THULIGAAD WATERSHED PROFILE

STATUS, CHALLANGES AND OPPORTUNITIES FOR IMPROVED WATERSHED MANAGEMENT

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Cover photo: A view of Thuligaad watershed from above in the Karnali River Basin.

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ABBREVIATIONS

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

IRBM	Integrated River Basin Management
IUCN	International Union for Conservation of Nature
KII	Key Informant Interview
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
MSC	Multi-stakeholder Consultation
NEFIN	Nepal Federation of Indigenous Nationalities
NFIWUAN	National Federation of Irrigation and Water Users' Association
NP	*Nagar palika* (new federal administrative unit; district level)
NPC	National Planning Commission
NRM	Natural resource management
PAANI	Program for Aquatic Natural Resource Improvement
USAID	United States Agency for International Development
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat
WWF	World Wildlife Fund

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 discussion draft watershed profile is the result of many people working together. Most significant were the generous contributions of time, thoughtful attention, and ideas of members of many community forest user groups (CFUGs), cooperatives, water user groups, and, especially, the communities dependent on aquatic biodiversity and local water management. Leaders of Jorayal, Chure, Badikedar, and Mohanyal rural municipalities and the newly elected 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—युएसएड पानी परियोजना—is grateful for the privilege of having been invited to support the above efforts. The Paani Program (Paani) is a consortium of DAI, WWF, SILT, and NESS that works closely with Nepal's Water and Energy Commission Secretariat (WECS) and draws on the support of the WECS' member agencies. Paani enriched the watershed profile by compiling and reviewing secondary data and carrying 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 NFIWUAN, FEDWASUN, NEFIN, MOE, MOFSC, MOAD, MOFALD, MOI, and MOPPT, who gave their full cooperation and support at the national, district and local levels. Any errors in this discussion document are those of the Paani team.

EXECUTIVE SUMMARY

This profile assesses the status, major challenges and opportunities for water resource management for the multiple users within the Thuligaad Watershed of Province No. 7.

The USAID Paani Program — also known as *Paani*, **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 Thuligaad 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]

The Thuligaad watershed is located within the Karnali River Basin that belongs to parts of Doti and Kailali districts. The watershed stretches across the Jorayal and Badikedar rural municipalities of Doti, and Mohanyal in Kailali. The total drainage density of this watershed is 935 m/km^3 and the total area of the watershed is 850 km^2. Altogether 17 streams and 156 tributaries in this watershed flow into the Karnali River. Water drains from the north between the Karnaso Gaad of Doti through to the Khimadi near Mohanyal in the south from where it eventually flows into Karnali River.

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[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.

According to the Nepal Survey Department, there are four major types of land cover in the Thuligaad watershed: forest (78%), cultivated land (19%), rivers and streams (2%), and the remainder is other wooded land and shrubs.

Agriculture is the most common livelihood and 37% of the land dedicated to crops is irrigated (15% with permanent irrigation). Rice, maize, wheat and millets are the main cereals.

Overall, we find decreasing river discharge during pre-monsoon, monsoon, and post-monsoon, but an increasing trend during winter (0.1 m^3/s year). Precipitation has decreased in this watershed while temperatures have increased, and it is believed these are the two main drivers of the decreasing river discharge, while increasing winter rains have fueled that increase.

The watershed is rich in biodiversity and agricultural land due to the altitudinal gradients in the watershed, which have produced a wide range of ecosystems from north to south. However, water remains a steady concern: only 16% of households reported having sufficient water all year round. The overall climate of the watershed is considered sub-tropical. At higher elevations, Chir pine (*Pinus roxburghii*) trees and other broad leaf tree species predominate in the forests. At lower altitudes, Sal forest (*Shorea robusta*) are the dominant species.

According to the public census, the estimated population of the watershed is 42,277 divided almost evenly between men and women. In terms of social composition, the watershed is widely varied in terms of ethnic origin, mostly Brahmin, Chhetri and Magar, but also Badi, Majhi, Lama, Bhote, Gurung, Newar, and Dalit. Major settlements are primarily composed of Brahman/Chhetri, Dalit, and Magar (CBS 2011) populations. Like elsewhere in Nepal, all populations in these communities of diverse origins are not treated equally, and women typically have lower social status than men and are assigned a higher level of household duties.

1. Priority Issues of Thuligaad Watershed

The Thuligaad watershed covers part of Doti and Kailali districts of the Far-Western Region (Pradesh No. 7) of Nepal. Most of the area of this watershed stretches from plains in the south to hilly areas in the center of the country. The watershed faces many challenges, among them the construction of improperly designed roads and variability in climatic patterns. Table 1 summarizes the priority issues in the watershed related to climate change and freshwater biodiversity conservation.

Table 1: Priority issues for watershed health

SN	Priority issues	Impacts
I	Climate-induced hazards such as landslides, flooding and sand deposition	Loss or degradation of natural habitats reduces the amount of natural resources available for local populations, such as declining fish populations and decreasing water availability. Landslides and flooding exact loss of property, infrastructure and human life.
II	Drying water sources	As water sources dry up, there is less water available for drinking, sanitation, and agriculture, and aquatic habitats are degraded. Additional investments are needed to improve water distribution and encourage adoption of modern technologies to improve efficiency of water use.
III	Declining fish populations and diversity	Destructive fishing practices are leading to unsustainable fish harvests, depleting available fish stocks and impacting the diversity of fish in the watershed. Traditional fishing communities are particularly affected by this trend.
IV	Forest degradation and wildfires	Available timber and non-timber forest products decline, negatively affecting livelihoods and food security. Root systems that store water and stabilize slopes are weakened, increasing the likelihood of erosion and landslide. Risk of wildfires increases.

I. Flooding, landslides, river cutting, sand deposition

Flooding and sand deposition are the major threats to both human and ecological communities. Floods and landslides, further aggravated by the construction of improperly designed roads, pollute water bodies and damage natural habitats of freshwater biodiversity. Figure 1 maps the risk hotspot locations for flood and landslide risk, while Table 2 provides specific information on these locations by VDC.

