part of watershed
		0 to 1	Southeastern part of watershed
Monsoon	Jun-Sept	0 to 10	Entire watershed
Post-monsoon	Oct-Nov	0 to 1	Entire watershed
Annual mean	Jan-Dec	-10 – 0	Northwestern part of watershed

		0 – 10	Southeastern part of watershed
		0 to 0.4	Northern part of watershed

2.5.2 TEMPERATURE

Temperature variation in the Phoksundo Suligaad watershed has been analyzed according to four prominent climatic seasons: winter (Dec-Feb), pre-monsoon/spring (Mar-May), monsoon/summer (Jun-Sept), and post-monsoon/autumn (Oct-Nov). As with rainfall, there are no long-term temperature recording stations in the watershed, so the Paani team used data from a station in Dunai, four kms south of the watershed boundary.

In addition to the seasonal temperature variations, differences in topography also induce spatial variations of temperature. Long-term temperature data recorded in the Rapti, Karnali and the Mahakali River basin were used to determine the temperature change rate with respect to the elevation change. Temperature was observed to decrease at an average rate of 4.4 ◦C, 4.6 ◦C, 4.6 ◦C and 4.8 ◦C per 1 km rise in altitude in winter, pre-monsoon, monsoon and the post-monsoon seasons respectively. Similarly, the annual average temperature is observed to decrease at the rate of 4.9 ◦C per 1 km rise in altitude.

Based on these findings, the long-term average monthly temperature variation (daily average) in the Phoksundo Suligaad watershed is shown in Figure 7. The average monthly temperature of the watershed varies from -8.22°C in winter to about 4.88°C in summer. Similarly the maximum and minimum monthly temperature varies from -4.11°C and -12.32°C in winter to 7.67°C and 2°C in summer. Maximum temperature in Phuksundo-Suligaad watershed in observed in June, and the minimum temperature is observed in January.

The long-term average annual temperature variation in Phuksundo Suligaad watershed is shown in Figure 8. The average annual temperature varies from -11.4°C in the north to 8.3°C in the south.

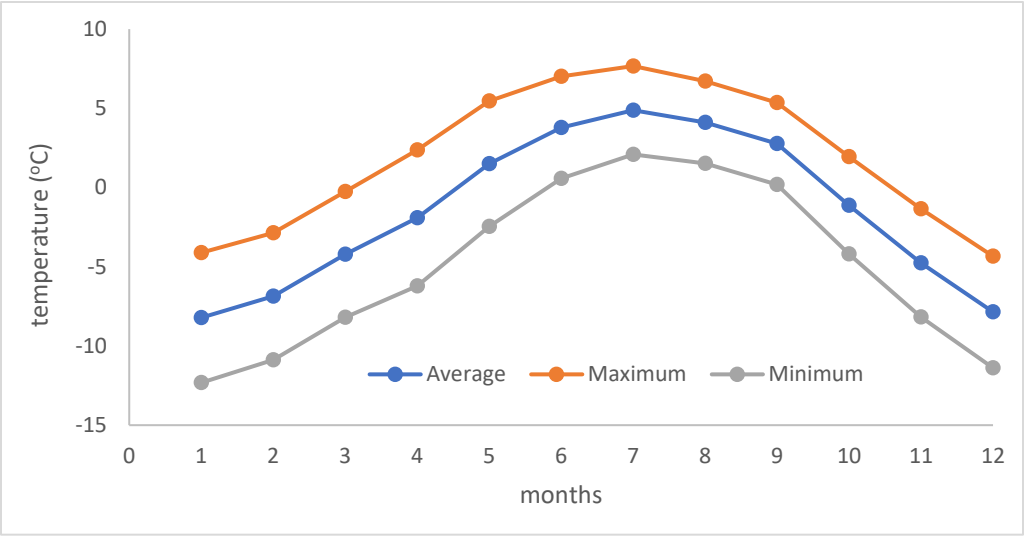

Figure 8: Maximum, minimum and average long-term monthly temperature (ºC) in the Phuksundo Suligaad watershed

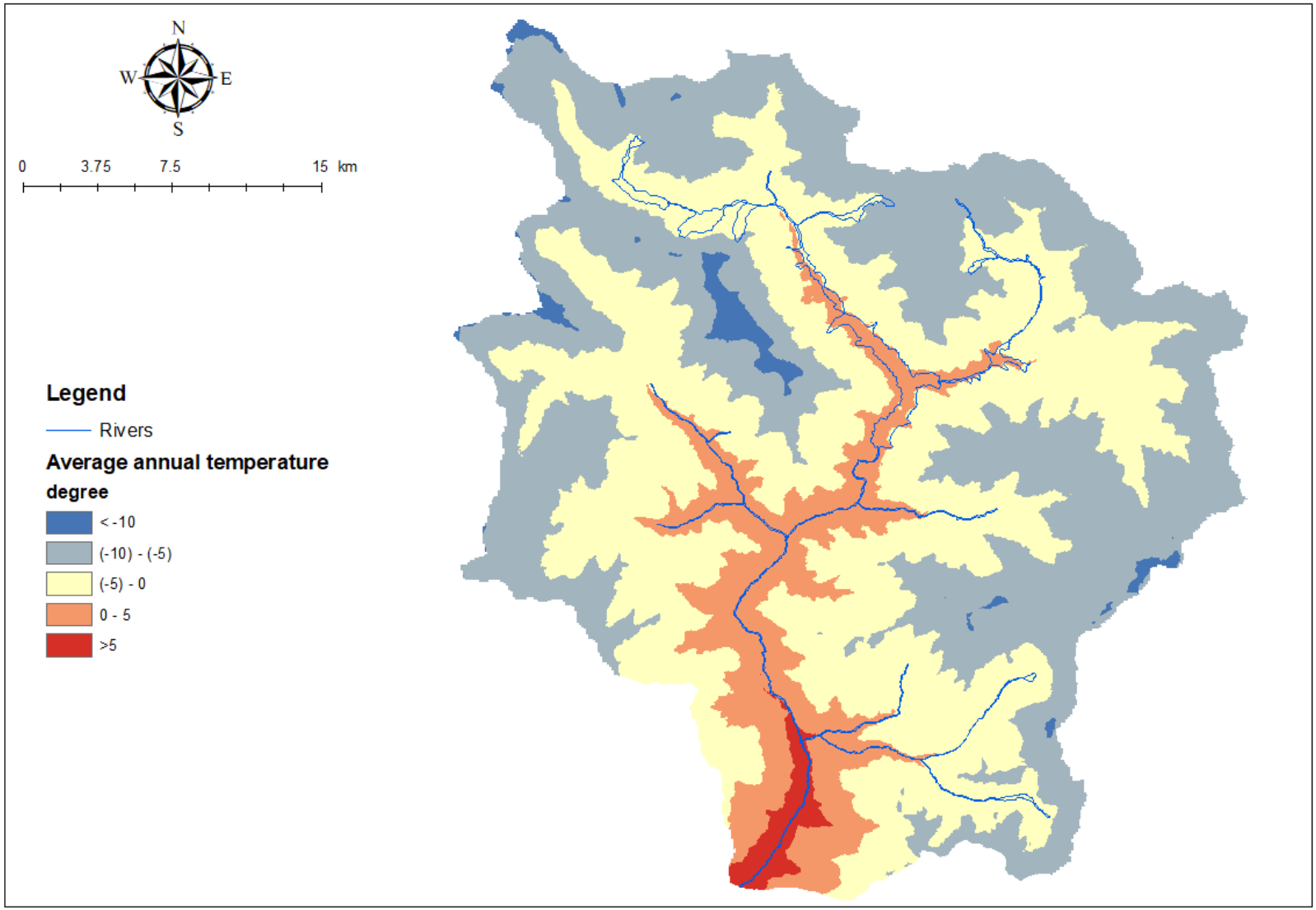

Figure 9: Mean annual temperature (ºC) distribution in Phuksundo-Suligaad watershed

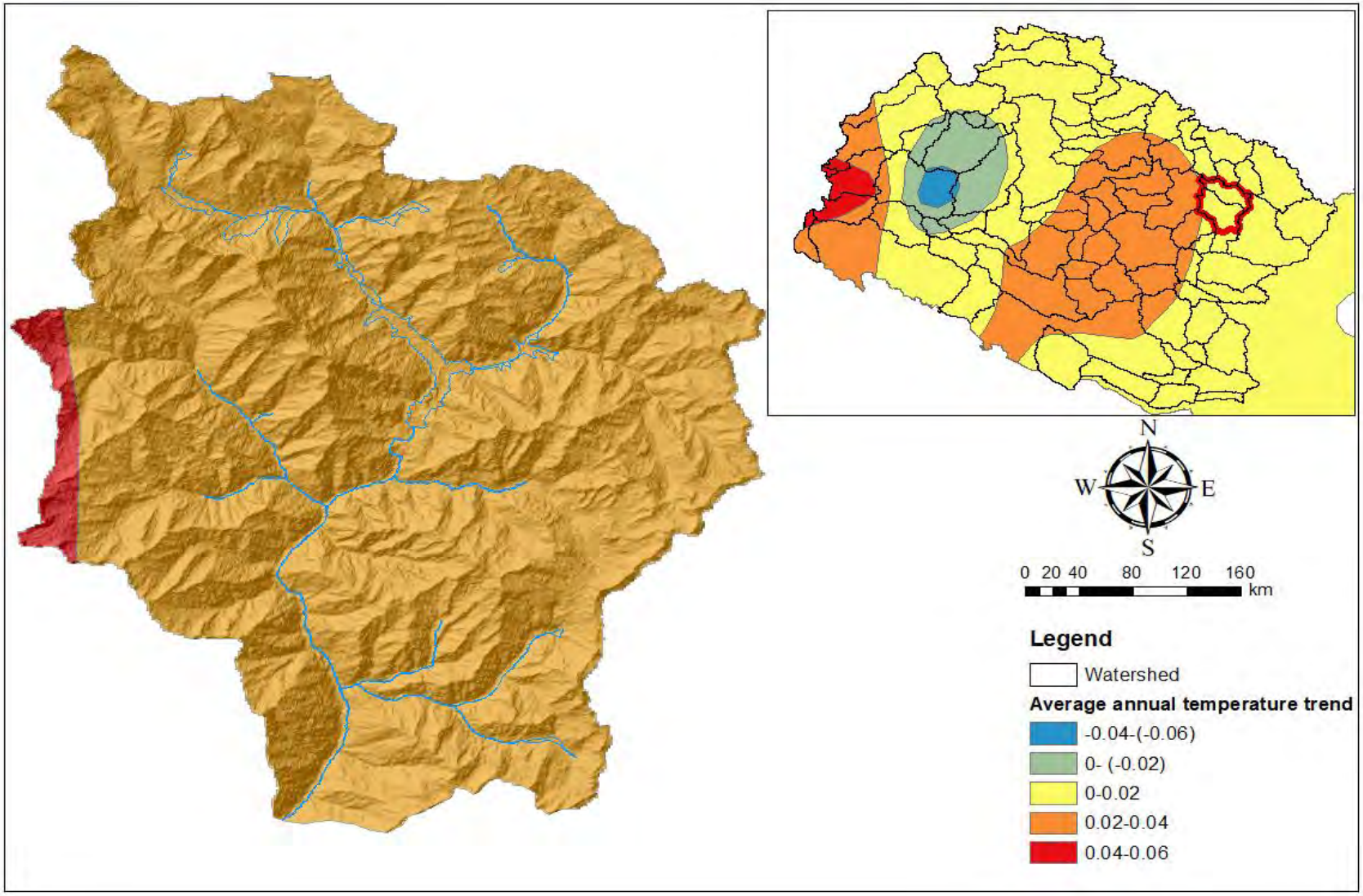

Figure 10: Annual mean temperature change trends in Phuksundo-Suligaad watershed

2.6 CLIMATE RESILIENCE AND DISASTER RISK REDUCTION

Because of the sharp differences in elevation from north to south in the watershed, the Paani team chose to conduct workshops in upstream and downstream locations, separately, to distill the specific climate change threats and adaptation activities prominent in each area. The upstream workshops were held in Pugmo and Rigmo. The downstream workshops were conducted in Rassi, Raha, Kageni, and Pareli.

Upstream climate change impacts and adaptation activities (Pugmo and Rigmo)

In a group discussion format, participants were asked to list and find consensus on the primary changes in weather they had noted over the past decade.

- Temperature patterns are changing. Typically, July and August were the warmest months, but now those temperature are occurring in May and June. Winters appeared to be getting warmer as well.
- Snowfall has decreased in the upstream portion of the watershed. Residents were accustomed to 1.5 m of snow during the winter months, but now snowfall reaches only 0.5 m.
- Cluster rainfall patterns have declined as well as intensity of rainfall.
- The changes in water and snowfall have raised concerns about groundwater recharge, water availability, and the yarshagumba crop.
- Fog and frost events are fewer throughout the year.

The participants were also asked to list and rank climatic hazards in the upstream area. Avalanches and changing rainfall patterns were the top priority, followed by landslides, forest fires and flash flooding. Drought was also cited as a hazard needing greater attention.

In the face of these hazards, residents were asked to describe adaptation practices they had implemented to stave off the effects of climate change. Some of the practices below were also noted by Paani field observations.

Agriculture: Farmers have begun trying new crops that can flourish in the warmer tempeartures, such as radish, apples carrots, cabbage, coriander, and cauliflower. Some farmers suffering pest attacks have begun spraying ash on their crops.

Frustrations with agriculture have convinced some farmers to turn to tourism and yarshagumba collection as alternate income sources. As plantation coincides with yarshagumba collection season, some farmers have decided this is a more lucrative pursuit, and thus overall agriculture production has declined, resulting in higher prices for local produce.

Livestock: The number of livestock per household has declined as labor and fodder have decreased. Young men are going abroad for work, while forest fires and drying water sources have contributed to the lack of fodder.

Downstream climate change impacts and adaptation activities (Rassi, Raha, Kageni, and Pareli)

In a group discussion format, participants were asked to list and find consensus on the primary changes in weather they had noted over the past decade. They observed that:

- Overall temperatures were warmer. Hot days associated with summer begin now in late March, early April and continue to October.
- Precipitation has decreased. While rain in this watershed usually occurs only in the four months of summer, the intensity of downpour has increased, causing flash floods along steep areas of streams.
- Snowfall typically occurs 6-7 months per year but now is limited to only 2 months. Overall amounts of snow have decreased as well: annual 1.5m of snowfall is now only 0.75m.

The participants were also asked to list and rank climatic hazards in the upstream area. Flash flooding and changing rainfall patterns were the top priority, followed by avalanche, landslides and drought. Many of the participants shared stories about the effects of the impacts, including loss of vegetation and livestock. Flooding is especially harmful as the area already struggles to produce enough food for consumption and sale.

In the face of these hazards, residents were asked to describe adaptation practices they had implemented to stave off the effects of climate change. Some of the practices below were also noted in Paani field observations.