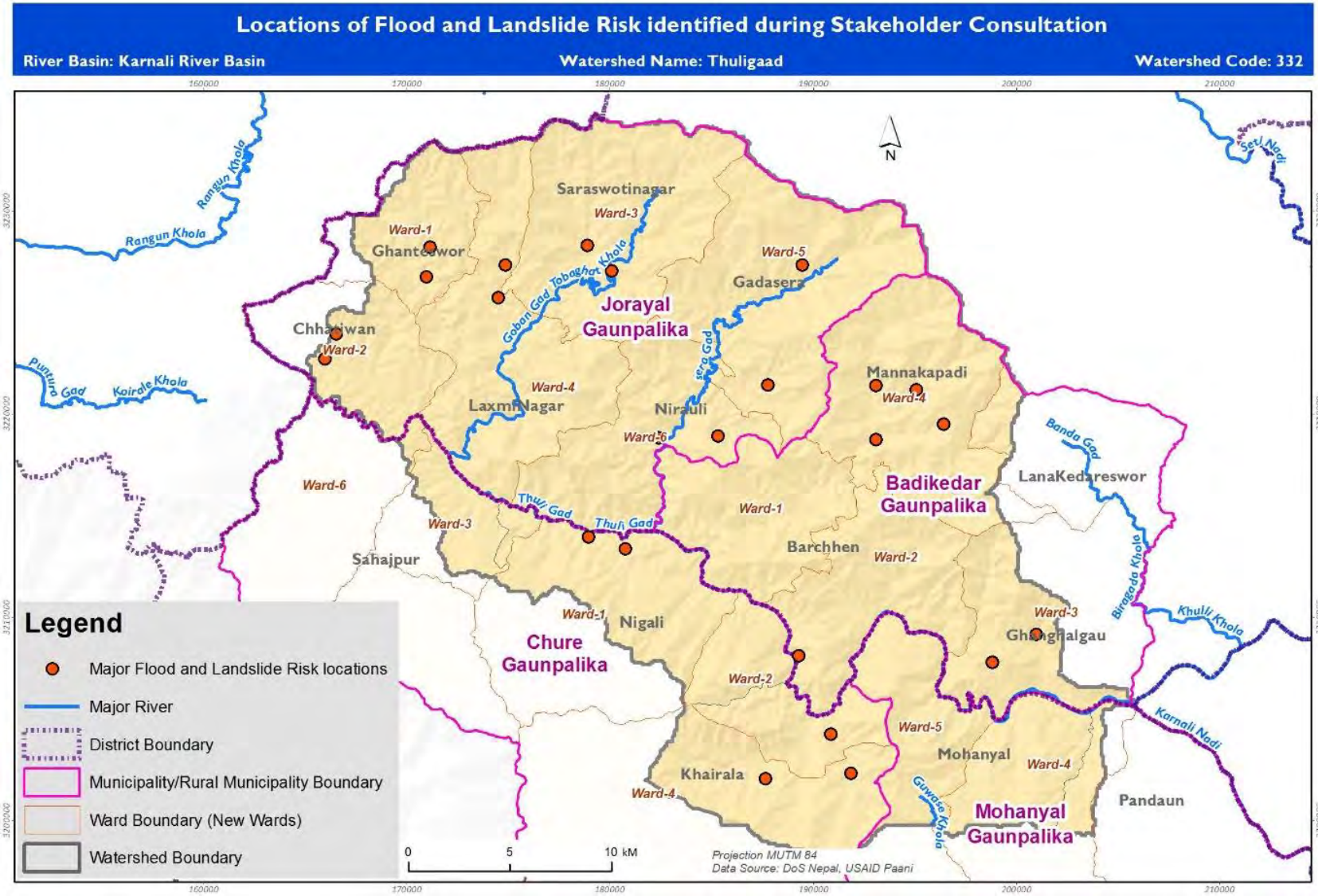

Figure 1: Map of major flood and landslide risk areas

Table 2: Major flood and landslide risk areas

Rural municipality (*gaun palika*)	Village Development Community	VDC ward numbers
Baddikedar	Barchhen	4
Jorayal	Saraswotinagar	2, 3
Jorayal	Laxminagar	2, 3
Chure	Nigali	2, 3, 4
Chure	Khairala	4, 5, 6
Baddikedar	Mannakapadi	3, 4, 6, 9
Badikedar	Gadsera	4, 7
Jorayal	Ghanteswor	5, 6
Baddikedar	Ghanghalgau	6, 8
Baddikedar	Nirauli	6, 7
Jorayal	Chhatiwan	2, 4
Jorayal	Lamaute	2

Flooding has become a near-perennial event in the watershed and with particular severity in 1983, 1998, and 2005, when croplands and houses were lost. In the 1998 flood, river cutting swept away more than 500 meters of irrigation canals and seven water mills in Lamaute in Jorayal rural municipality. From that point forward, affected farmers were forced to shift their rice farmers into rain fed maize farming.

Based on discussions of the data collected for this profile, stakeholders in Thuligaad put forth the following recommendations for further review and discussion:

- Support local technologies for retaining runoff water on-site, which will reduce erosion and protect agricultural land upstream;
- Support locally-initiated and low cost bioengineering and river bank management systems;
- Raise awareness on better ways to manage forest fires and open grazing (e.g., community forest user groups);
- Support communities to establish and/or strengthen early warning systems (EWS);
- Produce and disseminate communication materials and radio programs on best practices for water management;
- Improve implementation of environmental plans such as Disaster Preparedness and Response (DPRP); Local Adaptation Plans for Action (LAPA); Community Adaptation Plans for Action (CAPA); Local Disaster Risk Management Plans (LDRMP); and Water Use Master Plans (WUMP);
- Conserve wetlands to improve flood control;
- Construct raised drinking water taps and toilets; and
- Relocate or raise infrastructure (e.g., water taps, wildlife watch towers (*machan)* and shelter houses) out of the floodplains and other vulnerable areas.

II. Drying water sources

Availability of usable water in this area has declined due to increasing periods of intense rainfall that precipitate landslides and damages local waters sources, including irrigation systems. Periods of prolonged drought have contributed to this problem. Improperly constructed roads and climatic changes accelerate the drying up of springs and other groundwater resources. Respondents say drying water sources are particularly acute in Jorayal and Badikedar *gaun palika* (GP) in Doti and and Mohanyal GP in Kailali.

Thuligaad stakeholders proposed the following recommendations:

- Improve implementation of water use master plans (WUMPs);
- Implement low-cost techniques that stabilize slopes and riverbanks;
- Adopt modern and simple technologies, such as solar water pumps, Dhiki pumps (treadle pump), drip irrigation, and rainwater harvesting;
- Promote regulated gravel mining and excavation in upstream areas;
- Encourage enforcement of existing laws and regulations related to watershed conservation and management.

III. Declining fish population and diversity

Local communities reported that fish populations had declined due to disturbances to their natural habitats from climate change, landslides, and destructive fishing techniques (e.g., poison, explosives, electric current). These impacts were also causing fish diversity to decline.

Many families engage fishing for their livelihoods, but fishing groups are poorly organized in the Thuligaad watershed; only a few fishing groups exist. To date, hydropower projects upstream in the Karnali region have not had effects on fishing downstream.

Floods in the summer of 2015 and construction of the Sahajpur-Boktan-Dipayal road have negatively impacted the fishing holes in the Thuligaad, Gadsheragad and Kapadigad rivers. Fish habitats in these areas have been either lost or degraded due to soil and gravel deposition.

Stakeholders proposed the following recommendations:

- Conduct advocacy, training, and capacity building for fishing groups at the local level;
- Include civil service organizations (CSOs), community-based organizations (CBOs), community forest user groups (CFUGs), buffer zone management committees (BZMCs), and buffer zone community forest groups in creating plans for more sustainable fishing;
- Develop and endorse capture fishery guidelines;
- Initiate dialogues between district-level agencies and rural municipalities, and between government and non-governmental agencies (e.g., fishing groups, natural resource CBOs);
- Assess current sustainable capture fisheries practices;
- Promote ecotourism (e.g., sport fishing, catch and release programs)
- Mobilize community-based anti-poaching units (CBAPU) to combat destructive fishing practices; and
- Promote fishing enterprises by engaging fishing groups and communities.

IV. Forest degradation and wildfires

Forestry officials and residents cite forest fires as a perennial danger, particularly in the dry season. The risk and danger of forest fires are increased by over-grazing, forest degradation and over-collection of resin, which dries out the trees. Improperly constructed rural roads also contribute to forest fire risk, as soil erosion often increases when these roads are built, exacerbating water loss from soils and forests.

Stakeholders suggested the following recommendations:

- Raise awareness about the dangers of wild fires and how to prevent them;
- Provide community training for firefighting and distribute equipment to support these trainings
- Minimize livestock grazing where possible; and
- Establish community patrols during the dry season to warn about potential fire risk areas.

Watershed Health Report

These priority issues are discussed more in this profile and outlined in the associated Thuligaad watershed health report (link to be provided). The watershed health report portrays the current condition of the natural resources and the quality of ecosystem services available for community use. It identifies the drivers that pose threats to peoples' livelihoods, fresh water biodiversity and natural habitats. The health report provides relevant information to strengthen informed decisions, take action to protect and restore the watershed, and to reduce risks and create sustainable economic opportunities. The report also provides opportunities to identify the drivers of watershed health degradation and explore the options to mitigate, correct and prevent them timely for sustainable watershed management. The health report thus serves as a planning tool.

The Thuligaad watershed health report was developed drawing on information gathered during the watershed profiling process. It was prepared based on secondary literature and information related to biophysical conditions, socio-economic characteristics, infrastructure, vulnerability and disaster risk, and freshwater biodiversity of the watershed and multi-stakeholder consultations (MSCs) in the watershed. During the MSCs, participants discussed and agreed upon indicators, groups impacted by issues, and locations of issues within the watershed. The watershed health report contains a scoresheet with each issue ranked according to threat level (e.g., high, medium and low). Draft health reports have been shared with key stakeholders, including government line agencies, civil society organizations (CSOs) and local governments for their feedback before finalization.

A more detailed description of the report and its methodology can be found in Annex 1: Methodology.

1. THULIGAAD WATERSHED: OVERVIEW

The Thuligaad 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 different people and groups **make decisions** together about the watershed and its uses) [2]. 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 2016-17, 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 locations and impact groups identified environmental assets. During the exit workshop, the Paani team also identified champions among stakeholders and local government agencies for leveraging funds and expertise to support water resource management initiatives.

Paani took the 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

[2] 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

2.1 THULIGAAD WATERSHED AND KARNALI RIVER BASIN

The Thuligaad watershed is one watershed located in the Karnali River Basin. The Karnali is one of four major river basins in Nepal and flows through Doti, Kailali and Surkhet districts.

The Karnali River is a perennial and nearly undisturbed river of the Himalaya that originates from Mansarovar and Rakshastal Lakes in the Tibetan Autonomous Region. Several major snow-fed tributaries (e.g., Mugu Karnali, Humla Karnali, Thuli Bheri) contribute significantly to the annual water flow and discharge of the basin. The bottom of the Karnali is primarily boulders in the northern reaches and sandy in the South. At Chisapani, just 50 km north of the Indian border, the Karnali creates a spectacular gorge famous for its diversity of trans-Himalayan and sub-Himalayan fish, more than 70 species in all (Shrestha, 1990). Whitewater rafting and angling are common recreational activities on the Karnali and growing in popularity.

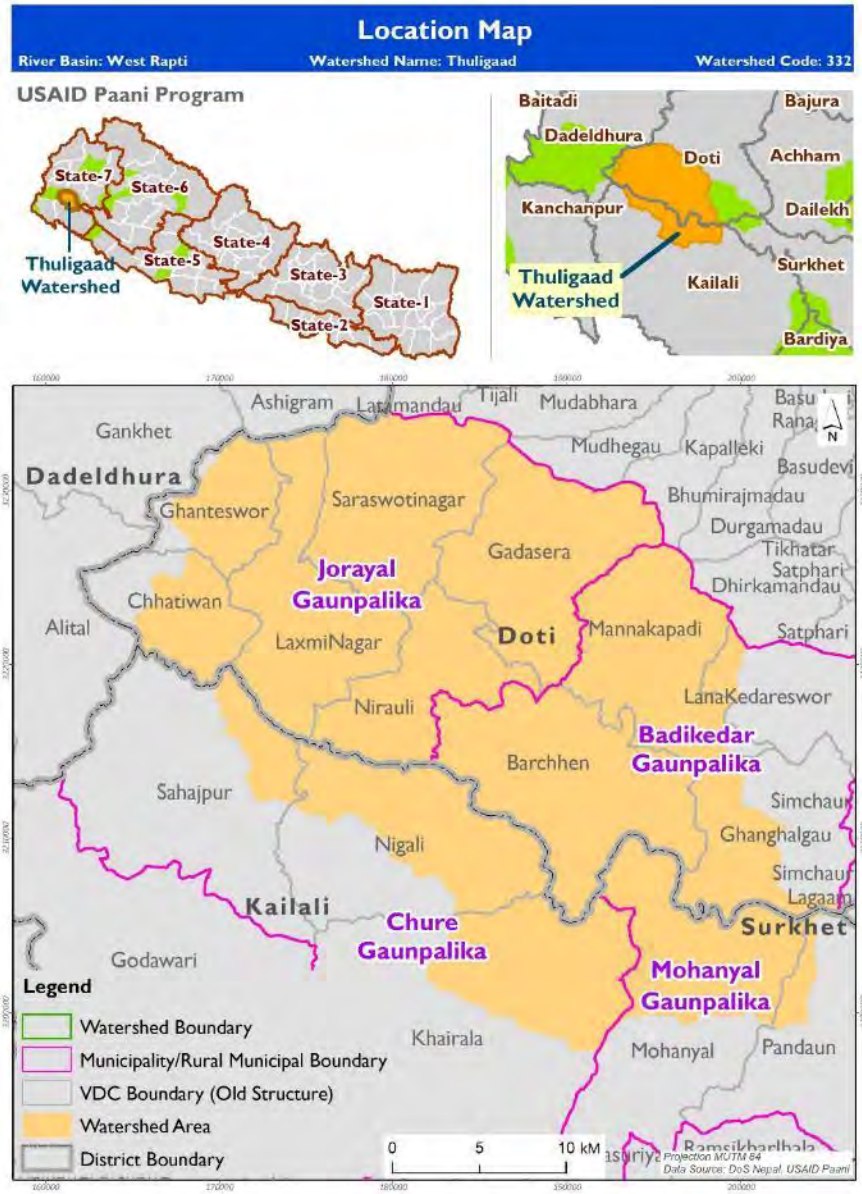

Figure 2: Map of the Thuligaad watershed

The Thuligaad watershed lies in the Karnali River Basin and belongs to parts of Doti and Kailali districts in southwestern Nepal (Figure 2). The watershed stretches across the Jorayal and Baddikedar rural municipalities (in Doti), and the Chure and Mohanyal rural municipalities (in Kailali) District.

In the Thuligaad watershed, 17 streams and 156 tributaries flow into the Karnali River, the major waterway of the region. Local households say many of these streams and rivulets are shrinking and drying due a variety of causes: natural disasters, human activity, and over exploitation of mines and forests. Each of these factors imposes a negative effect on freshwater biodiversity. The watershed has four freshwater lakes (Brahm, Jwalaban, Rakxes and Chhatiwan), which are important habitat for aquatic species in the region.

Major groups in the watershed include Brahmin/Chhetri/Thakuri (59%), Dalit (17%), and a wide range of Janajatis (24%), including Magar, Badi, Majhi, Lama, Bhote, Gurung and Newar (CBS, 2011). For livelihoods, agricultural and livestock breeding are most common, while more and more young people are migrating abroad and within Nepal for work. Gravel mining, commerce and short-term labor are other common forms of livelihood usually practiced in combination with agriculture.

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

2.2 WATER AVAILABILITY AND QUALITY

The Thuligaad watershed is a complex network of various streams and rivulets. One hundred and fifty-six tributaries flow through the area comprised of 17 sub-watersheds, as denoted by the District Soil Conservation Offices (DSCO) of Doti and Kailali. Figure 3 illustrates how this river network extends through the watershed.