Agriculture: As in the upstream area, many farmers are turning to yarshagumba collection because traditional crops (e.g., beans, buckwheat, and potato) have become unreliable and because climatic hazards (i.e., flood and drought) have increased.

Livestock: Owners of livestock have begun moving further upstream in search of more grassland. Pastures in the downstream area have decreased due to fires and drying water sources.

Fish farming: Some residents who have relied on NTFPs from nearby forests have tried fish farming as an alternative income source.

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 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 flood, there is no early warning system (EWS) currently available in the Phoksundo Suligaad watershed. Given the number of anecdotes about land and property loss, an EWS could provide significant benefits.

3. WEALTH

The Phoksundo Suligaad watershed is sparsely populated: only 2,258 people live in 14 settlements across 984 km^2, a population density of 2.3 persons per square kilometer. The population is 51% male and 49% female, living in 508 households. Currently, Brahmin/Chhetri/Thakuri/Sanyasi (BCTS) is the most populous group in the watershed (57%), followed by Janajati (36%), Dalits (6%) and Newar (1%).

Agriculture is the primary occupation in the watershed (92.9%), growing staple crops (e.g., maize, millet, potatoes) and some fruits (e.g., apples). The remaining 7.1% of households cite daily wage labor, poultry farming, and medicinal plant collection as their primary livelihood. Most households round out their income and daily subsistence needs with NTFPs from nearby forests; however, this is only true in the southern portion of the watershed where forests are plentiful. Many of the NTFPs are aromatic and medicinal and can be sold in local and regional markets, or to wholesalers who transport them to urban centers for distribution. Other livelihood options include tourism and animal husbandry. Those households with livestock harvest the milk and wool for sale and employ horses for transport of goods.

Due to the high elevation of this watershed, this occupational ecosystem is fragile and particularly susceptible to changes in climate and environmental conditions. For this reason, some households have routinely practiced internal migration (transhumance), moving north in the warmer months to plant crops, graze livestock and, in more recent years, harvest yarshagumba. As Table 3 illustrates, nearly half the families surveyed in the watershed have cash reserves of less than three months, highlighting the acute vulnerability of households.

Table 3: Amount of reserve income by household in the Phoksundo Suligaad watershed

Income reserve in months	Households	%
Less than 3 months	128	47.60
4-6 months	96	35.92
7-9 months	16	5.83
10-12 months	28	10.68
Total	268	100

Because of the unpredictable nature of crop farming in a warmer climate with changing rainfall patterns, more households are turning to harvest yarshagumba, which has a cascading effect on the state of agriculture. With more people turning now to this alternative source of income, less attention and labor are paid to sustaining and adapting the crops that can grow in the region. Household surveys revealed that yarshagumba is not the only alternative source of livelihood. Some men and women are turning to new occupations to generate additional income, including: service sector, handicrafts, smithing, masonry, and carpentry.

Conferring with local officials of FECOFUN, local residents offered the following ideas for building livelihood resilience into the watershed:

1. Animal husbandry: Focus on improving breeds of mules and goats in the downstream areas, and for yak in the upstream areas. Improved breeding will strengthen the transhumance system of livestock.
2. NTFPs: Strenghten local systems for regulating sustainable harvests of these goods.
3. Tourism: Focus on developing opportunities for tourism, while also maintaining the integrity of the land, Phoksundo Lake, and other natural assets.

GESI issues: In the watershed, women find themselves having to accept more and more responsibility for household support, as men migrate externally for work and climate change renders traditional forms of income generation unreliable. Many women have begun making handicrafts for sale to tourists. The upfront costs to acquire materials, however, does prevent some women from engaging this opportunity. Additionally, handicraft production adds to an already considerable load of managing finances, producing/cooking food, and tending to other family needs (e.g., elders and children). In this environment, finding effective adaptation measures will not only alleviate daily stress but will also provide time (and relief) to women to pursue other types of self-improvement activities.

There are no banks or formal financial institutions in the watershed. A few saving and credit cooperatives are available in Dunai just outside the watershed. Per household survey, 28% of families have accounts with these institutions.

Interviews and field observations yielded few examples of climate-smart technologies in the watershed; however, there is great potential, particularly in regard to slope and terrace improvements with bio-engineered solutions (e.g., gabion boxes). As many residents listed landslides and flooding among their greatest concerns for natural hazards, terrace improvement could help minimize the danger and impact of these events.

Related annexes
Annex 3: Population

3.1 AGRICULTURE PRODUCTIVITY

As described above, agriculture is the primary occupation in the watershed, but various climatic and economic pressures are forcing more households to turn away from crop production and toward tourism and harvesting lucrative NTFPs. Maize, wheat, barley, millet, buckwheat and potato are the main crops, but some farmers are now growing various nuts and fruits (e.g., apples, walnuts, peaches, and damson plums) as a way to cope with long droughts and changing growing conditions. There are nine operating irrigation systems in the watershed, all supported by local irrigation user groups responsible for their operation and maintenance (more details in sections 3.2.4 and 4.2.2)

Accordingly, food security is a major concern for families. Nepal Khadya Suraksh Anugaman Pranali (NeKSAP) ranks Dolpa district as "moderately food insecure" in a national assessment from 2017. This

ranking means most households can meet food needs through traditional coping strategies but cannot afford some essential non-food expenditures.

The District Agricultural Office (DAO) in Dolpa provides some technical support to watershed farmers through trainings and by distributing improved seeds. However, our surveys find this outreach does not engage farmers in the furthest areas of the watershed. In Tripurasundari NP, the DAO is working with farmers to improve terraces and irrigation so as to capitalize on the area's ability to grow potatoes. Similar work is underway in Shey Phoksundo GP to optimize apple production.

Regional markets are available in Dunai and Juphal outside the watershed, but the loack of motorable roads makes it difficult for residents to participate. Handcrafts 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 these exchanges.

There are no seed banks in the watershed.

3.1.1 SOIL MANAGEMENT AND FERTILITY

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.

Of greater concern, again, is the increasing inattention paid to agriculture, as households turn away from crops to other income-generating options. More and more fields are being left barren and overcome by weeds. In fact, 70% of the agricultural land in Rikhe was no longer being used for cultivation. This situation suggests that coming back to agriculture will be more difficult should yarshagumba harvests decline or tourism begin to lag. Furthermore, the increasing incidence of fires, landslides and intense rainfall events will contribute to the degradation of this otherwise cultivable land.

3.2 INFRASTRUCTURE

The design and construction of infrastructure, such as irrigation and hydropower plants, has an impact on the health of the watershed. For example, poorly designed irrigation can increase benefits to one group of farmers while reducing the amount of water available to other farmer populations. 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. 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.

3.2.1 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.

Related annexes

Annex 9: Hydropower

3.2.2 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 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 demand for and extraction of sand, stone and gravel from this area.

Table 4: Material extraction sites in the Phoksundo Suligaad watershed with annual extraction amount limits

SN	River and district	Stone (mt)	Sand (mt)	Gravel (mt)
1	Vyasgad Khola, Dolpa	1,600	6,400	8,000
2	Thuli Bheri, Dolpa	3,500	14,000	17,500
3	Suligaad, Dolpa	1,800	7,200	9,000
4	Ankhe Khola, Dolpa	1,500	6,000	7,500
5	Phoksundo Khola, Dolpa	1,700	6,800	8,500
6	Sumduva Khola, Dolpa	1,400	5,600	7,000

Source: Shey-Phoksundo National Park and Buffer Zone Management Plan, 2018-2022

3.2.3 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 motorable roads. There are 10 facility roads, 6 of which lie within the watershed and total 280 kms. These roads were constructed with support of 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.

Related annexes

Annex 8: Road network in the Phoksundo Suligaad watershed

3.2.4 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 all year round. The remainer of households rely on seasonal irrigation or rainfed agriculture. Water for irrigation comes from either rainfall (86%) or canals that bring water from the river (14%).

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

3.3 SOLID WASTE AND MANAGEMENT

As tourism to SPNP has increased in the past decade, solid waste from hotels and restaurants has become an aggravating source of pollution, in particular for plastics and glass. While hoteliers attempt to compost organic waste, systems are not in place for proper disposal of non-biodegradable materials. Focus group discussions revealed that dumping into the river has increased in recent years.

Incineration of garbage is still the dominant mode of disposal. According to surveys, 48.9% of households burn their waste, while 46.3% use it for composting, 33.2% use local landfills, and 8.2% dispose into nearby waterways.[8] For wastewater, 71% said they re-used water in their kitchen gardens, 50% dispose into sewage systems, 19% use safety tanks, while 9% dump waste water directly into water bodies or open spaces.

Within SPNP, park officials monitor tourists for proper trash disposal and levy fines against offenders. However, they note that there are three areas in which they seek to improve waste management. While tourists are well-informed about designated trash pits in the park, residents (including local hotels) are more likely not to use these areas. Some of this behavior, park officials said, is due to lack of compliance, but others are not aware of the availability of the trash pits. A program is needed to promote understanding for the need for improved sanitation. At higher elevations, open defecation is still an issue due a lack of toilets in some places and a lack of awareness of the issues related to non-toilet use. Finally, the high plains where yarshagumba grows is not equipped to handle the annual influx of people who come to harvest this fungus. As a result, the overall sanitation and health of the area is diminished and could become an acute public health issue if not soon addressed.

Related annexes

Annex 12: Major pollution points in the Phoksundo Suligaad watershed

[8] Figures for this question total higher than 100 because respondents were allowed to give multiple answers.

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 Phoksundo Suligaad watershed. Analysis indicates there is a need to better understand how current institutional arrangements related to, for example, tourism or NTFP harvesting are positioned (or not) to improve resource sustainability and benefit sharing with local populations.

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 Phoksundo Suligaad watershed.

4.1.1 ACCESS TO WATER FOR DOMESTIC AND AGRICULTURAL USE

Drying water sources are a major cause for concern in the Phoksundo Suligaad watershed. While the issue of drying springs is still not perfectly understood, local residents attribute their disappearance to landslides, forest fire, soil erosion, and lack of groundwater recharge.

Phoksundo Lake, the Phoksundo River and its tributaries are primarily snow fed from glaciers nested in the Himalayas. Dwindling snowfall and rainfall amounts in the watershed have gotten the attention of local residents. Focus group discussions revealed that some tributaries (e.g., Upper Sim Khola) are dry many months of year. Female participants noted that formerly perennial springs now issue water only in the wettest months of the year, while others had dried up completely. Reports such as these were echoed in many locations: Ruma, Parilagaun, Rigmo, Chhepka, Pugmo, and Byashgadh. Many respondents noted that the changes in water availability were not anthropogenic, as very little of the land area in the watershed is under cultivation.

In this environment, access to water is a troubling issue. Twenty-two percent reported that they believed access to available water to be 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%)[9]. 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.

The 2015 Constitution of Nepal (Section 57) declared the newly-devised federal system would delegate significant authority to local municipalities, including many related to water resource management and relevant environmental issues. This development could have promise for residents as the government recently declared its intent to provide one tap for each house in Nepal.

Per the recent switch to a federal system of governance in Nepal, several watershed-related district offices will now fall under the jurisdiction of the gaunpalika or nagarpalika. These offices include the District

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

Agriculture Development Office (DADO), the District Livestock Development Office (DLDO), the Women's Development Office (WDO), and the Drinking Water and Sanitation Division Office (SWSDO).

Under the current framework and the new federal system, protected areas (such as SPNP) will continue to be managed centrally by the Federal Department of National Parks and Wildlife Conservation (DNPWC), which is contained in the Ministry of Forest and Enviroment (MoFE). The Department of Forest and Soil Conservation will maintain responsibility for forest and soils in the watershed that fall outside SPNP and its buffer zones.

These new governance responsibilities suggest time is appropriate to work closely with local authorities to develop plans to promote improved watershed health. Figure 1 shows the two new nagarpalikas and two new gaunpalikas that are entirely in the Phoksundo Suligaad watershed. This list below contains the main agencies responsible for water resource management in Phoksundo Suligaad watershed:

- Four local governments: Thulibheri NP, Tripurasundari NP, Kaike GP, and Shey Phoksundo GP
- Irrigation Division, Dolpa
- Water Supply and Sanitation Division, Dolpa
- Shey Phoksundo National Park
- Buffer Zone Management Council
- Buzzer Zone Users Committee
- Federation of Water Users and Sanitation (FEDWASUN)
- Nepal Red Cross Society

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

Section 2.6 listed the various natural hazards that occur in the Phoksundo Suligaad watershed. Of those events, flooding, landslides and avalanches are the greatest concern for their ability to impose immediate and significant loss and damage to life and property.

There is no EWS system currently operating in the watershed, but the value of such a system is easy to appreciate. Additional minutes and hours to prepare for impending disaster could minimize the impact of future disasters.

Residents and local officials in Phoksundo Suligaad noted that an EWS system as employed in other parts of Nepal would not be sufficient in their watershed. Due to the steep slope of rivers, an EWS should include rainfall forecasting so that downstream residents could be informed of even the potential for flood and landslides.

4.1.3 ACCESS AND INCLUSION IN LOCAL NRM PLANNING

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.

In the Phoksundo Suligaad watershed, stakeholders have identified these agencies (Table 5) as critical to addressing natural resource issues:

Table 5: Key offices in Phoksundo Suligaad for addressing natural resource issues

Office	Location	Remarks
Shey Phoksundo National Park (SPNP)	Suligaad, Dolpa	Serves under the Department of National Parks and Wildlife Conservation within the Ministry of Forests and Environment
District Livestock Office (DLO)	Dunai, Dolpa	Fisheries and livestock management
District Agriculture Development Office (DADO)	Dunai, Dolpa	Agriculture crops, horticulture and technical support to farmers, mainly seasonal and off seasonal crop production systems
District Drinking Water and Sewerage Development Office (DWSS)	Dunai, Dolpa	Planning, designing and implementation of water supply (Mainly domestic) and sanitation.
District Forest Office	Dunai, Dolpa	Forest management, sustainable livelihood promotion
Buffer Zone Management Committee (BZMC), Buffer Zone User Groups (BZUG)	Suligaad Deuti BZUC at Suligaad, Devi BZUC at Raha and Phoksundo BZUC at Ringmo	Work with SPNP officials to manage and sustain areas on the periphery of the national park. Apex body of BZCFUGs, planning and implementation of different conservation and sustainable development activities through different groups in their respective areas.
Snow Leopard Conservation Committee (SLCC)	Ringmo, Dolpa	Awareness raising, support in research/monitoring
Phoksundo Lake Management Committee (PLMC)	Ringmo, Dolpa	Phoksundo lake management and conservation, sanitation, eco tourism promotion, coordination and cooperations with different line agencies and fund raising
World Wildlife Fund, Nepal	Kathmandu	Forest and wildlife conservation, livelihoods promotions, support to alternative energy promotions (metal stoves, microhydro) and research
National Lake Conservation Development Committee (NLCDC)	Kathmandu	Support to lake conservation and management
Great Himalayan Trail Consortium	Kathmandu	Foot trail construction, upgrading and maintenance

Red Cross Nepal	Dunai, Dolpa	Disaster and emergency relief, social welfare, health and sanitation
KADURI	Surkhet	Infrastructure development (Foot trail, suspension bridge), micro hydropower
TASHI-D	Saijol, Dolpa	Supports to Tapriza school (infrastructure, hostel management), conservation of cultural heritage, and skill development trainings to women.

Following the federal restructuring of the country, the functions of DADO, DFO, and other government NRM agencies will fall under the jurisdiction of local governments (GP and NP). This new authority vested in local government will enable them to exercise greater focus and energy into freshwater and biodiversity conservation, including the development of infrastructure (e.g., roads, irrigation, and hydropower) as they affect environmental conditions in the watershed.

It is hoped that the new government structure will improve participation in local level planning – processes such as Local Adaptation Plans of Action (LAPA), Community Adaptation Plans of Action (CAPA), 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% aware of LAPA, and only 9% 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).

However, many households feel that membership in these groups is not effective, and, furthermore, that women and persons from marginalized groups are denied meaningful participation, either in the general assembly or leadership positions.

Related annexes
Annex 13: Community forest user groups
Annex 14: Buffer zone user committees

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 polices 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 Phoksundo Suligaad 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, climate-smart technologies can strengthen cropping and livestock systems and promote greater resilience overall.

However, uptake and use of these technologies has been generally slow in the watershed: only 20% of households surveyed said they had adopted a climate-smart technology or practice for their homes and/or work. Among the practices reported and observed were reforestation, drought-resistant crop varieties, water recharge ponds, and gabion boxes to fight soil erosion.

As mentioned in the previous sections, LAPAs and CAPAs provide maps that communities and municipalities can follow to improve their overall ability to cope with climate change impacts. These plans are generally designed at the VDC level, according to the pre-federal form of governance. It is not yet known how GPs and NPs will manage these processes. In the watershed, only Raha VDC at the southern end of the region had a LAPA implemented at the time of this study. No locations had implemented a CAPA.

4.2.2 NATURAL RESOURCE MANAGEMENT (NRM) GROUPS AND ACTIVITIES

As nearly 98% of the watershed falls within SPNP, Buffer Zone groups play a significant role in sustaining natural resources and conserving biodiversity. In particular, Phoksundo Suligaad has three Buffer Zone User Committees (BZUC) and 10 Buffer Zone Community Forest User Groups (BZCFUG). Together, these organizations perform a range of conservation practices dedicated to preserving the environment and the ecosystem services so important to local communities. Some of the practices include plantation, forest fire management, water source protection, soil erosion control, and regular patrolling of forests. SPNP, DADO, DFO, and DSCO all provide support to the user groups in terms of technical assistance and legal guidance.

However, in spite of the presence of these groups, some stakeholders in the watershed feel they operate below optimum capacity. During focus group discussions and key informant interviews, respondents said that training and skill development was needed for community groups in the areas of book keeping, report writing and database management. On the other hand, several community user group members said they did not receive adequate support from SPNP officials for conducting their work.

Proper representation also hampers the effectiveness of user groups. Only 16% of leadership positions in the buffer zone user groups were held by women and/or marginalized groups. This finding suggests that important viewpoints may be considered in devising work plans.

Related annexes

Annex 13: Community forest user groups
Annex 14: Buffer zone userAnnexes committees

4.2.3 COMPLIANCE WITH LAWS AND POLICY PROVISIONS

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 persons 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 NRM groups held a leadership position.

4.3 GOVERNANCE

Governance and its responsiveness to community needs and aspirations offers a 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 their lack of implementation would lead to conflict between communities on issues of fish, forests and water. More specifically, respondents echoed the following concerns:

- Even though local residents revealed a generally solid knowledge of and compliance with existing conservation policies and regulations, there is confusion about the differences in regulations for the national park and the buffer zones. And this confusion is complicated further by different regulations for buffer zones that sit within SPNP and those that sit outside the park boundary. Clarification of these regulations would streamline planning and action for conservation activities. For example, buffer zone residents are entitled to compensation for identifying predators, but the level of evidence needed for this compensation is unclear and disputed.
- A fundamental incongruence between elected local bodies and government staff makes conservation planning difficult. While elected officials have a five-year appointment, government staff have career-long tenure. This difference in tenure fosters different outlooks on planning and implementation of conservation activites. Elected officials want to produce results to satisfy constituents, while government staff take a more conservative approach to making changes in existing policy.
- User groups require capacity building and staff development in book keeping, report writing, and database management. The lack of these skills hampers their effectiveness and discourages stronger participation by members.
- Enforcement of existing regulatioins is lacking, particularly in regard to solid waste management along trails and on the plains where livestock graze and yarshaguma is cultivated.
- Respondents indicated that the government does not have an adequate understanding of the need for transhumance in the watershed and that existing restrictions on moving livestock show reveal this weakness.
- Many residents are confused about how the federal re-structuring of government will appear in terms of agency representation and responsibility. For example, under the current goverance system, SPNP falls under the DNPWC. Will this change under the federal system? What level of authority will be shared with local stakeholders for decisions resource allocation?

Beyond these themes, survey responses indicate that coordination among VDCs, municipalities, districts, and provinces is quite low. Women and marginalized persons are not well represented in the formal and informal institutions and organizations in Phoksundo Suligaad watershed. Similarly, village and municipality level governments planning and budgeting processes (e.g., LAPA, CAPA, WUMP) are neither very transparent nor 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.

Related annexes

Annex 15: Key stakeholders – organizations and offices

5. MAJOR ISSUES AND CHALLENGES

Stakeholders in the Phoksundo Suligaad watershed were asked to list their environmental concerns, particularly in relation to sustainability and livelihoods.

The lists below present weakness and challenges as identified by participants in an exit multi-stakeholder consultation (MSC) workshop. The lists were compiled after the Paani Program team presented its initial major findings about the Phoksundo Suligaad watershed. The workshop participants were selected from a wide range of backgrounds representing local residents, civil society groups, and government agencies.

Weaknesses and threats in the Phoksundo Suligaad watershed:

- Low gender inclusion and social inclusion of marginalized groups in watershed-related groups and planning processes;
- Poor public participation overall in watershed-related planning processes;
- Increased flooding and landslides along the rivers;
- Degradation of water sources along the Phoksundo River from Suligaad to Phoksundo Lake;
- Forest fires impacting biodiversity;
- Decreasing numbers of forest species and wildlife; and
- Degradation of forest health and declining agricultural productivity.

Challenges in the Phoksundo Suligaad watershed:

- Households along the river drain septic tanks directly into the water source;
- Low forest cover in the watershed (6%) and low level of ecosystem services from forests;
- Lack of awareness on the importance of improved watershed management;
- Incongruence between national park and buffer zone policies;
- Declining biodiversity in the watershed due to climate change impacts;
- Increased flooding makes work in the watershed difficult; and
- Poor managmenet of yarshagumba threatens the sustainability of this valuable resource.

6. PRIORITIZING ENVIRONMENTAL THREATS AND OPPORTUNITIES

Based on the data collected for this watershed profile at the same exit MSC described in section 5, residents of the Phoksundo Suligaad watershed identified seven key issues to be addressed in the coming years with regard to improving freshwater management and biodiversity conservation.

1. Drying water sources and shrinking snow cap;
2. Increasing occurrence of floods, landslides and avalanches damanging local infrastructure;
3. Increasing waste management issues associated with increased tourism in the watershed;
4. Declining fish numbers in rivers and Phoksundo Lake;
5. Poor knowledge base about the watershed's aquatic biodiversity;
6. Poor coordination of efforts between SPNP officials and user groups; and
7. Low institutional capacity of government and local organizations to improve governance of natural resources.

Given these seven issues, the participants were then asked to prioritize (using red, yellow or blue) these concerns based on their relationship to nature, wealth, and power – the three factors used to organize this report:

- Nature – the state of the watershed environment and its resources
- Wealth – the socio-economics and infrastructure of the watershed
- Power – how people and groups make decisions about the watershed, including issues of transparency and inclusiveness

These ratings were then used to sort the issues into one of three priority categories, indicating the severity of the problem, as perceived by participants. These rankings are provided here in Table 6.

Table 6: Threats to environmental health and management in the Phoksundo Suligaad watershed

SN	Issue	Nature	Wealth	Power	Priority
1	Low institutional capacity of government and local organizations to improve governance of natural resources				I
2	Increasing occurrence of floods, landslides and avalanches damanging local infrastructure				II
3	Poor knowledge base about watershed's aquatic biodiversity				II
4	Poor coordination of efforts between SPNP officials and user groups				II
5	Increasing waste management issues associated with increased tourism in the watershed				II
6	Declining fish numbers in rivers and Phoksundo Lake				III
7	Drying water sources and shrinking snow cap				III

In light of these priorities emerging from the workshop, the participants were then asked to devise a list of opportunities that these threats presented to the watershed.

1. Space for SPNP and buffer zone groups to combine efforts to improve freshwater biodiversity research and conservation-related activities;
2. Eco-tourism development could generate additional income for the region while also improving waste management;
3. Promotion of citizen-based science would create a much-needed knowledge base of the watershed while cultivating greater awareness for environmental issues;
4. Improved water source conservation;
5. Increased hydropower generation to provide more income-generating opportunities and decrease local work burdens; and
6. Produce more ideas and solutions for addressing proximate environmental challenges.

7. VISION AND MISSION OF PHOKSUNDO SULIGAAD WATERSHED

This Phoksundo Suligaad 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 PHOKSUNDO SULIGAAD WATERSHED

Exit MSC workshop participants were asked to draft a list of ideas and qualities that they would like to see in the future for the watershed. Using these lists, the participants were divided into groups to generate a statement that would encapsulate a collective vision for Phoksundo Suligaad.

After each group shared their vision statements, two representatives from each group were selected to synthesize the various statements into a single, shared version:

"For a healthy Phoksundo Suligaad watershed, supported by sustainable management of natural resoruces and biodiversity, responsible eco-tourism, and improved opportunities for inclusive economic growth."

7.2 COMMITMENTS TO CONSERVING THE PHOKSUNDO SULIGAAD WATERSHED

Following the vision statement exercise, the groups were asked to make commitments to future action based on their individual and/or organizational roles in the community and in relation to biodiversity conservation. These commitments are summarized in table 7.

Table 7: Action commitments for improved freshwater and biodiversity conservation in the Phoksundo Suligaad watershed

1	**Group**	**Dolpa Dalit Empowerment Center**
	Priority issue	Institutional and capacity development of NRM groups for governance
	Action(s)	1. Two day-workshop on awareness raising (at Raha) 2. One-day training on NRM groups and governance (at Parela)
	Expected output (by July 2019)	1. Increased awareness in group members on laws and policy 2. Women's leadership development
	Focal point representative	Kamala BK

2	**Group**	**Shree Bhawani Adharbhut Vidyalaya**
	Priority issue	Declining yields of yarshagumba and sustainable management of this resource
	Action(s)	1. Forest fire control 2. Waste management 3. Regulating harvesting time/duration 4. Implementing awareness raising activity
	Expected output (by July 2019)	1. Forest fire control in Suppakuna area will decrease the mortality rate of larva of yarshagumba (in coordination with Local authority, BZC, SPNP) 2. Coordinate with local authorities for managing waste in habitat areas 3. Coordinate with local authorites regulating harvesting time to maintain regeneration 4. Awareness raising activity will support and enhance to regulate all activities mentioned above for sustainable management of yarhshagumba
	Focal point representative	Raj Kumar BK
3	**Group**	**Ward office, number 8, Shey-Phoksundo GP**
	Priority issue	Institutional and capacity development of NRM groups for governance
	Action(s)	1. Training on institutional capacity development 2. Implementing public auditing/hearings for the activities of all locally based organizations, including ward authority
	Expected output (by July 2019)	1. Improved coordination and governance 2. All users are informed with rules and regulation.
	Focal point	Ward authority with support from Paani
4	**Group**	**Sumse Women Multipurpose Cooperatives, Raha**
	Priority issue	Lack of adaptation plan against the impact of floods, landslides, and avalanche on rural infrastructure
	Action(s)	1. Monitoring activities for impacted and potential impact area in and around Raha (Ward 11)
	Expected output (by July 2019)	1 Monitoring system implemented 2. Initiation of embankment and riverside establishment activities (e.g., gabion boxes)
	Focal point	Ratikanya Rokaya

5	**Group**	**Phoksundo Lake Conservation Committee**
	Priority issue	Lack of proper management of lake and no research on aquatic life of the lake
	Action(s)	1. Establish coordination with local authorities, SPSN and BZC for proper management. 2. Implement lakeside management
	Expected output (by July 2019)	1. Initiate research on aquatic lives in lake in coordination with all relevant organizations. 2. Waste disposal system including toilets and campsite management around lake.
	Focal point	Phonksundo Lake conservation committee with the support from Local authorities, Park and BZC
6	**Group**	**Nepal Red Cross, Dolpa**
	Priority issue	Lack of adaptation plans against the impacts of floods, landslides and avalanche on rural infrastructure
	Action(s)	1. Collection of information on impacted areas
	Expected output (by July 2019)	1. Establishment of natural hazard database
	Focal point	Nepal Red Cross Socitety, Dolpa, with support from Paani
7	**Group**	**Shey Phoksundo GP**
	Priority issue	Declining yarshaguma yields and sustainable management of this resource
	Action(s)	Dialogue with SPNP
	Expected output (by July 2019)	Four separate meetings focusing on 1) local rules and laws and policies, 2) benefit sharing, 3) waste management, and 4) program prioritization.
	Focal point	Padam Budha, Chairperson, Shey Phoksundo BZC
8	**Group**	**Swagat Hotel and Lodge, Shyangta**
	Priority issue	Lack of adaptation plans against the impact of flood, landslides, and avalanche on rural infrastructure
	Action(s)	1. Initiate supervision and study of impacted area 2. Restore damaged or lost infrastructures
	Expected output (by July 2019)	One Community Adaptation Plan of Action (CAPA) prepared and implemented.