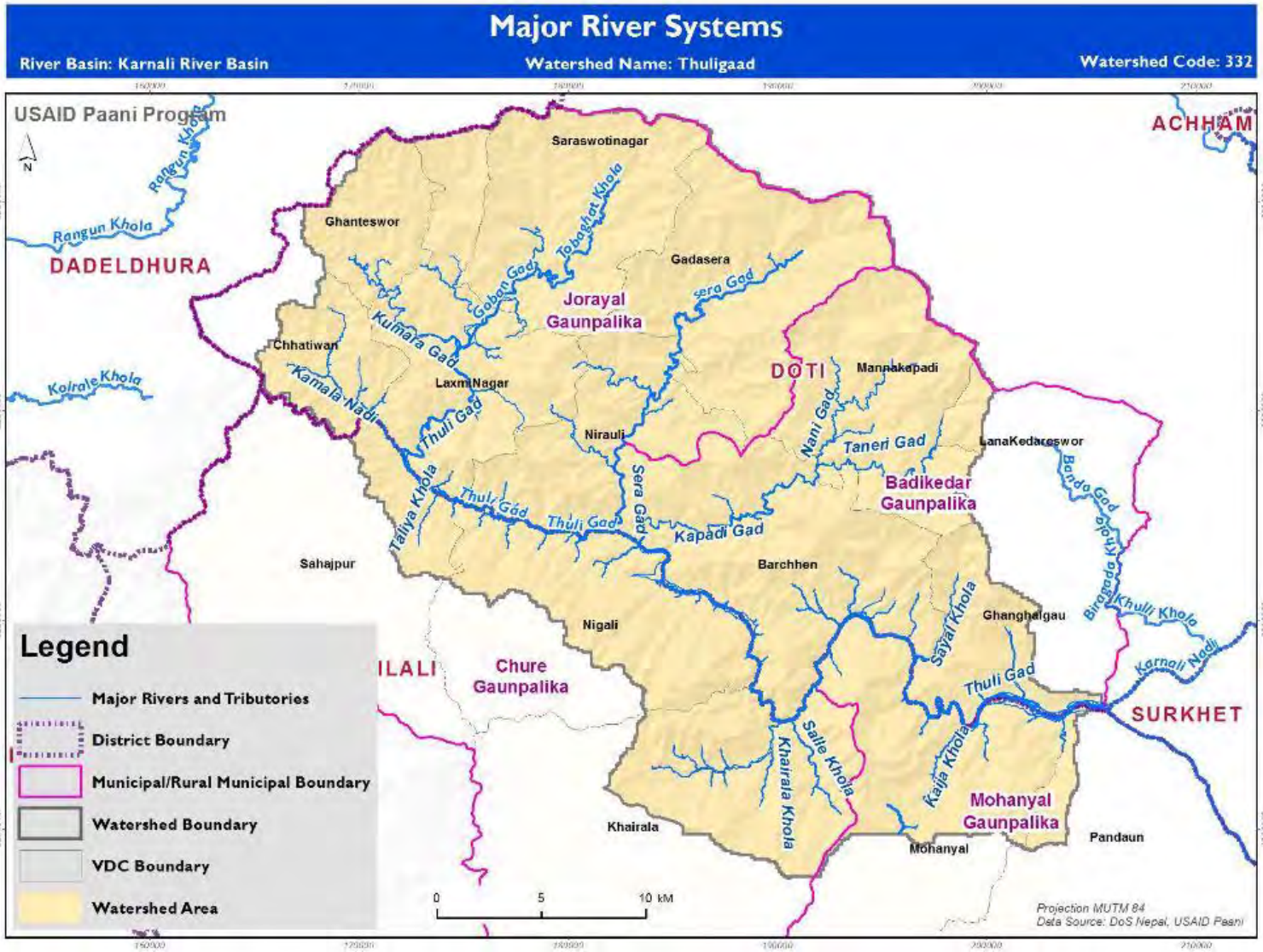

Figure 3: The river network in the Thuligaad watershed

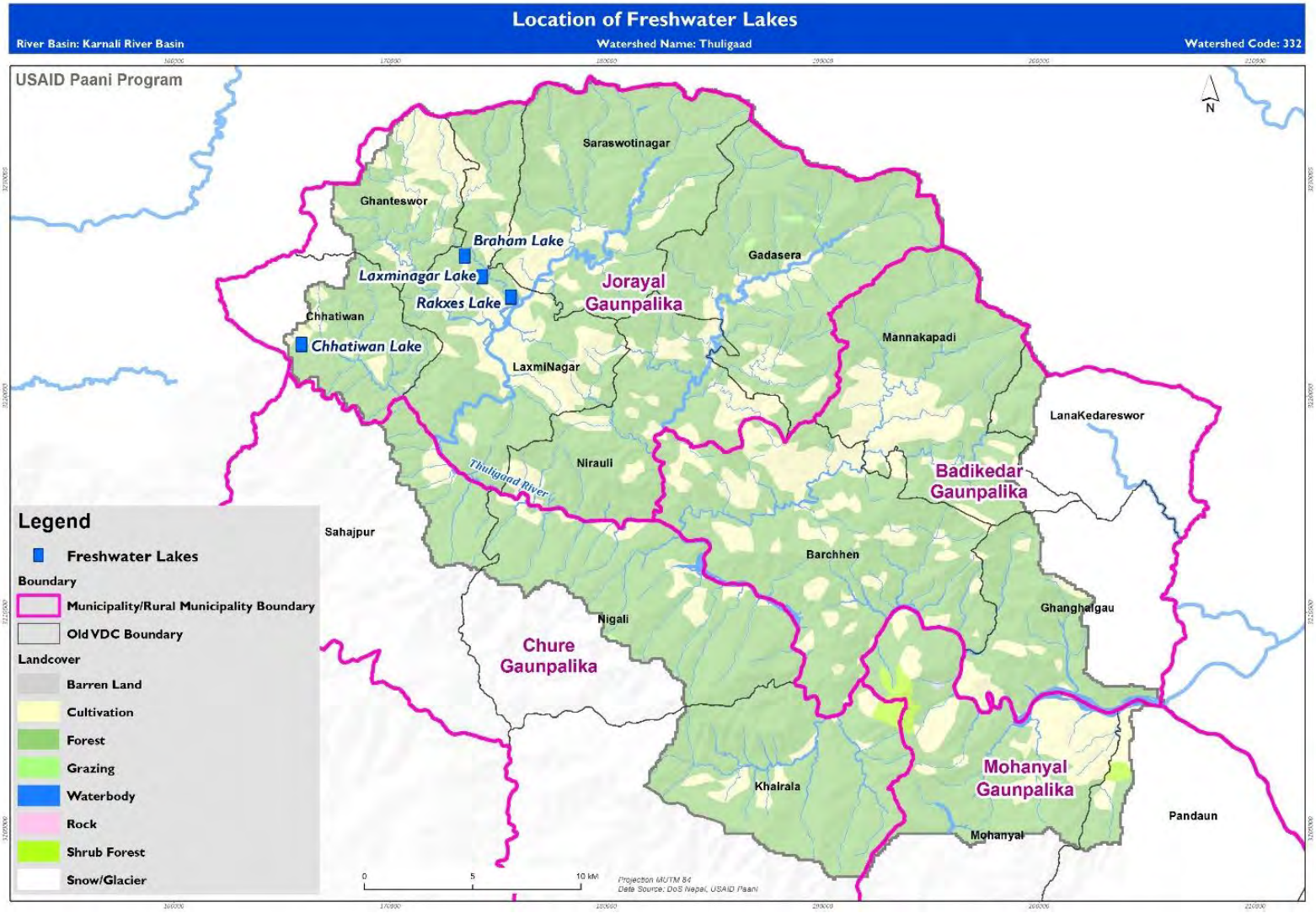

Figure 4: Location of freshwater lakes in the Thuligaad watershed

Streams and rivulets are the main sources of water, used for drinking, irrigation, sanitation, and hydropower. This watershed has four freshwater lakes: Braham, Jwalaban, Rakxes, and Chhatiwan (Figure 4). These bodies are important habitat for aquatic species, especially fish and migratory birds. Several species of indigenous fish are also located here. Residents have concerns about invasive species in the lakes and report that debris from road construction is affecting the quality of the water and lake habitats.

To access water for domestic use, most households use piped systems (72%), followed by surface water extraction (18%), dug wells (2%), waterfalls (4%) and tube well boring (1%). More than 97% report having trouble in accessing water due to drying water sources. In many areas (e.g., Mannakapadi and Ghangalgau of Badikedar GP, Khairala and Nigali of Chure GP, Mohanyal of Mohanyal GP, and Nirauli of Jorayal GP) respondents say springs and are drying out. Biophysical test results reveal that water quality of the Thuligaad River and its tributaries is suitable for irrigation and domestic use.

Ninety-nine percent of households have a toilet, largely due to anti-open defecation efforts in the area.

The watershed has great potential for developing micro-hydropower, and five plants are already operation with another six in the planning phase. Each of the plants has conducted an environmental impact assessment (EIA) but none has an emergency action plan (EAP) on site.

Regarding irrigation schemes, there are 16 small and medium sized projects in the watershed, serving 439 hectares among 1,400 households.

Residents in every part of the watershed reported that smaller streams and tributaries are under threat from numerous influences, including human activity and overexploitation of forests and gravel.

Water discharge in five tributaries of the Thuligaad watershed was estimated using the floating method and area velocity during a biophysical survey on the availability of water from November to February 2017 (Table 3). Numerous tributaries on the northern side of the watershed were completely dry at that time.

Table 3: River and stream discharge rates

Name of Rivers / Streams	Latitude	Longitude	Elevation (m)	Date of measurement	Estimated Discharge (L/S)
Karnaso Khola	29.04716	80.62635	925	1-Apr-17	194
Kapadigaad	29.00596	80.7490	712	2-Apr-17	700
Kamala Nadi	29.00536	80.7491	719	2-Apr-17	1,195
Thuligaad	29.042998	80.63281	933	1-Apr-17	1,090
Gadserigaad	29.012978	80.73689	704	2-Apr-17	338

Source: Paani biophysical measurement survey, 2017

Overall, we find decreasing river discharge trends during pre-monsoon, monsoon and post-monsoon. However, river discharge during the winter season has been increasing at the rate of 0.1 m3/s year. The decreasing trend of precipitation and the increasing trend of temperature are the main drivers in the decreasing trend of discharge. The increasing trend of rainfall during winter season has resulted in an increase of discharge during the winter.

Rising water scarcity has led to occasional conflict among communities and community members in the watershed. Recent cases from Karnaso Khola and Bisalla Gad illustrate this problem where farmers disputed equality of access to an irrigation canal. For this reason, the role of water user groups and water management committees are becoming more central and more important to adjudicate and rectify these issues. In cases of unequal access to water, Dalits and Janajati are most commonly excluded due to their landless status.

GESI Issues: Caste-based discrimination is still practiced in various communities of the watershed. These discriminations take the form of restrictions placed against lower castes from using the same water sources as Brahmins and Chhetris. Although police can be consulted to resolve these disputes, most Dalits feel this discrimination persists.

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

Related annexes

Annex 5: Lakes, streams, rivers, and sub-watersheds
Annex 13: Micro hydropower – potential rivers and streams
Annex 14: Irrigation projects
Annex 15: Water quality