	Focal point	Chhyangkhado Lamo
9	**Group**	**Jharana Hotel and Lodge**
	Priority issue	Lack of adaptation plans against the impact of flood, landslides, and avalanche on rural infrastructure
	Action(s)	1. Initiate supervision and study of impacted area from concerned agency 2. Restore damaged or lost infrastructures
	Expected output (by July 2019)	Work initiated for reclaiming damaged/lost cultivated land
	Focal point	Sanchita Lama
10	**Group**	**Pipal Bari Group, Kagani**
	Priority issue	Lack of adaptation plans against the impact of flood, landslides, and avalanche on rural infrastructure
	Action(s)	1. Monitoring activities for impacted and potential impact area around Raha Phakchu Khola: Raha, Kageni)
	Expected output (by July 2019)	1 Monitoring and field study implemented 2. Initiation of embankment and riverside establishment activities (e.g., gabion boxes)
	Focal point	Kausila Ukheda
11	**Group**	**KIRDARC Nepal, Dolpa**
	Priority issue	Waste management
	Action(s)	1. Implementation of awareness raising activities (e.g., meetings, trainings, door to door visits, etc) 2. Management of waste pits in each small village
	Expected output (by July 2019)	1. Youth clubs, mothers' groups, health posts, and health management committees in all GPs and NPs will be involved in awareness raising activities 2. Waste disposal pits wil be developed and managed in Rassi, Raha, Rigmo, Pugmo, Ryanchi, Kagani, and Chhepka.
	Focal point	Om Bahadur Chand
12	**Group**	**KIRDARC Nepal, Dolpa**
	Priority issue	Institutional and capacity development of local NRM groups for governance

	Action(s)	1. Implementation of capacity development activities (trainings, workshops)
	Expected output (by July 2019)	1. CBO capacity will be enhanced and CBOs in Thulibheri NP, Tripurasindari NP, and Shey Phoksundo GP: (ward no 8 and 9) will be formed 2. CBOs will start to contribute to conservation activities 3. Governance and inclusive participation will be enhanced
	Focal point	Om Bahadur Chand
13	**Group**	**Division of Water and Sanitation (DWS), Dolpa**
	Priority issue	Access to drinking water
	Action(s)	To install DWS projects in villages and to increase awareness of sanitation: 1. Awareness programs through local radio and street drama 2. Practical hands-on training to select local people on maintenance of system. 3. Regular monitoring of drinking water schemes (DWS)
	Expected output (by July 2019)	1. FM radio covering all rural municipalities or municipalities and street drama at major locations of GP and NP targeting organizations working in the health and sanitation sector 2. Two people from the users of each schemes 3. Technicians from GPs, NPs, and DWS office will monitor the fitting/lining work, intake and RV constructions, and tap stands construction
	Focal point	1. DWS Sub-division Office, Dolpa 2. DWS Users Committees 3. DWS Sub-division Office and GP/NP
14	**Group**	**Native fish rearing farmers (Nava Raj Mahat)**
	Priority issue	Declining fish numbers in local waterbodies
	Action(s)	Explore training opportunities
	Expected output (by July 2019)	Obtain more knowledge on rearing native fish in ponds, constructing and managing ponds, and upgrading existing ponds.
	Focal point	Nava Raj Mahat with support from SPNP and relevant NGOs and INGOs
15	**Group**	**Women's Empowerment Center**
	Priority issue	Institutional and capacity development of local NRM groups for governance

	Action(s)	1. Awareness raising and information dissemination through media 2. Conduct trainings and workshops on governance 3. Conduct dialogues on equity and justice in NRM
	Expected output (by July 2019)	1. Raised awareness of regulations, laws and policy
	Focal point	Chairpersons and Vice-chairpersons of watershed GPs and NPs
16	**Group**	**FECOFUN, Dolpa**
	Priority issue	Institutional and capacity development of local NRM groups for governance
	Action(s)	1. Interaction meeting to determine how to build the capacity of CFUGs 2. Awareness raising training 3. Observation tour 4. Preparation of operation plans for CFUGs focusing on biodiversity
	Expected output (by July 2019)	1. Full participation of all the members of executive committees will identify way forward 2. Demand/need based training events conducted 3. Demand/need based tours organized for committee members of all CFUGs in GP and NP areas in the watershed
	Focal point	Chairperson and Secretary of FECOFUN, Dolpa
17	**Group**	**SPNP Office, Suligaad**
	Priority issue	Coordination and cooperation between NRM user groups and SPNP
	Action(s)	1. Orientation training on laws and policies relating to SPNP wildlife and conservation of the buffer zone 2. Conduct trainings, interaction workshops and informal classes 3. Relevant message dissemination through radio, hoarding boards and pamphlets.
	Expected output (by July 2019)	1. Sixty needy persons from BZ and park area under WS
	Focal point	Park Office
18	**Group**	**CEDA Nepal, Dolpa**
	Priority issue	Lack of adaptation plan against the impact of floods, landslides, and avalanche on rural infrastructure

	Action(s)	1. Develop plan 2. Identify slide prone areas and build embankment or protection measures as appropriate.
	Expected output (by July 2019)	Raha, Rassi and wards 8 and 9 of Shey Phoksundo GP
	Focal point	Yogendra Budha
19	**Group**	**Devi Buffer Zone Committee**
	Priority issue	Institutional and capacity development of local NRM groups for governance
	Action(s)	Interaction meetings
	Expected output (by July 2019)	Raised awareness among CGUF and BZUC groups about relevant laws and policy
	Focal point	Bichhya Karki, BZMC Chairperson

8. RECOMMENDATIONS

In the executive summary, this profile presented seven primary watershed issues, as developed by various stakeholders in Phoksundo Suligaad. In the exit workshops conducted by the Paani team, stakeholders were given a chance to address the issues by offering recommendations for action. These are presented together in Table 8.

Table 8: Issues and recommendations in the Phoksundo Suligaad watershed

SN	Issues	Recommendations
I	**Low knowledge of conservation-related laws and policies among local organizations**	• Assess the knowledge level of individuals of each group; • Design and implement trainings on conservation-related policy; • Assess local livelihood options, provide support for sustainable livelihood promotion, and link this work with local and regional market places; • Promote cooperatives to improve financial management of local conservation groups, and all residents; and • Encourage formation of conservation groups to build local response to environmental challenges.
II	**Floods and landslides**	• Provide training and support for low-cost slope stabilization techniques (e.g., gabion boxes); • Provide improved support to control water runoff; • Raise awareness about forest fires and open grazing, and how these phenomena relate to other natural hazards; • Strengthen the early warning system of the watershed to allow increased response time to impending disaster; • Disseminate information through print and radio about best practices for watershed management; • Improve the implementation of Disaster Preparedness and Response Plans (DPRP); and • Promote cooperative maintenance of foot trails in the watershed.
III	**Low levels of evidence-based research available related to local biodiversity**	• Increase biodiversity research for the watershed and bathymetry of Phoksundo Lake, and encourage local participation in these efforts; • Build management capacity in the Phoksundo Lake Management Committee; and • Prepare a Phoksundo Lake Management Plan.
IV	**Low coordination and planning integration**	• Establish regular coordination meetings between SPNP management, BZMCs and BZUCs;

	between National Park and Natural Resource Management organizations (e.g., user groups)	• Build capacity of buffer zone organizations on SPNP rules and regulations; • Provide trainings to buffer zone organizations on proper book keeping; • Promote team building exercises for SPNP, BZMCs and BZUCs; and • Provide trainings for all groups on report writing.
V	**Waste management**	• 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; • Increase water quality monitoring of the Phoksundo River and tributaries; • Promote improved waste management programs specifically for hotel and restaurant managers; and • Develop waste management plan tailored to the unique context where yarshagumba is harvested.
VI	**Decreasing fish numbers**	• Promote research on fish diversity and fish population dynamics; • Promote local awareness on the importance of aquatic biodiversity conservation; and • Encourage natural fish farming as an alternative livelihood option.
VII	**Drying water sources**	• Promote re-forestation on barren land for water retention; • Construct water recharge ponds; • Promote rainwater harvesting by household; • Coordinate workshops to educate local residents about the value of soil erosion control and means for avoiding water conflict; • Implement climate-smart agricultural practices where appropriate; • Prepare local adaptation plans (CAPA and LAPA) to support adaptation measure throughout the watershed.

In addition, workshop participants also generated a separate list of gender-specifc recommendations for the watershed:

- Form women's savings groups to promote financial literacy and build management capacity;
- Promote local enterprise development (esp. handicrafts) for women to benefit from rising tourism;
- Appoint women to the Northern Mountain Conservation Project scholarship committee to ensure fair representation of girls in the nomination process;
- Provide leadership and advocacy training to women involved in BZUCs
- Support installation of small irrigation schemes to alleviate women's work burdens; and
- Provide technical trainings to women on the topics of solid waste management, early warning systems, and hydropower development.

WORKS CONSULTED

Anderson, Jon, Mike Colby, Mike McGahuey, and Shreya Mehta. "Nature, wealth and power: leveraging natural and social capital for resilient development." Washington, DC: USAID (2013). https://rmportal.net/library/content/nwp-2.0

Government of Nepal. Country Report on the State of Forest Genetic Resources. Kathmandu: Ministry of Forests and Soil Conservation, 2013. http://www.apforgen.org/fileadmin/user_upload/publications/SOW_country_reports/Nepal.pdf

Government of Nepal. Local Body Financial Administration Rules, 2064. Kathmandu: Government of Nepal, 2007. http://nepalpolicynet.com/images/documents/localdevelopment/regulations/Local%20Body%20Financial%20Administration%20Rules,%202064%20(2007).pdf

Government of Nepal. Local Body Resource Mobilization and Management Procedures, 2069. Kathmandu: Government of Nepal, 2009. http://lbfc.gov.np/content/local-body-resource-mobilization-and-management-procedures-2069

Government of Nepal. Local Self-Governance Act, 2055. Kathmandu: Government of Nepal, 1999. http://www.np.undp.org/content/dam/nepal/docs/reports/governance/UNDP_NP_Local%20Self-Governance%20Act%201999,%20MoLJ,HMG.pdf

Government of Nepal. National Adaptation Programme of Action. Kathmandu: Ministry of Environment, 2010. https://unfccc.int/resource/docs/napa/npl01.pdf

Government of Nepal. National Disaster Response Framework. Kathmandu: Government of Nepal, 2013. http://www.ifrc.org/docs/IDRL/2011%20National%20Disaster%20Response%20Framework%20(unofficial%20translation%20).pdf

Government of Nepal. Rural Energy Policy, 2006. Kathmandu: Ministry of the Environment, 2006. http://www.aepc.gov.np/files/20130818051011_RE-Policy-2006_english.pdf

Government of Nepal. Statistical Pocket Book Nepal. Kathmandu: Central Bureau of Statistics, 2010. http://cbs.gov.np/publications/statisticalpocketbooknepal_2010

Karki, K. B., and A. K. Rai. "Observation on the effectiveness of some local plants used as fish poison." Proc. First Nation. Sci. Tech. Cong (1982): 270-273.

Marahatta, Suresh, Bhawani S. Dangol, and Gehendra B. Gurung. Temporal and spatial variability of climate change over Nepal, 1976-2005. Practical Action Nepal Office, 2009.

McCarthy, James J., Osvaldo F. Canziani, Neil A. Leary, David J. Dokken, and Kasey S. White, eds. Climate change 2001: impacts, adaptation, and vulnerability: contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change. Vol. 2. Cambridge University Press, 2001.

Nepal Climate Vulnerability Study Team. "Vulnerability through the eyes of the vulnerable: climate change induced uncertainties and Nepal's development predicaments." Institute for Social and Environmental Transition-Nepal (2009).

Neupane, B. and S. Paudel. Socio-economic study of fishers community of River Seti-West. Kathmandu: Nepal Electricity Authority, 1999.

Pradhan, G. B. N., and S. B. Shrestha. "Status of fisheries and aquaculture development and their potential for expansion in Nepal." In Proceeding of National Symposium on Role of Fisheries and Aquaculture in the Economic Development of Rural Nepal, NEFIS, Kathmandu, pp. 15-16. 1996.

Sajhedari Bikaas. Rapid Assessment Report on the Community Development Infrastructure in Eight Districts of Mid- and Far-western Nepal. Kathmandu: Nepal Participatory Action Network, 2013.

Shah, R. K. "Energy Mapping Using GIS and Hydropower Model in Koshi, Narayani, Bagmati and Kankai Basin." PhD diss., M. Sc. Thesis, 2009.

Sharma, Chhatra M. "Freshwater fishes, fisheries, and habitat prospects of Nepal." Aquatic Ecosystem Health & Management 11, no. 3 (2008): 289-297.

Shrestha, J. Enumeration of the Fishes of Nepal. Euroconsult, 1995.

Shrestha, Jiwan. "Coldwater fish and fisheries in Nepal." Fish and fisheries at higher altitudes. Asia. FAO Fish. Tech. Pap 385 (1999): 13-40.

Shrestha, T. K. "Studies on the resource biology and ecology of freshwater of Kathmandu Valley with particular reference to fish production, management, marketing and conservation." Research Project, Research division TU, Kathmandu, Nepal (1979): 267-278.

Smith, Brian Douglas, Bishnu Bhandari, and Kumar Sapkota. "Aquatic biodiversity in the Karnali and Narayani river basins-Nepal." (1996).

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 Phoksundo Suligaad 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 Phoksundo Suligaad watershed's stakeholders on the current and future situation;
- 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 Phoksundo Suligaad area where the USAID Paani Program and other projects can provide support; and
- Providing a platform for consultation and advocacy for Phoksundo Suligaad 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-stakeholder consultation [MSC] was conducted to

    a) Share preliminary results of watershed conditions;

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

    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 significance values 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 and cross cutting areas were used while conducting surveys including governance, gender and social inclusion, and policy.

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

All total 286 HHs surveys were conducted in locations selected during the entry MSC as participants indicated specific issues and challenges appropriate to their respective areas.

To complement the surveys, we conducted 8 FGDs and16 KIIs to investigate the key issues identified by households. Citizen scientists were mobilized for water quality testing and discharge measurement.

They conducted water quality testing one time in the dry season in May 2018, including testing of ph value, iron, nitrogen nitrite, nitrite nitrate, ammonia, phosphate, conductivity, turbidity, dissolved oxygen, temperature and discharge of water. Paani used different tools and methods for testing water quality and discharge. Paani used the AKVO flow application for testing water quality. For this purpose, Paani trained the citizen scientists and mobilized them to conduct the tests.

Figures and tables in this section

Table 9: Household (HH) surveys by topic and number conducted

Group	Number of surveys
BCTS	141
Dalit	16
Janajati	111
	268
Male	181
Female	87

Annex 2: Population

Table 10: Major settlements in the Phoksundo Suligaad watershed, including numbers of households and primary ethnicity

SN	Name	# of HH	Location	Major caste or ethnic group
1	Ringmo Village	60	Shey Phoksundo GP	Lama, Gurung
2	Chhekpa	10	Shey Phoksundo GP	Lama and Gurung
3	Ryanchi	12	Shey Phoksundo GP	Gurung
4	Rikhe	15	Shey Phoksundo GP	Lama, Gurung
5	Chunuwar/Saijol	12	Shey Phoksundo GP	Gurung, Magar
6	Pugmo, Kunasa	45	Shey Phoksundo GP	Lama, Gurung
7	Suligaad	10	Thulibheri NP	Magar and Chhetri
10	Parila Gaun	30	Thulibheri NP	Magar and Chhetri
8	Raha Village	150	Thulibheri NP	Chhetri and Dalit
9	Syangta	2	Thulibheri NP	Janajati
11	Khalrupi	12	Thulibheri NP	Magar
12	Kagani	15	Thulibheri NP	Chhetri and Magar
13	Gumba Gaun	30	Tripurasundari NP	Lama
14	Rassi	105	Tripurasundari NP	Magar
	Total	**508**		

Table 11: Population by municipality, sex, and caste/ethnicity

Name	Male	Female	Total	Janajati – Hill	Janajati – Terai	BCT	Dalit	Newar	Total
Shey Phoksundo GP	274	276	550	532	6	12	0	0	550
Thuli Bheri NP	442	396	838	0	3	815	20	1	838
Tripurasundari NP	442	428	870	408	0	320	121	21	870
Total	**1,158**	**1,100**	**2,258**	**940**	**9**	**1,147**	**141**	**22**	**2,258**

Annex 3: Temperature and precipitation

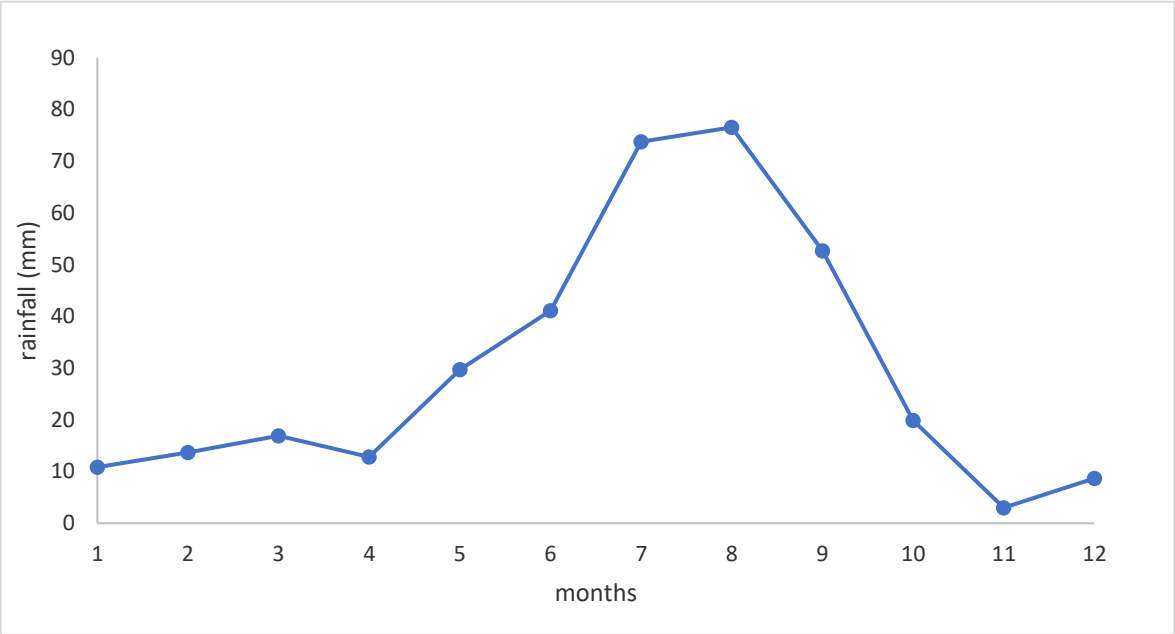

Figure 11: Long-term average monthly rainfall (in mm) measured at Dunai (312) rain gauge station

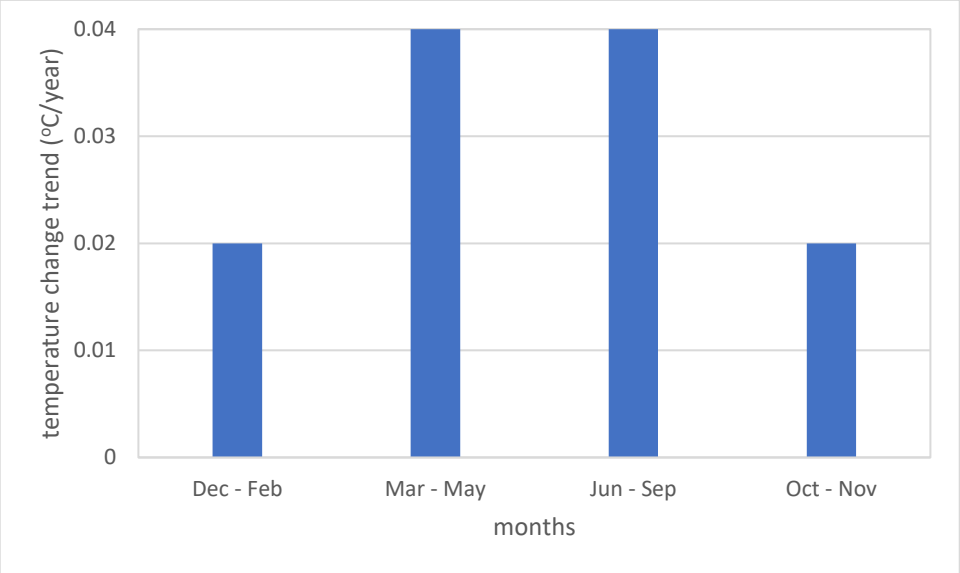

Figure 12: Seasonal temperature change trend (°C/year) observed in Phuksundo Suligaad watershe

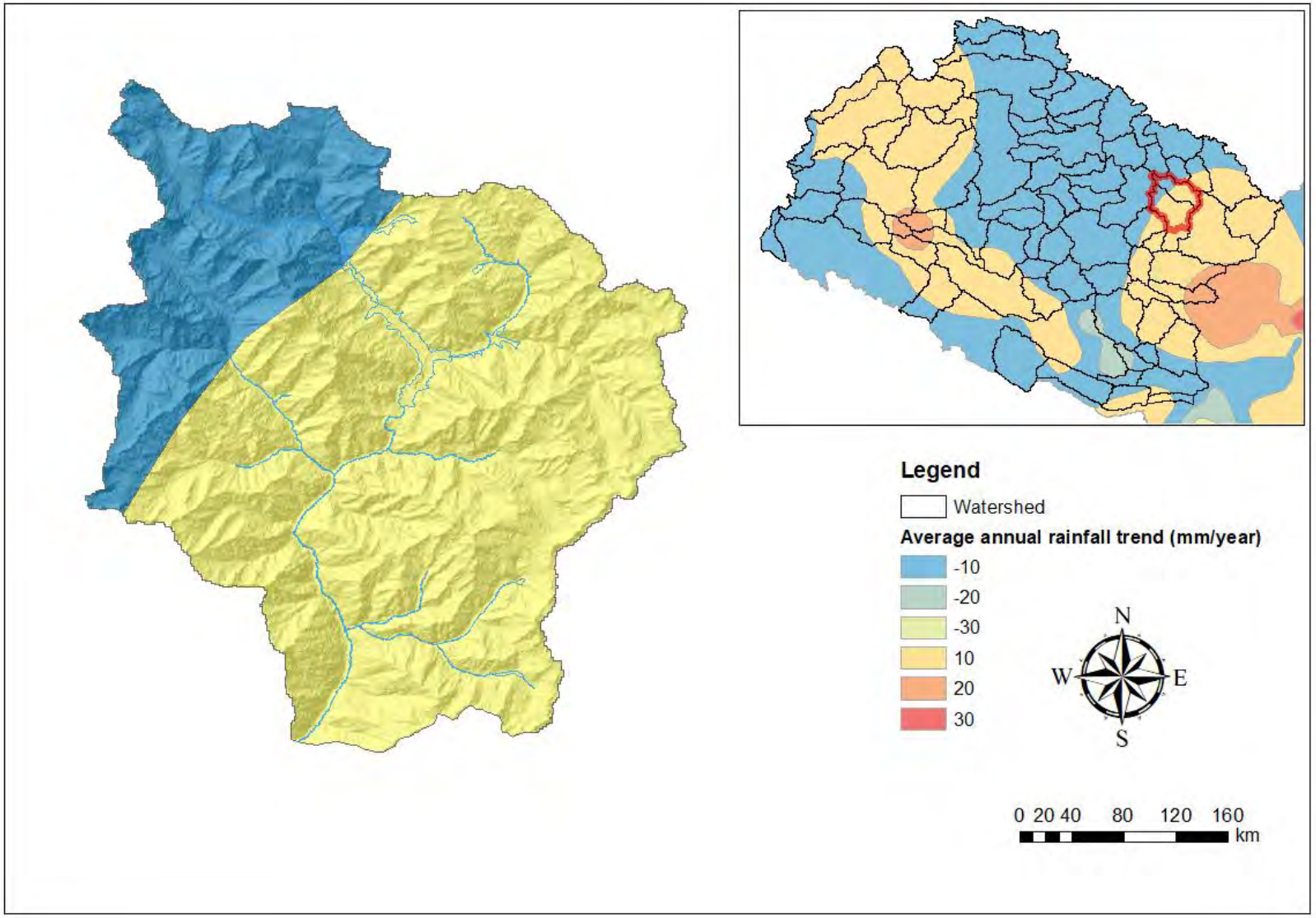

Figure 13: Long-term annual mean rainfall trend (mm/year) observed in Phuksundo Suligaad watershed

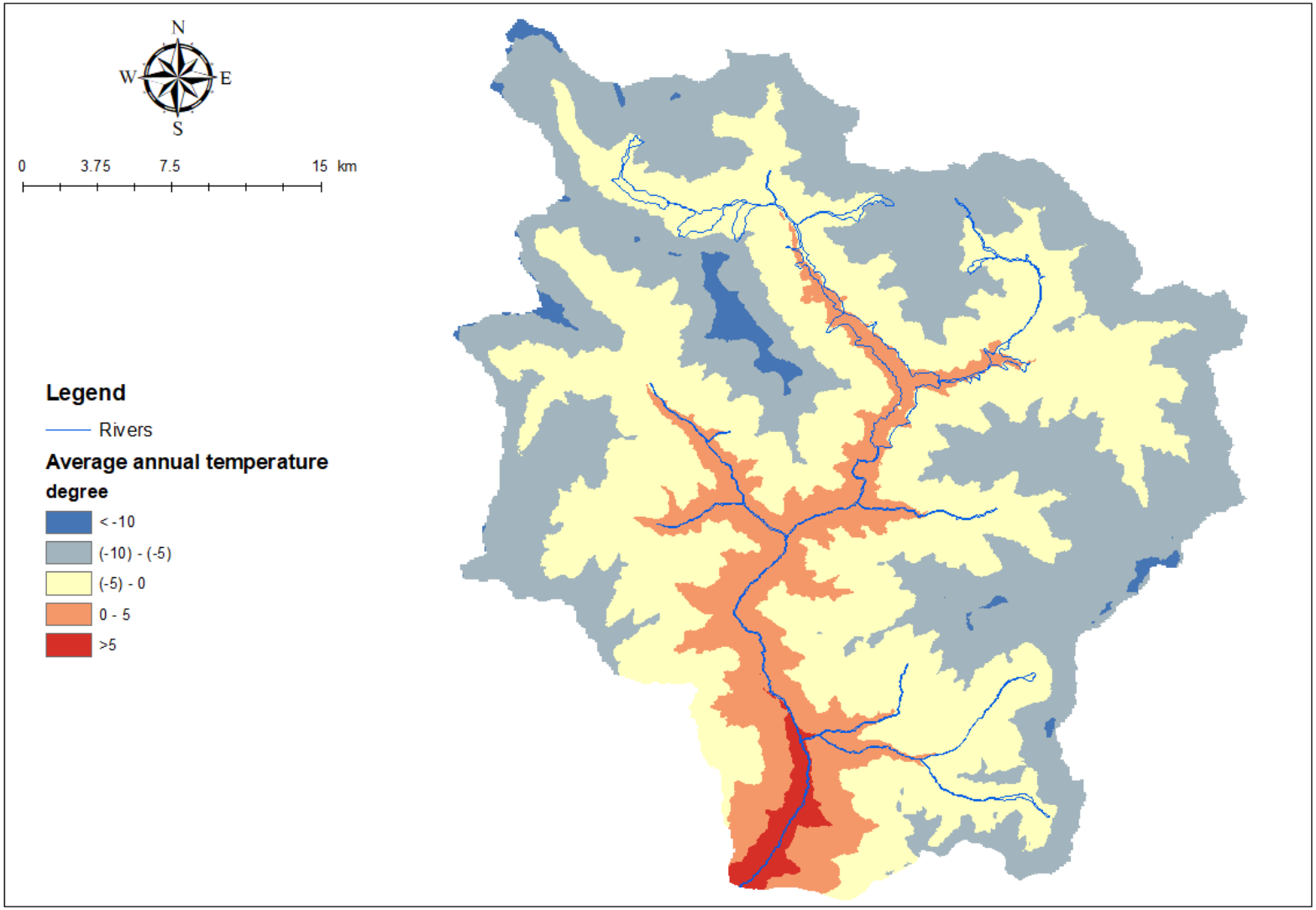

Figure 14: Mean annual temperature (°C) distribution in Phuksundo Suligaad watershed

Annex 4: Lakes, streams, rivers, and sub-watersheds

Table 12: Lakes, ponds and waterfalls in the Phoksundo Suligaad watershed

SN	Name	NP or GP	Location	Area (ha)
1	Phoksundo Lake	Shey Phoksundo GP	Ringmo	494
2	Phoksundo Waterfall	Shey Phoksundo GP	Ringmo	NA
3	Chhonakyo (Black Lake)	Shey Phoksundo GP	Pugmo	NA
4	Chhokarpu (White Lake)	Shey Phoksundo GP	Pugmo	NA
5	Chhononyo (Blue Lake)	Shey Phoksundo GP	Pugmo	NA
6	Chholukhal Lake	Shey Phoksundo GP	Pugmo	NA
7	Tangalanga Lake	Shey Phoksundo GP	Kunasa	NA
8	Chhokarpu (White Lake)	Shey Phoksundo GP	Perikapuwa	NA
9	Chhamkuni Lake	Thulibheri NP	Parila	NA
10	Gyalbara Lake	Thulibheri NP	Raha	NA
11	Majhban Bhimchaur	Thulibheri NP	Raha	NA
12	Mate Lake	Thulibheri NP	Raha	NA
13	Simeni Raithana	Thulibheri NP	Raha	NA
14	Tauti Waterfall	Thulibheri NP	Raha	NA
15	Rato Panera Dabuchaina	Thulibheri NP	Raha	NA
16	Sano Khola Rela Waterfall	Thulibheri NP	Raha	NA
17	Parba Raman	Thulibheri NP	Raha	NA

Annex 5: Forest types and composition

Table 13: Forest cover and type in the Phoksundo Suligaad watershed

Forest Type	Area (km²)	% area
Mixed hardwood	12.94	22
Pine	8.57	15
Banjh oak (Quercus)	2.12	4
Himalayan fir (Abies)	1.26	2
Deodar cedar	0.26	0
Uttis	30.81	53
Spruce	2.3	4
Total area	**58.25**	**100**

Table 14: List of endemic plants identified in the Phoksundo Suligaad watershed

English	Nepali	Scientific name
None	Ponkar	Aconitum navicular
Wild daisy	None	Aster netalensis
None	None	Carex hemineuros
None	Unknown	Clematis phlebantha
None	None	Corydalis alburyi
None	None	Ermaniopsis pumila
None	None	Fagopyrum magacarpum
None	None	Impatiens williamsii
None	None	Nepeta stationii
None	None	Pedicularis sectifolia
None	None	Primula sharmae
None	None	Saussure chrysotricha
Queen's root	None	Stillingia linearifolia
None	None	Saussurea platyphyllaria
None	None	Saxirfaga nigra

None	None	S. neopropaquulifera
None	None	S. rhodopetala
None	None	Sedum nepalaicum

Table 15: List of important medicinal plants in the Phoksundo Suligaad watershed

Species	Parts used	Comments
Aconitum spicatum	Rhizome	None
Arnebia benthamii	Root	Maximum harvest rates need to be established. Assess if harvesting part of the root kills the plant; monitor population size.
Corallodiscus lanuginosus	Flower, leaf	Care should be taken to harvest; preferably with scissors; rare plant in Dolpo..
Corydalis cashmeriana	Flower, leaf	Care should be taken when harvesting; established fixed transect in Talgera to monitor population changes.
Corydalis megacalyx	Flower, leaf	Care should be taken when harvesting; established fixed transect in Talgera to monitor population changes.
Dactylorhiza hatagirea	Rhizome	Monitor the population for potential overharvesting to satisfy consumer demand
Delphinium brunonianum	Flower, leaf	Monitor the population for overharvesting; confirm and record the amount of plants harvested and the parts used.
Delphinium caeruleum	Flower, leaves	No major concerns at present.
Dracocephalum tanguticum	Stem, leaves, flower	Confirm species population; establish if other local populations exist; establish amount harvested annually.
Gentiana robusta	Flower, leaf	The scattered local population around Rigmo should be monitored for population reduction, if possible.
Gentianella paludosa	Flower, leaf, seed	Only found in Upper Dolpo; recommended that monitoring of this species be implemented.