2.3 LAND USE AND LAND COVER

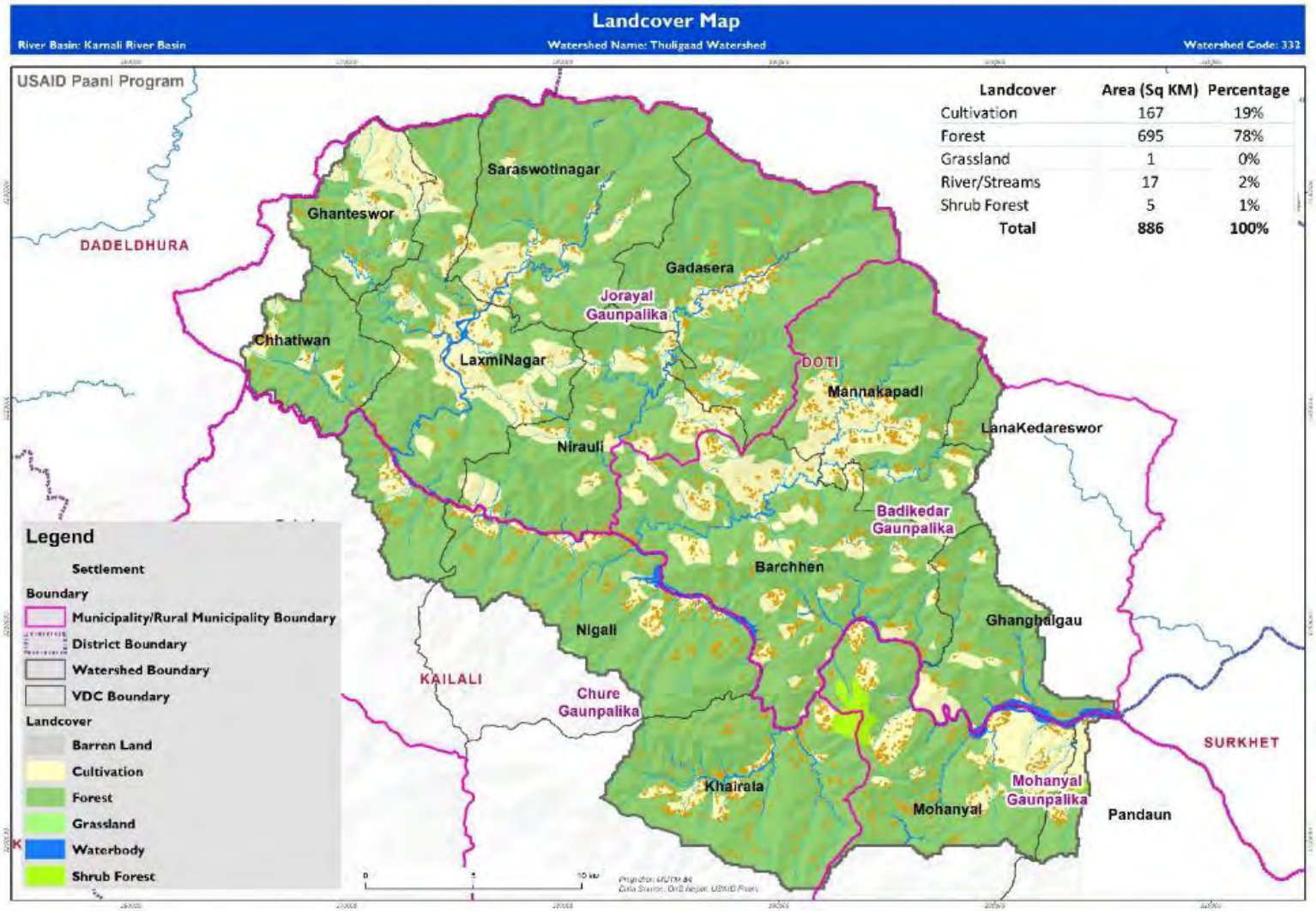

Figure 5: Land use and land cover type in the Thuligaad watershed

Turning to land cover and vegetation, the National Forest Inventory documents four types in the Thuligaad watershed: forest (78%), agricultural and pasture land (19%), other wooded land (1%), and shrub land (0.3%). Rivers and streams account for 17 square kilometers (sq. km) of land cover, or 2% (Figure 5).

The forested area is primarily mixed hardwoods (43%) and pine (37%). The Chir pine are used to harvest resin for industrial use (Figure 6).

Despite the significant forest coverage in the watershed, loss and gain data from Global Forest Watch (Figure 7) from 2000-2016 show that forest cover has decreased 630 ha in some areas (1%) while 110 hectares (ha) (0.2%) have been added in other parts. Looking more closely at the Figure 7, we can see that large patches of forest loss have been reported in Chhatiwan, Laxminagar, Sahajpur, Nigali and Mohanyal VDCs.