Halenia elliptica	Flower, leaf, stem	Small population in SPNP. Not clear if this species is monocarpic or polycarpic. Proper field surveys are needed.
Incarvillea mairei	Flower, leaf	Record all local populations and leave sufficient flowers for seed setting.
Lagotis kunawurensis	Flower, leaf	Local stock appears healthy. Amchis (local Tibetan healers) should monitor for proper harvesting.
Meconopsis grandis	Flower, leaf	No comments.
Meconopsis horridula	Flower, leaf	Establish and record all harvested populations and keep records on flowering and fruiting in different years.
Megacarpea polyandra	Leaf	Monitor one or two local populations for impacts. Harvesting should not damage the floral shoot. Anecdotal evidence suggests that harvesting encourages vigorous resprouting.
Nardostachys grandiflora	Rhizome	Monitor for commercial trade. Carefully select and harvest the rhizome to avoid killing the genet.
Neopicrorhiza scrophulariiflora	Rhizome	Monitor for commercial harvest within SPNP. Provide training to lay people in sustainable harvesting methods and replantation.
Podophyllum hexandrum	Fruit	Monitor for commercial harvest within SPNP. Only fruits are harvested by Amchis, therefore plant remains mostly intact.
Primula buryana	Flower	Although large numbers of flowers are required to collect a single kg, there seems to be no major concern as long as each local population is harvested selectively.
Rheum australe	Rhizome	Harvest main populations in three-year rotation. Monitor the harvest in SPNP.
Soroseris hookerana	Flower	Confirm main harvesting areas and how harvesting periods coordinate with grazing schedules.

Annex 6: Mammals in the Phoksundo Suligaad watershed

Table 16: List of mammals found in the Shey Phoksundo watershed, including status and distribution range

Scientific name	English	Nepali	Status	Distribution range
Bos grunniens	Wild yak	Jungali chaurigai	Rare	Nepal-Tibetan border
Capricornis sumatraensis	Serow		Common	Below 3,300m
Gazella gazelle	Mountain gazelle	Tibbati gajal	Rare	Nepal-Tibetan border
Hemitragus jemlahicus	Himalayan tahr	Jharal	Common	Below 3,800m near Toijam
Moschus chrysogaster	Alpine musk deer	Kasturi Mriga	Protected	Below 3,000m in Lower Dolpa
Nemorhaedus goral	Goral	Ghoral	Common	Nepal-Tibetan border
Ovis ammon	Argali	Argali/Nayan	Rare	Nepal-Tibetan border
Pantholops hodgsoni	Tibetan antelope	Chiru	Rare	Above 3,200m in Upper Dolpa
Pseudois nayaur	Himalyan blue sheep	Naur	Common	Below 4,000m
Sus scrofa	Wild boar	Bandel	Common	Below 3,000m in Lower Dolpa
Canis aureus	Jackal	Syal	Common	Upper and Lower Dolpo
Canis lupus	Grey wolf	Bwanso	Protected	Above 3,000m in Pugmo, Palam
Cuon alpinus	Dhole (or wild dog)	Ban Kukur	Common	Above 2,100m near Toijam, Rike, Rigmo
Felis chaus	Jungle cat	Ban Biralo	Common	Below 3,800m
Herpestes edwardsii	Indian gray mongoose	Nyauri Muso	Common	Pugmo
Martes flavigula	Yellow-throated marten	Malsapro	Common	Below 3,500m
Mustela sibirica	Siberian weasel	Malsapro	Common	Saldang
Panthera pardus	Leopard	Chituwa	Common	Below 3,200m near Sumduwa, Pahada, Khaliban

Panthera uncia	Snow leopard	Hiu chituwa	Protected	Above 3,200m; Upper Dolpa
Selenarctos thibetanus	Asian black bear	Himali Kalo Bhalu	Common	Below 2,800m near Pahada, Khaliban, Kaigaun
Vulpes vulpes	Red fox	Phyauro	Common	Below 5,300m
Cynopterus sphinx	Greater short-nosed fruit bat	Chamero	Common	Toijam, Kagmara
Lepus oiostolus	Wooly hare	Hiu Kharayo	Rare	Above 4,000m in Upper Dolpa
Ochtona roylei	Royle's pika	Muse Kharayo	Common	Upper Dolpa
Ochotona spp.	Pika	Muse Kharayo Prajati	Common	Above 3,000m
Equus kiang	Tibetan wild ass	Jungali Gadha	Common	Nepal-Tibetan Border
Macca mulatta	Rhesus macaque	Bandar	Common	Below 2,400m near Ralli
Presbytis entellus	Northern plains gray langur	Dhendu Bandar	Common	Below 2,600m in Lower Dolpa
Hystria Indica	Asian porcupine	Dumsi	Common	Below 2,900m near Kaigaun, Toijam
Marmota bobak	Himalayan marmot	Phyau Muso	C/III	Above 2,800m ; Singthupra, Sagarla
Petaurista petaurista	Red giant flying squirrel	Lokharke	Common	Lower Dolpa
Rattus rattus	Black rat	Muso	Common	Throughout the watershed

Table 17: List of protected animals found in Shey Phoksundo National Park and surrounding buffer zones

SN	Scientific Name	English	Nepali	Locations
1	Uncia uncia	Snow leopard	Hiu Chituwa	Above 3,200m in Upper Dolpa
2	Moschus chrysogaster	Musk deer	Kasturi Mriga	Below 3,000m in Lower Dolpa
3	Ailurus fulgens	Red panda	Habre	Toijam, Kaigaun
4	Ovis ammon	Tibetan sheep	Nayan	Nepal-Tibetan border
5	Pantholops hodgsoni	Tibetan antelope	Chiru	Above 3200m in Upper Dolpa
6	Canis lupus	Tibetan wolf	Bwanso	Above 3,000m in Pugmo, Palam, Pufu
7	Felis lynx	Lynx	Links	Renchi, Toijam
8	Felis bengalensis	Leopard cat	Chari Bagh	Chhepka, Sangta, Toijam
9	Bos gruniens	Wild yak	Chauri Gai	Nepal-Tibetan border
10	Manis crassicaudata	Chinese pangolin	Salak	Chaurikot, Chhanchu
11	Lophophorus impejanus	Himalayan monal	Danphe	Baksha, Pugmo
12	Tragopan satyra	Crimson horned pheasant	Munal	Chaurikot, Renchi
13	Catreus wallichii	Cheer pheasant	Cheer Kalij	Dagina, Chaurifarm, Palam

Annex 7: Birds in the Phoksundo Suligaad watershed

Table 18: List of bird species found in the Phoksundo Suligaad watershed, including status and distribution range

Scientific name	Common	Status	Distribution range
Family: Acciptridae			
Accipiter nisus	Eurasian sparrowhawk	Common	3000-4000m
Accipiter gentilis	Northern goshawk	Common	3300-4200m
Aquila chrysaetos	Golden eagle	Common	Pahada, Khaliban, Kaigaun, Saldang 3500-4700m
Aquila nipalensis	Steepe eagle	Rare	
Aquila rapax	Tawny eagle	Rare	3200-4900m
Buteo buteo	Common buzzard	Rare	3000-4800m
Buteo hemilasius	Upland buzzard	Common	Suligaad, Ralli, Madhu
Circus cyaneus	Hen harrier	Common	Pericapuwa, Suligaad, Ralli, Madhu
Gypaetus barbatus	Lammergeier	Rare	Throughout
Gyps himalayensis	Himalayan griffon	Common	Throughout
Hieraatus pennatus	Booted eagle	-	-
Milvus migrans	Black kite	Rare	Palam
Neophron percnopterus	Egyptian vulture	Common	Suligaad, Palam
Family: Aegithalidae			
Aegithalos niveogularis	White-throated tit	Rare	3000-3600m
Aegithalos concinnus	Black-throated tit	-	Toijam, Rigmo
Family alaudidae	Family alaudidae	-	-
Alauda gulgula	Oriental skylark	Common	Toijam 3600-3800m
Calandrella acutirostris	Hume's short-toed lark	-	-
Calandrella brachydactyla	Greater short-toed lark	Rare	-

Eremophila alpestris	Horned lark	Common	4700-4800m near Chhoilapu, Chhoregaun, Singthupra, Sagar
Family: Anatidae			
Anas penelope	Eurasian wigeon	Common	Palam
Anser indicus	Bar-headed goose	Rare	-
Aytha fuligula	Tufted duck	Common	Rigmo
Rhodonessa rufina	Red-crested pochard	Common	Rigmo
Tadona ferruginea	Ruddy shelduck	Common	Rigmo, Chhoilapu
Family: Apodidae			
Apus apus	Common swift	Rare	4500-4800m near Perikapuwa, Toijam
Tachymarptis melba	Alpine swift	Common	-
Apus pacificus	Fork-tailed swift	Common	Perikapuwa, Campkapuwa, Larcha
Collocalia brevirostris	Himalayan swiftlet	Common	Tiojam, Campkapuwa, Larcha, Chhoregaun, Dhekuthang
Family: Caprimulgidae			
Caprimulgus macrurus	Large-tailed nightjar	-	-
Family: Certhiidae			
Subfamily certhiinae	Subfamily certhiinae	-	-
Certhia himalayana	Bar-tailed treecreeper	Common	2900-3300m near Palam
Certhia familiaris	Eurasian treecreeper	Rare	3000-3400m near Pugmo and Chaurifarm
Subfamily: Troglodytinae			
Troglodytes troglodytes	Winter wren	Common	2900-4300m near Palam, Campkapuwa, Shey
Family: Charadriidae			
Subfamily: Recurvirostrinae			
Ibidorhyncha struthersii	Ibisbill	-	-

Family: Cinclidae			
Cinclus cinclus	White-throated Dipper	Common	Saldang
C. pallasii	Brown Dipper	Common	Ankhe-Palam; 2600-3800m
Family: Cisticolidae			
Prinia criniger	Striated prinia	Common	Campkapuwa
Family: Columbidae			
Columba livia	Rock pigeon	Common	Throughout
Columba rupestris	Hill pigeon	Common	Throughout
Columba hodgsonii	Speckeled wood pigeon	Common	Ankhe, Palam
Columba leuconota	Snow pigeon	Common	Throughout
Streptopelia chinensis	Spotted dove	Common	Throughout
Streptopelia orientalis	Oriental turtle dove	Common	Throughout
Family: Corvidae			
Subfamily: Corvinae			
Tribe corvini	Tribe corvini	-	-
Corvus corax	Common raven	Common	4800m near Palam (seasonal) and Saldang
Corvus macrorhynchos	Large-billed crow	Common	2900-3900m
Pyrrhocorax graculus	Yellowbilled chough	Common	3400-5300m near Rigmo, Larcha, SheyGumba, Shey-la-pass, Saldang, Sagar-la
Pyrrhocorax pyrrhocorax	Redbilled chough	Common	Chhoilapu, Larcha, Dhekuthang, Rigmo
Pseudopodoces humilis	Hume's ground pecker	Common	Palam, Rigmo
Nucifraga caryocatactes	Spotted nutcracker	Common	3200-3800m near Palam and Pugma
Subfamily: Dicrurinae			
Tribe dicrurini	Tribe dicrurini	Common	

Dicrurus aeneus	Bronzed drongo	Common	3100m above Palam
Dicrurus leucophaeus	Ashy drongo	Common	Suligaad, Ankhe, Palam
Dicrurus hottentottus	Spangled drongo	Rare	3100m above Palam
Subfamily: Dicrurinae			
Tribe rhipidurini	Tribe rhipidurini		-
Rhipidura hypoxantha	Yellow-bellied fantail		-
Tribe oriolini	Tribe oriole	-	-
Oriolus traillii	Maroon oriole	Rare	Kaigaun, Toijam
Oriolus oriolus	Eurasian golden oriole	-	Ralli
Pericrocotus ethologus	Long-tailed minivet	Common	2100-3500m near Suligaad and Rigmo
Family: Cuculidae			
Cuculus saturatus	Oriental cuckoo	Common	Palam, Rigmo
Cuculus poliocephalus	Lesser cuckoo	Common	Palam
Cuculus canorus	Eurasian cuckoo	Common	Palam, Rigmo
Family: Falconidae			
Falco amurensis	Amur falcon	Rare	2800-4800m near Suligaad, Palam
Falco columbarius	Merlin	Common	2800-4800m near Suligaad, Ralli, Toijam, Palam, Chhoilapu
Falco tinnunculus	Common kestrel	Common	2800-4800m near Suligaad, Ralli, Madhu,Palam
Falco vespertinus	Redlegged falcon	Common	2800-4800 near Suligaad, Palam
Family: Fringillidae			
Subfamily: Emberizinae			
Emberiza cia	Rock bunting	Common	2700-3800m
Embriza leucocephalos	Pine bunting	Common	3100m near Palam, Rigmo, Pugmo
Emberiza pusilla	Little bunting	Common	3100m near Palam