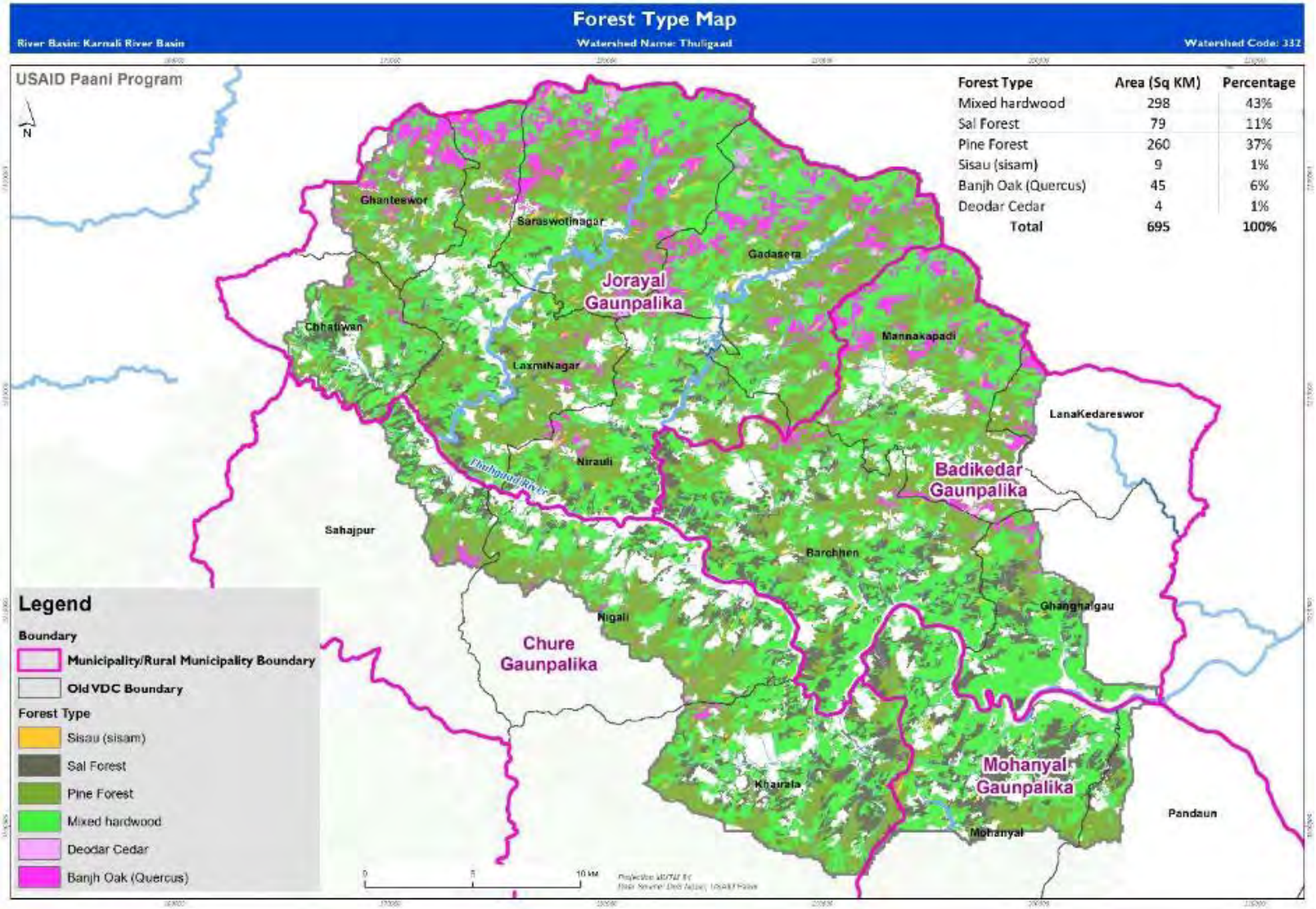

Figure 6: **Forest coverage by type in the Thuligaad watershed**

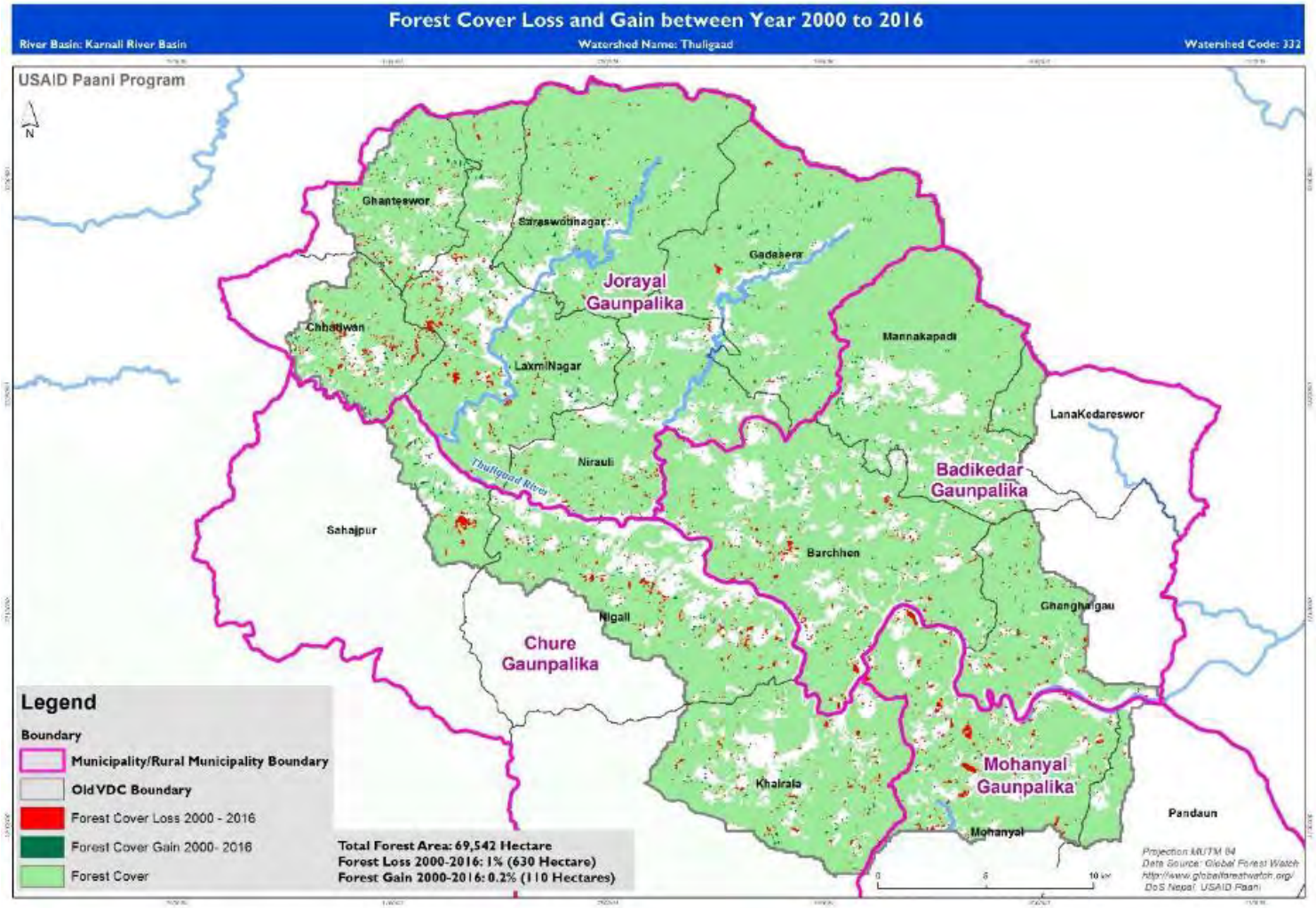

Figure 7: Forest cover and gain in the Thuligaad watershed from Global Forest Watch

Related annexes

Annex 6: Forest types and composition

2.4 BIODIVERSITY AND INVASIVE SPECIES

The Thuligaad watershed contains numerous and diverse habitats for aquatic and terrestrial species among its numerous forests, rangelands and wetlands. The forests are dominated by pine (*Pinus roxburgii*) and mixed broad-leaved trees including Sal (*Shorea robusta*) in lower altitudes and Quercus at higher elevations.

The watershed has four freshwater lakes – Brahm, Jwalaban, Rakxes, and Chhatiwan – that provide important habitat for fish and migratory birds. While data on biodiversity in the Thuligaad watershed is scarce, through discussions with respondents and by consulting secondary sources, we determined that 17 wildlife species of national and global importance, nine species of reptile, and 20 species of birds can be found in the area. Regarding aquatic vegetation, the District Forest Office (DFO) reports 16 species of aquatic vegetation currently present. Twenty-seven species of fish have been reported in the watershed, 14 of those verified through a biophysical survey.

Related annexes

Annex 7: Climate change impacts: biodiversity and vulnerabilities
Annex 8: Fish and aquatic life
Annex 9: Mammals and population trend
Annex 10: Reptiles and population trend
Annex 11: Birds and population trend

2.5 CLIMATE AND PHYSIOGRAPHY

There are four prominent climatic seasons in Nepal: winter (December –February), spring/pre-monsoon (March-May), summer/monsoon (June-September) and autumn/post-monsoon (October-November). Temperature and rainfall variations persist not only by season but also by altitudinal gradients. Rainfall and temperature data from nearby metrological and hydrological stations in Doti and Dipayal suggest the mean monthly temperature ranges from 15°C in winter to 31°C in summer.

Within the Thuligaad watershed, the average annual temperature is 23°C. Similarly, the mean maximum and minimum monthly temperature ranges for the watershed range from 5°C to 24°C in winter to 21°C and 40°C in the summer. From a historical perspective, analyzing temperature and precipitation from 1976-2005, Marahatta et al. (2009) finds an overall increasing trend for both, not only in Thuligaad but in all of Nepal.

2.5.1 RAINFALL

In terms of rainfall, there is a clear monsoonal pattern with the highest rainfall from June to September. The mean annual rainfall recorded in the watershed is 1,122 mm, of which more than 80% falls during monsoon. The highest and lowest monthly rainfall occur in the months of July and November, respectively. In the dry season of November to April, the average monthly rainfall is 94 mm/month.

Spatial as well as seasonal variations in rainfall were observed in Thuligaad watershed; however, the trends are not consistent. In the western part, annual rainfall showed a decreasing trend but increased towards the eastern region. The rate of change varied from -10 mm/year in the western part to 10 mm/year in the

east (Figure 8). Similarly, mean monsoon (June-Sept.) rainfall change varies from -10 mm/year in the western part to 10 mm/year in the eastern part the watershed. Mean winter rainfall (Dec.-Feb.) is observed to increase at the rate of 1.6 - 2 mm/year. The mean pre-monsoon (Mar.-May) rainfall change rate varies from -1mm/year in the east to -2 mm/year in the west. Finally, mean post monsoon season (Oct.-Nov.) rainfall is observed to decrease at the rate of -1 mm/year throughout the watershed.

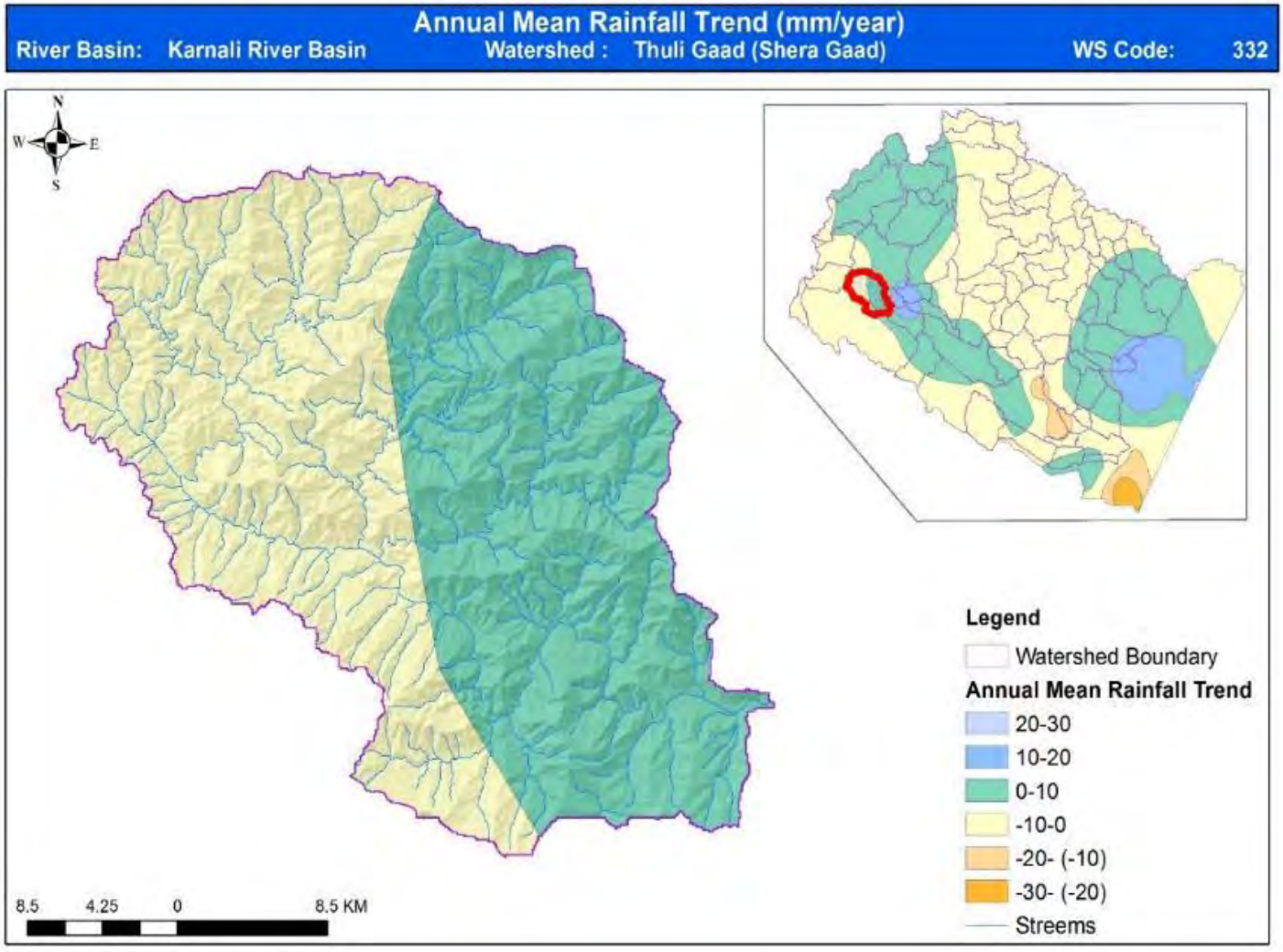

Figure 8: Long-term annual mean rainfall trend (mm/year)

2.5.2 TEMPERATURE

Temperature variations in the Thuligaad watershed have also been analyzed along the four major seasons. As there are no long-term temperature recording stations in the Thuligaad watershed, the profile used data recorded at the nearest stations: Godavari (215), Dipayal (218) and Dadeldhura (104).