Melophus lathami	Cresting bunting	Rare	Ralli, Madhu
Subfamily: Fringillinae			
Carduelis flavirostris	Twite	Common	Palam, Khaliban, Ghodakhola, Larcha, Churangla, SheyGumba
Carduelis spinoides	Yellow-breasted greenfinch	Common	Palam, Ralli, Khaliban, Pahada, Dagina, Toijam, Campkapuwa, Larcha
Carpodacus erythrinus	Common rosefinch	Common	3000-3600m; Palam, Rigmo
Carpodacus rodochrous	Pink-browed rosefinch	Rare	3500-3700m
Carpodacus pulcherrimus	Beautiful rosefinch	Common	3000-4800m; Palam, Rigmo, Pugmo, Chhoregaun, Singthupra, Dhekuthang
Carpodacus rubicilla	Great rosefinch	-	Palam
Carpodacus rubicilloides	Streaked-fronted rosefinch	Common	4500-4800m
Carpodacus puniceus	Red-fronted rosefinch	Common	4500-4900 m
Carpodacus thura	White-browed rosefinch	Common	Ranchi
Fringilla coelebs	Chaffinch	Common	Above Palam
Leucosticte nemoricola	Hodson's mountainfinch	Common	4000-4800m
Leucosticte brandti	Brandt's mountainfinch	Common	4000-4800m
Mycerobas carnipes	White-winged grosbeak	Common	Palam, Rigmo (March/April)
Mycerobas affinis	Collared grosbeak	Rare	Kaigaun
Pyrrhula erythrocephala	Red-headed bullfinch	Common	Rigmo, Chhoilapu
Serinus pusillus	Fire-fronted serin	-	Toiljam
Family: Hirundinidae			
Delichon dasypus	Asian house martin	Common	3100-4500m; Palam, Perikapuwa, Chhoilapu, Toijam, Hurikot

Hirundo rupestris	Eurasian crag gartin	Rare	3100-4700m; Perikapuwa, Toijam
Family: Lanidae			
Lanius schach	Long-tailed shrike	Common	3100m; Palam, Kaigaun, Chhoilapu, Chhoregaun, Dhekuthang
Lanius tephronotus	Grey-backed shrike	Common	2700-3700m; Palam, Pahada, Dhekuthang
Lanius vittatus	Bay-backed shrike	-	Khaliban, Toijam
Family: Megalaimidae			
Megalaima virens	Great barbet	Rare	Rigmo
Family: Meropidae			
Merops orientalis	Green bee-eater	Rare	-
Family: Muscicapidae			
Subfamily: Muscicapinae			
Tribe muscicapini			
Ficedula superciliaris	Ultramarine flycatcher	Rare	Khaliban
Ficedula tricolor	Slaty-blue flycatcher	*	-
Ficedula westermanni	Little Pied Flycatcher	Rare	Toijam
Muscicapa ruficauda	Rareusty-tailed flycatcher	Rare	2900m; Toijam
Muscicapa sibirica	Dark-sided flycatcher	Common	2600-2700m; Toijam
Muscicapa superciliaris	White-browed flycatcher	Rare	2600-2700m; Toijam
Muscicapa strophiata	Rufous gorgetted	Common	2600-2700m; Toijam
Niltava sundara	Rufous-bellied niltava	-	Rigmo
Tribe saxicolini			
Enicurus maculatus	Spotted forktail		Pahada, Khaliban
Enicurus scouleri	Little forktail	Common	Above Palam

Tarsiger pectoralis	White-tailed rubythroat	Common	2900-4700m; Ranchi, Perikapuwa, SheyGumba
Tarsiger cyanurus	Orange-flancked bush robin	Common	2900-4700m; Sumduwa, Campkapuwa
Tarsiger chrysaeus	Golden bush robin		-
Tarsiger indicus	White-browed bush robin		-
Phoenicurus schisticeps	White-throated redstart	Common	2900-4700m; Chhoilapu, Taicha
Phoenicurus erythronota	Rufous-backed redstart	-	Palam, Chhoilapu
Phoenicurus erythrogaster	White-winged redstart	Common	Suligaad-Chhoilapu
Phoenicurus hodgsoni	Hogdson's redstart	Common	Above Palam, SheyGumba, Chhoregaun
Rhyacornis fuliginosus	Plumbeous water redstart	Common	Palam, Pahada-Khaliban, Kaigaun, SheyGumba
Hodgsonius phoenicuroides	White-bellied redstart	Common	Dunai, Suligaad
Grandala coelicolor	Grandala	-	2100-3300m; Suligaad-Palam
Saxicola torquata	Common stonechat	Common	Suligaad-Palam, Ralli, Pahada
Saxicola ferrea	Grey bushchat	Common	Suligaad-Palam
Saxicoloides fulicata	Indian robin		Campkapuwa, Larcha
Saxicoloides insignis	Hodgson's ushchat		Ralli-Tripurakot-Pahada
Luscinia brunnea	Indian blue robin	*	-
Chaimarrornis leucocephalus	White-capped water redstart	Common	Suligaad, Ankhe, Khaliban, Pahada
Monticola rufiventris	Chestnut-bellied rock thrush	-	Chhoilapu
Oenanthe deserti	Desert wheatear	-	-
Phoenicurus coeruleocephalus	Blue-capped redstart	Common	Suligaad, Rigmo
Phoenicurus ochruros	Black redstart	Common	-
Phoenicurus frontalis	Blue-fronted redstart	Common	4400-4800m; Taicha

Subfamily: Turdinae			
Monticola solitarius	Blue rock thrush	Common	-
Myophonus caeruleus	Blue whistling thrush	Common	Suligaad, Pahada, Khaliban, Kaigaun, Toijam, Pugmo, Dhekuthang, Ranchi, Chhepka, Raltang
Turdus albocinctus	White-collared blackbird		Throughout
Turdus unicolor	Tickell's thrush		Palam
Turdus ruficollis	Dark-throated thrush		Tripurakot-Pahada
Turdus viscivorus	Mistle thrush		-
Zoothera mollissima	Plain-backed thrush	Rare	Above Palam
Family: Nectariniidae			
Subfamily: Nectariniinae			
Tribe nectarinii			
Dicaeum ignipectus	Fire-breasted flowerpecker	Rare	Ankhe
Nectarinia asiatica	Purple sunbird		Ralli
Family: Paridae			
Parus monticolus	Green-backed tit	Common	2900-3800m; Suligaad
Parus melanolophus	Spot-winged tit	Common	2900-3800m; Suligaad
Parus rubidiventris	Rufous-vented tit	Common	3200-4000m; Chhoilapu, Campkapuwa
Parus rufonuchalis	Rufous-napped tit	Common	3300m; Above Rigmo
Parus dichrous	Grey-crested tit	Rare	-
Parus ater	Coal tit	Rare	Pugmo, Sumduwa
Family: Passeridae			
Subfamily: Motacillinae			
Anthus hodgsoni	Olive-backed pipet	Common	2900-3800m; Chhoilapu, Larcha
Anthus pelpopus	Rosy-breasted pipet	Rare	3300-4800m; Toijam, Palam
Anthus sylvanus	Upland pipet	Common	3300-4800m; Toijam, Palam
Motacilla alba	White wagtail	Common	2700-3500m; Chhoilapu, SheyGumba, Saldang
Motacilla cinerea	Grey wagtail	Common	2700-3600m; Kaigaun, Chhoilapu, Phoksumdo Lake, Chhoregaun
Motacilla citreola	Citrine wagtail	Common	3000-3500m; Above Chhoilapu

Subfamily: Passerinae			
Montifringilla adamsi	Tibet snowfinch	Common	Saldang, Chhoragaun, Sagarla
Passer domesticus	House sparrow	Common	Suligaad-Rigmo, Ralli, Madhu, Tripurakot, Pahada, Khaliban, Kaigaun
Passer montanus	Eurasian tree sparrow	Common	Throughout
Passer rutilans	Russet sparrow	Rare	Throughout
Subfamily: Prunellinae			
Prunella atrogularis	Balck-throated Accentor	?	-
Prunella collaris	Alpine accentor	Common	3600-4600m; Rigmo
Prunella fulvescens	Brown accentor	Common	4400-4700m; Shey
Prunella himalayana	Altai accentor	Common	4400-4700m; Shey
Prunella rubeculoides	Robin accentor	Common	Ralli-Madhu, SheyGumba
Prunella strophiata	Rufous-breasted accentor	Common	360-4600m; Palam
Family: Phalacrocoracidae			
Phalacrocorax carbo	Great cormorant	Rare	Suligaad
Family: Phasinidae			
Alectoris chukar	Chukar	Common	Madhu, Palam, Saldang, Chhoregaun, Singthupra
Lerwa lerwa	Snow partridge	Rare	Sagar Pass
Lophophorus impejanus	Himalayan monal	Protected	Pugmo
Lophura leucomelanos	Kalij pheasant	Rare	Dagina, Kaigaun
Perdix hodgsoniae	Tibetan Partridge	Rare	Saldang, Chhoregaun
Pucrasia macrolopha	Koklas pheasant	Rare	Rikhe, Kaigaun
Tetraogallus tibetanus	Tibetan snowcock	Rare	Above 3100m; Rikhe, Kaigaun
Tetraogallus himalayensis	Himalayan snowcock	Common	Chhoregaun, Dhekuthang
Catreus wallichii	Cheer pheasant		Dagina, Chaurifarm, Palam
Family: Picidae			
Dendrocopos darjellensis	Darjeeling woodpecker	-	Khaliban, Chaurifarm
Junx toquilla	Eurasian wryneck	Rare	Saldang
Family: Pycnonotidae			

Hypsipetes leccocephalus	Black bulbul	Common	2700-3200m; Suligaad-Palam
Hypsipetes mcclellandi	Mountain bulbul		Dagina-Khaliban (Ghatta Khola)
Pycnonotus leucogenys	Himalayan bulbul	Common	Suligaad-Palam, Ralli, Madhu, Pahada
Family: Rallidae			
Fulcia atra	Eurasian coot	Rare	Phoksundo Lake
Family: Scolopacidae			
Subfamily: Scolopacinae			
Gallinago nemoricola	Wood snipe	Rare	-
Subfamily: Tringinae			
Actitis hypoleucos	Common sandpiper		
Tringa ochropus	Green sandpiper		
Family: Sittidae			
Sitta cashmirensis	Kashmir nuthatch		
Sitta leucopsis	White-cheeked nuthatch	Common	Campkapuwa
Tichodroma muraria	Wallcreeper	Common	2100-3600m; Suligaad
Family: Strigidae			
Strix aluco	Tawney owl	Common	3000-3700m; Dhvane, Taichin
Asio flammeus	Short-eared owl	Rare	
Athene noctua	Little owl	Rare	
Family: Sturnidae			
Acridotheres tristis	Common mynah	Common	
Family: Sylviidae			
Subfamily: Acrocephalinae			
Phylloscopus affinis	Tickell's leaf warbler	Common	4700m; Above Palam
Phylloscopus pulcher	Buff-barred warbler	Common	Phoksundo Lake, Shey Trail, Khaliban, Chaurifarm
Phylloscopus humei	Hume's warbler	Common	Tiojam, Rigmo-Chhoilapu
Phylloscopus inornatus	Yellow-browed warbler	Common	2700-3600m; Shey Trail
Phylloscopus proregulus	Yellow-rumpedleaf warbler	Common	2700-3600m; Shey Trail
Phylloscopus magnirostris	Large-billed Leaf warbler	Common	Rigmo, Shey Trail, Khaliban, Kaigaun, Chhoilapu

Phylloscopus reguloides	Blyth's leaf warbler	Common	3100m; Above Palam
Phylloscopus trochiloides	Greenish warbler	Common	Phaparbari, Toijam, Rigmo, Chhoilapu, Saldang-Chhoregaun, Dhekuthang, Palam
Phylloscopus griseolus	Sulphur-bellied warbler		
Phylloscopus maculipennis	Ashy-throated warbler	Common	Phaparbari, Palam
Seicercus burkii	Golden-spectackled warbler		
Seicercus xanthoschistos	Grey-hooded warbler	Common	2700m; Suligaad
Leptopoecile sophiae	White-browed tit warbler	Common	Tukaksa
Cettia pallidipes	Pale-footed bush warbler		Chhoilapu, Larcha
Cettia brunnifrons	Grey-sided bush warbler		-
Hippolais caligata	Booted warbler		-
Regulus regulus	Goldcrest	Common	-
Subfamily: garrulacinae			
Garrulax variegatus	Variegated laughingthrush	Common	2200-3700m; Palam, Pugmo, Khaliban, Chaurifarm, Toijam, Chhoilapu-Larcha
Garrulax lineatus	Streaked laughingthrush	Common	Palam, Pugmo
Subfamily: Sylviinae			
Tribe timaliini			
Fulvetta vinipectus	White-browed fulvetta		
Heterophasia annectans	Rufous-backed sibia		Khaliban
Pteruthius xanthochlorus	Green Shrike babbler		
Pnoepyga albiventer	Scaly-breasted wren babbler		Kaigaun-Hurikot
Stachyris pyrrhops	Black-chinned babbler		Toijam
Family: Upupidae			
Upupa epops	Hoopoe	Common	Palam, Ralli, Madhu, SheyGumba, Dhekuthang
Family: Zosteropidae			
Zosterops palpebrosus	Oriental white-eye	Common	Suligaad, Palam, Rigmo

Annex 8: Road networks

Table 19: Key roads in the Phoksundo Suligaad watershed

SN	Villages linked	Length (km)
1	Dunai – Raha - Ankhe Khola – Chhepka - Renchi	50
2	Renchi – Pugmo - Kagmara Pass - Hurikot	75
3	Renchi – Punikha – Kunasa	30
4	Pugmo – Rinkhe – Muduva – Rigmo – Sheygumba	80
5	Pugmo – Palam – Rigmo	30
6	Dunai – Khalarupi – Jyalas - Ankhe Khola	15
	Total	280

Annex 9: Micro hydropower schemes

Table 20: Micro-hydropower plants in the Phoksundo Suligaad watershed

SN	Name	Location	Capacity (kW)	HH benefited	Remarks
1	Aankhe Khola	Shyangta, Thulibheri NP	52	NA	Operational
2	Pugmo	Pugmo, Shey Phoksundo GP	16	40	Operational

Annex 10: Irrigation projects

Table 21: Irrigation projects in the Phoksundo Suligaad watershed

SN	Name	Location[10]
1	Rike Chaur Sana Sinchai Aayojana	Phoksundo 2
2	Raulai Sana Sinchai Aayojana	Raha 3, 4
3	Parika Sana Sinchai Aayojana	Raha 1
4	Tammu Khola Sinchai Aayojana	Raha 4
5	Thala Sahakar Sinchai Yojana Fro Tara Khola Muhan	Raha 4
6	Tammu Khola Sinchai Aayojana	Raha 8
7	Chyama Sana Sinchai Aayojana	Phoksundo 2
8	Pipleni Sahakari Sinchai Aayojana	Raha
9	Chhunimuni Sana Sinchai Aayojana	Raha 8, 9
10	Gabugauda to Parila Irrigation (**proposed**)	Raha 1, 2, 3

[10] Because these irrigation projects were established prior to the implementation of Nepal's federal system of government, the locations in this table refer to the Village Development Committee wards under the former structure.