In addition to the seasonal temperature variation, which was expected, differences in topography also induce spatial variation of temperature (Figure 9). Long-term temperature data recorded in the Rapti, Karnali and Mahakali river basins were used to determine the temperature change rate with respect to the elevation change.

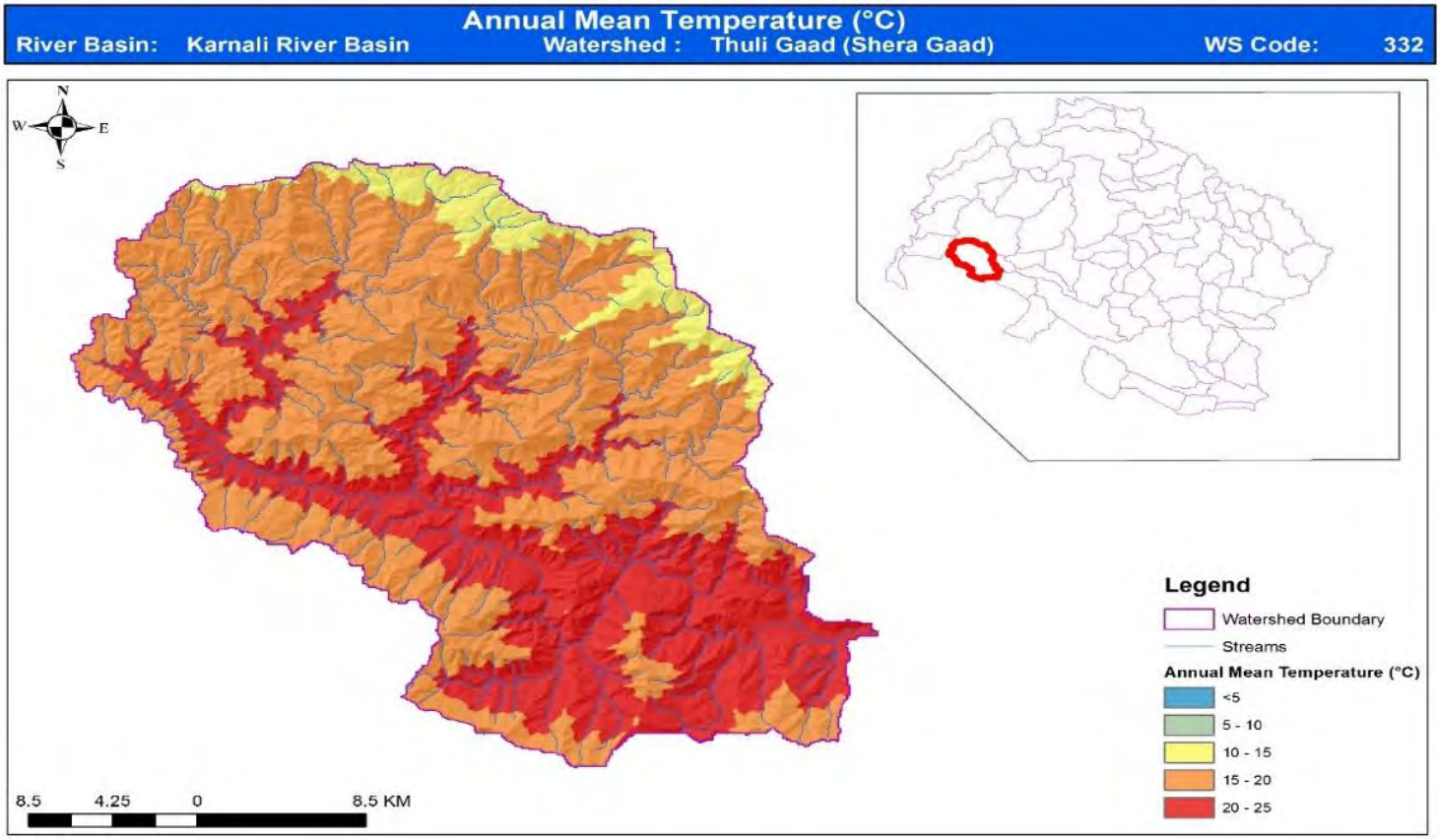

Figure 9: Mean annual temperature (^{0}C) distribution

Related annexes

Annex 4: Temperature and precipitation

2.6 CLIMATE RESILIENCE AND DISASTER RISK REDUCTION

With the onset of climate change impacts (Table 4), watershed residents are beginning to realize the importance of climate resilient activities to fortify their livelihoods in the short- and long-terms. Examples of climate resilience activities include tree planting, water source protection, sprinkler irrigation, solar pump irrigation, and rainwater harvesting, among others.

Three percent of households surveyed reported they had adopted at least three climate resilient activities. Seven percent had adopted two, and 10% had adopted one.

Climate resilience is also garnering greater attention in local government offices. In Doti and Kailali, District Disaster Preparedness and Response plans have been prepared by the respective District Disaster Relief Committees (DDRC).

Table 4: Major climatic hazards and vulnerability ratings by location

Climatic Hazards	Vulnerability	Location/Places	
		Doti	Kailali
Climate and water induced hazards (Flooding, river cutting and landslides)	Very high	Nirauli-7, Barchhen-6, Ghangal-3, Chachari, Simali, Chhatiwan, Laxminagar, Niroli, Barchhen, Gadsra,	Nigali, Khairaula, Mohanyal
Forest fires	High	Pipalkunde, Thali, Chhapanna, Laskar	Khanidand, Sahajpur, Mohanyal
Invasive species in lakes and natural ponds	Low	Chhatiwan, Thuligaad, Gadsera (Chirkatte area)	Khairala
Drying water sources	High	Dharapani, Chhativan, Khar, Puran, Patal, Thali and Alad	Chure, Mohanya, Khairala

Source: Paani multi-stakeholder consultation workshop, 2017

GESI issues: In Thuligaad, the challenges posed to water availability and accessibility are felt more acutely by girls and women who shoulder the burden for fetching water daily. Surveys found that girls and women spend between 1-2 hours daily collecting water, and sometimes even more during the dry season. This time could be devoted to other tasks and self-improvement (e.g., education, literacy training, and job skill development).

Households surveyed revealed numerous climate-resilient activities underway, such as fruit tree plantation, kitchen and waste water reuse for gardens, and promotion of off-season vegetables for sale.

In Laxminagar and Saraswoti VDCs, local governments had drawn up Local Disaster Risk Management Plans (LDRMP). However, we did not find any early warning systems operating in the watershed. Instead, local governments rely on radio and newspapers to inform residents of impending disaster risks.

3. WEALTH

The estimated population of the Thuligaad watershed is 42,227, distributed evenly between males and females. The population density of the area is low (56 people/km^2), concentrated primarily in small urban settlements such as Gairabazar, Budar, Laxmingar, Saraswotinagar, Bipinagar, and Mannakapadi. Fifty-nine percent of the population identifies as Brahmin/Chhetri/Thakuri, 24% as Janajati, and 17% as Dalit.

Agriculture and livestock herding are the primary sources of livelihood. Soil in the watershed is fertile and suitable for cereal crops of many variations.

Many households necessarily diversify their income sources to protect against shocks by fishing, gravel mining and migrating for labor (seasonally and abroad). In spite of these measures, securing sufficient income beyond the present needs remains a constant challenge (Figure 10).

Figure 10: Household income sufficiency in the Thuligaad watershed

GESI issues: Dalit communities struggle in their traditional occupations, such as metalsmithing, tailoring, and shoe making, among others. They are increasingly having to compete against cheaper, industrially-produced goods brought to market from urban areas.

Twenty-two percent of respondents in the household survey said at least one family member had a bank account in a recognized financial institution. Of this 22%, 41% are Brahmin/Chettri/Thakuri, 11% Dalit, and just 8% Janajati. In the watershed, there are three commercial banks, four micro-finance services, and 13 cooperatives providing financial assistance to personal and commercial ventures.

To bolster livelihood security, we observed several climate-smart technologies in use in the Thuligaad watershed. These technologies include green manure and composting, kitchen water reuse, and fruit tree plantation.