Annex 11: Water quality

Table 22: Water quality parameters in the Phoksundo Suligaad watershed, dry and monsoon seasons

	Location	Altitude (m)	Season	River Discharge	Electrical Conductivity(µS/cm)	Temperature(°C)	Total Iron(mg/L)	pH	Nitrate- Nitrogen(mg/L)	Nitrite- Nitrogen(mg/L)	Dissolved Oxygen (DO) (mg/L)	Turbidity (NTU)	Ammonium(mg/L)	Phosphate-Phosphorous (mg/L)
1	Akhay Khola	2443.4	Dry	1389.31	229.5	7.6	0	6.3	1	0	9	6.27	0	0
			Monsoon		246	12.2		7.3		0	8.26	3.08	1	0.9
2	Ryanchi khola	2919.7	Dry	54.95	204.5	9.3	0	6.2	1	0.05	8.11	16.2	0	0.6
			Monsoon		249.6	11.3		6.3		0	7.59	1.77	17.5	17.5
3	Kunasha khola	3156.6	Dry	1028.09	186.8	11.5	0.05	6.6	2.9	0.05	7.78	5.04	0	1.5
			Monsoon		230.6	10.7		5.5		0	7.56	2.88	1	0.6
4	Maduwa khola	3197.8	Dry	1504.65	235.7	8.9	0	6.7	2.6	0.03	8.09	3.06	0	10
			Monsoon		220.4	10		5.6		0	7.95	1.98	0	5.1
5	Phoksundo lake outlet	3595.6	Dry	3170.33	258.8	8.9	0	6.5	1.8	0.05	8	1.71	0	0.3
			Monsoon		238.6	13		7.3	0	0	7.27	1.94	3	2.7
6	Phoksundo khola	1915.8	Dry		425.4	19.1	0	7.1	0.7	0.06	7.97	6.3	0	0
			Monsoon		245.8	12.1		5.5	0	0	8.4	1.73	0	7.9
7	Phoksundo khola	3563.6	Dry	6621.74	270.8	8.1	0	6.2	1	0.03	7.19	1.28	0	0
			Monsoon		261.6	12.2		6.5		0	7.19	0.99	1	1.8

Annex 12: Major pollution points in the watershed

Table 23: Major pollution points in the Phoksundo Suligaad watershed

SN	Name	Source	Location	Latitude	Longitude	Elevation (m)
1	Suligaad	National Park / Tea shops	Thulibheri NP	28°58'35.33"N	82°52'47.52"E	2,193
2	Kageni	Hotels	Thulibheri NP	29° 0'33.17"N	82°54'6.27"E	2,339
3	Shangta	Hotels	Thulibheri NP	29° 2'26.65"N	82°54'14.91"E	2,551
4	Renchi	Hotels	Phoksundo GP	29° 7'0.41"N	82°53'9.52"E	3,141
5	Sundhuwa	Hotels	Phoksundo GP	29° 8'27.92"N	82°54'32.10"E	3,239
6	Pugmo	Hotels / settlement	Phoksundo GP	29° 9'36.21"N	82°52'24.45"E	3,352
7	Rigmo	Hotels	Phoksundo GP	29°10'18.57"N	82°56'11.28"E	3,627
8	Chhepka	Hotels	Phoksundo GP	29° 3'23.16"N	82°53'50.88"E	2,754
9	Palam	Hotels	Phoksundo GP	29° 8'35.00"N	82°54'46.60"E	3,314

Annex 13: Community user forest groups

Table 24: Community user forest groups by location and representation

SN	Name	Location	Registration year	Area (ha)	HH represented
1	Chhamkuni Daha	Thulibheri-10	2003	205	20
2	Mate	Thulibheri-11	2003	205	97
3	Shanti	Thulibheri-10	2003	125	121
4	Himali	Tripurasundari M-1 & 2	2000	486.8	44
5	Bikramshahi Maharaja	Tripurasundari M-1	2001	136.8	128
6	Rajarani	Tripurasundari M-1	2003	25	58
7	Deuti	Tripurasundari M-2	2003	50	52
8	Bandevi	Tripurasundari M-2	2003	40	86

9	Mahakal	Tripurasundari M-2	2003	100	85
10	Deurali	Tripurasundari M-2	2003	100	168
			Total	**1473.6**	**859**

Table 25: Buffer zone community forest user groups in Shey Phoksundo National Park

SN	Name	Location	Area (ha)	HH	District	Remarks
1	Chhamkuni Daha	Thulibheri NP	205	20	Dolpa	Inside the watershed
2	Mate	Thulibheri NP	205	97	Dolpa	Inside the watershed
3	Shanti	Thulibheri NP	125	121	Dolpa	Inside the watershed
4	Himali	Tripurasundari NP	486.8	44	Dolpa	Inside the watershed
5	Bikramshahi Maharaja	Tripurasundari NP	136.8	128	Dolpa	Inside the watershed
6	Rajarani	Tripurasundari NP	25	58	Dolpa	Inside the watershed
7	Deuti	Tripurasundari NP	50	52	Dolpa	Inside the watershed
8	Bandevi	Tripurasundari NP	40	86	Dolpa	Inside the watershed
9	Mahakal	Tripurasundari NP	100	85	Dolpa	Inside the watershed
10	Deurali	Tripurasundari NP	100	168	Dolpa	Inside the watershed
11	Mastabhawani	Tripurasundari NP	790	210	Dolpa	Outside the watershed
12	Samling	Jagadulla GP	1005	41	Dolpa	Outside the watershed
13	Sukdaha	Jagadulla GP	45	45	Dolpa	Outside the watershed
14	Dudhkundali	Jagadulla GP	1326	147	Dolpa	Outside the watershed
15	Maluwahimal	Jagadulla GP	465	62	Dolpa	Outside the watershed
16	Sunaulorani	Jagadulla GP	54	51	Dolpa	Outside the watershed
17	Jagdulla	Jagadulla GP	43	40	Dolpa	Outside the watershed
18	Himali	Jagadulla GP	633.2	123	Dolpa	Outside the watershed
19	Raphu	Mugum Karmarong GP	324.47	39	Mugu	Outside the watershed

20	Rukgumba	Mugum Karmarong GP	324	59	Mugu	Outside the watershed
21	Semukche	Mugum Karmarong GP	537.5	52	Mugu	Outside the watershed
22	Yurugad	Mugum Karmarong GP	33.82	52	Mugu	Outside the watershed
23	Sawadhuk	Mugum Karmarong GP	31.32	57	Mugu	Outside the watershed
24	Chhayannath	Mugum Karmarong GP	29.67	56	Mugu	Outside the watershed
25	Lapama	Mugum Karmarong GP	17.5	51	Mugu	Outside the watershed

Annex 14: Buffer zone natural resource management groups

Table 26: Buffer zone user committees around Shey Phoksundo National Park by location

SN	Name	GP or NP	District	Remarks
1	Deuti	Thulibheri NP	Dolpa	Inside the watershed
2	Devi	Thulibheri NP	Dolpa	Inside the watershed
3	Tripurasundari	Tripurasundari NP	Dolpa	Inside the watershed (partial)
4	Mahadev	Tripurasundari NP	Dolpa	Outside the watershed
5	Tirtha	Tripurasundari NP	Dolpa	Outside the watershed
6	Mukuteshwor	Tripurasundari NP	Dolpa	Outside the watershed
7	Malika	Jagadulla GP	Dolpa	Outside the watershed
8	Bhagawati	Jagadulla GP	Dolpa	Outside the watershed
9	Mahadevsthan	Jagadulla GP	Dolpa	Outside the watershed
10	Pailehimal	Jagadulla GP	Dolpa	Outside the watershed
11	Jagadulla	Jagadulla GP	Dolpa	Outside the watershed
12	Phoksundo	Shey-Phoksundo GP	Dolpa	Inside the watershed
13	Buddha	Shey-Phoksundo GP	Dolpa	Outside the watershed
14	Mukporung	Shey-Phoksundo GP	Dolpa	Outside the watershed
15	Nyasamba	Dolpo Buddha GP	Dolpa	Outside the watershed
16	Chhayannath	Mugum Karmarong GP	Mugu	Outside the watershed
17	Rimbochchhe	Mugum Karmarong GP	Mugu	Outside the watershed

Annex 15: Key stakeholders – organizations and offices

Table 27: Key organizations and offices relevant to watershed health

Name of organizations/stakeholders	Location
District Coordination Committee	Dunai, Dolpa
Thuli Bheri Municipality	Juphal, Dolpa
Tripurasundari Municipality	Tripurakot, Dolpa
Shey-Phoksundo Rural Municipality	Saldang, Dolpa
Kaike Rural Municipality	Sahartara, Dolpa
Shey Phoksundo National Park (SPNP)	Suligaad, Dolpa
District Livestock Office (DLO)	Dunai, Dolpa
District Agriculture Development Office (DADO)	Dunai, Dolpa
District Drinking Water and Sewerage Development Office (DWSS)	Dunai, Dolpa
District Forest Office	Dunai, Dolpa
Buffer Zone Management Committee (BZMC)	Suligaad
Buffer Zone User Committee (BZUC)	Deuti BZUC at Suligaad, Devi BZUC at Raha and Phoksundo BZUC at Ringmo
Snow Leopard Conservation Committee (SLCC)	Ringmo, Dolpa
Phoksundo Lake Management Committee (PLMC)	Ringmo, Dolpa
WWF Nepal	Kathmandu
National Lake Conservation Development Committee (NLCDC)	Kathmandu
Great Himalayan Trail Consortium	Kathmandu
Nepal Tourism Board	Kathmandu
Poverty Alleviation fund (PAF)	Kathmandu
Rural Reconstruction Nepal (RRN)	Nepalgunj
Karnali Region Tourism Board	Surkhet
KADURI	Surkhet
Red Cross Nepal	Dunai, Dolpa
TASHI-D	Saijol, Dolpa
Federation of Water Users and Sanitation (FEDWASUN)	Dunai, Dolpa
Federation of Community Forestry Users Nepal (FECOFUN)	Dunai, Dolpa
National Federation of Irrigation Water Users Association Nepal (NFIWUAN)	Dunai, Dolpa
Dalit Association	Dunai, Dolpa
Dolpa Dalit Empowerment Center	Dunai, Dolpa

Sumse Women Multiporpose Cooperativs	Raha, Dolpa
Federation of Nepalese Chambers of Commerce and Industry (FNCCI)	Dunai, Dolpa
Pipal Bari Group	Kagani, Dolpa
KIRDAC Nepal, Dolpa	Dunai, Dolpa
Women Empowerment Center	Dunai, Dolpa
CEDA Nepal, Dolpa	Dunai, Dolpa
Buffer Zone Community Forest Users Group (BZCFUG)	Watershed area
Women's Groups, Sister groups	Righmo, Pugmo Dolpa
The Sung Gumba	Ringmo, Dolpa
Community Micro Hydro Powers	Syangta and Pugmo Dolpa
Hotel/Lodge Owners	Ringmo, Pugmo, Ryanchi, Sunduwa, Chhepka, Kageni, Syangta and Suligad
Mahakal Inovative Youth Club	Rassi, Dolpa
Himali Devi Laganshil Youth Club	Raha, Dolpa
Irrigation Groups	Watershed area
Water Users Groups	Watershed area

Annex 16: Vision building framework employed for compiling the Phoksundo Suligaad watershed profile.
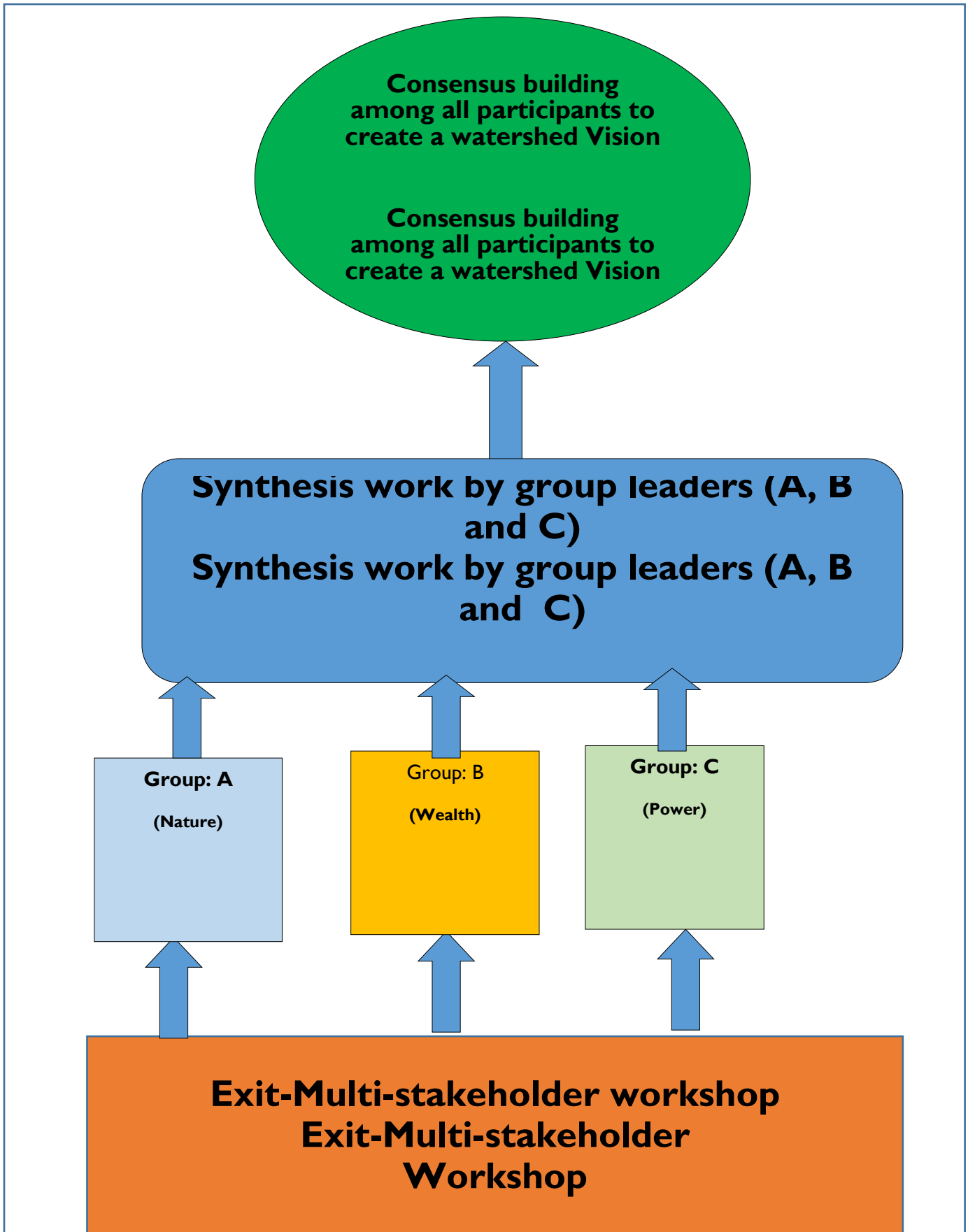
Figure 15: Vision building framework