3.1 FISHING PRACTICES

In terms of fisheries, there is a strong relationship between fish stocks and fish-dependent livelihoods. In the lakes, rivers, and streams of the watershed, 27 species of fish and 16 species of aquatic vegetation were reported. Of those species, *sahar, zebra machha, buche asla, asala soal, chuche asla,* and *rajabam* are commercially valuable native fish species. Surveys reveal that 69% of households perceive that native fish species are declining. This perception is supported by a rise in the use of destructive fishing practices, such as gill nets and draining water.

Fish are harvested in numbers sufficient only for sale in local markets in Bipinagar, Laxminagar, Gadsera, and Sahajpur, among others.

3.2 AGRICULTURAL PRODUCTIVITY

The major sources of livelihood in the Thuligaad watershed include agriculture, labor (migratory), and gravel mining.

Agricultural land (14.7% of total land) in the watershed is both rain fed and irrigated, and approximately 37% of this land is irrigated (15% with permanent irrigation). A favorable monsoon climate and fertile soil enable this watershed to be one of the most productive in the region.

However, climate change impacts and other human factors are contributing to a decline in production, and this is reflected in local perceptions: 59% attributed productivity declines to climate change. Ninety-one percent say climate change has led to decreased soil fertility over the past decade.

Major crops include rice, millet, maize, wheat, barley, buckwheat, mustard, potato, tobacco, lentil, beans, soybeans and sugarcane. Farmers can draw technical and administrative assistance from several line agencies such as the Agriculture Services Center (ASC) and Livestock Service Center (LSC). Surplus produce for market is taken to one of two collection centers in Ghanteshowr and Bipinagar and sold at larger outlets in Dhangadhi and Mahendrangar, India.

GESI issues: While irrigation canals are becoming more common in Thuligaad, many Dalit and Janajati cannot benefits from these improvements, as they are landless. Furthermore, these groups are often excluded from hiring to construct these projects.

Several community-managed seed banks and cold storage are available for selling high-quality seed locally. A solar-powered fruit storage facility is available in Nirauli. Markets in Gaira, Budar, and Bipinagar provide a space to sell produce to larger markets. A dairy in Budar collects milk to produce value-added products like sweets, ghee, and yogurt for sale.

Maintaining food security presents another perennial challenge to many families in the watershed. Only 6% of households report having resources to ensure food security for more than 12 months. Full information is presented in Table 5.

Table 5: Food security levels by household

Food sufficiency level	Households	Percentage
Less than 3 months	8,095	19.56
3 to less than 6 months	14,458	34.94
6 to less than 9 months	9,590	23.17
9 to less than 12 months	6,680	16.14
12 months or more	2,559	6.18
Total	**41,382**	**100.00**

Source: DADO Doti, Annual Report, 2016

3.2.1 SOIL MANAGEMENT AND FERTILITY

A large majority of households expressed concern about soil fertility in the Thuligaad watershed: 91% say climate change has led to decreased soil fertility over the past decade. To cope with these changes, many famers have begun opting for chemical fertilizers instead of traditional manures, while other farms use both.

Deforestation, habitat degradation, over grazing, and non-point source pollution were listed as threats to soil fertility. Agricultural runoff was cited as problematic due its tendency to increase soil erosion, which is particularly acute when combined with the steep topography of the watershed.

The Soil and Water Conservation Act (1982) provides strategic direction to implement conservation measures and some authority to declare watersheds as "protected areas'. Although the Act aims to ensure sustainable soil and water management, implementation of its provisions has been low.

3.3 INFRASTRUCTURE

The design and construction of infrastructure can impact watershed health. For example, rural roads that do not follow environment-friendly guidelines can greatly increase soil erosion and the likelihood of landslides. Hydropower plants that impound water can negatively impact aquatic life or downstream farmers who need minimum levels to support their livelihoods. Irrigation canals, if not designed properly, can reduce the water available to some farmers while inequitably delivering more water to others.

As these examples demonstrate, the design, construction and operation of infrastructure needs to account for a range of social, economic, and environmental impacts within a watershed. Sustainable infrastructure should provide equitable distribution of benefits with minimal long-term environmental impacts.

3.3.1 HYDROPOWER

There is no large hydropower in the Thuligaad watershed, however seven micro hydro plants are operational (Salmuni Devi, Masta, Chankatte I, Chankatte II, Gadserigad I, Gadserigaad II and Thulikhali)

and one more is planned (Cheda Gad) for meeting rural energy needs in Doti and three micro hydro (Thuligaad, Ghatte and Bhutka) in Kailali (Figure 11).

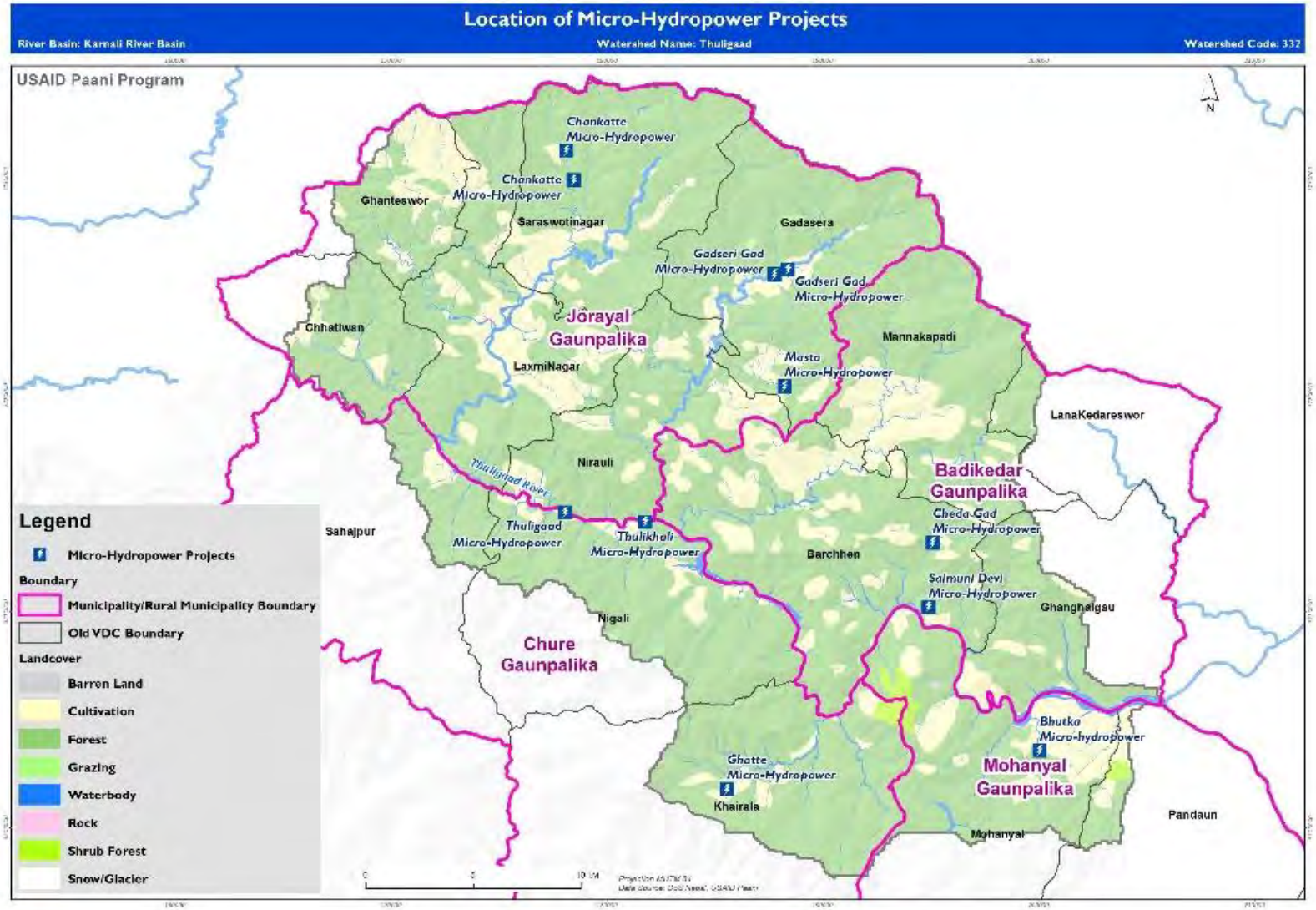

Figure 11: Map of micro-hydropower plants in the Thuligaad watershed

Related annexes
Annex 13: Micro hydro – potential rivers and streams

3.3.2 GRAVEL MINING AND CONSTRUCTION MATERIALS

Gravel mining is present in the watershed at four sites – Laxminagar, Kamalanadi, Bipinagar and Kapadigaad – but residents say the extent of the mining is low and has had negligible negative impacts on the watershed (Figure 12). Proper record keeping of gravel mining operations and assessment of its impact are not available.

All local mining contractors secured licenses through the respective VDCs. In each of the four sites, environmental impact assessments were not conducted prior to operation.

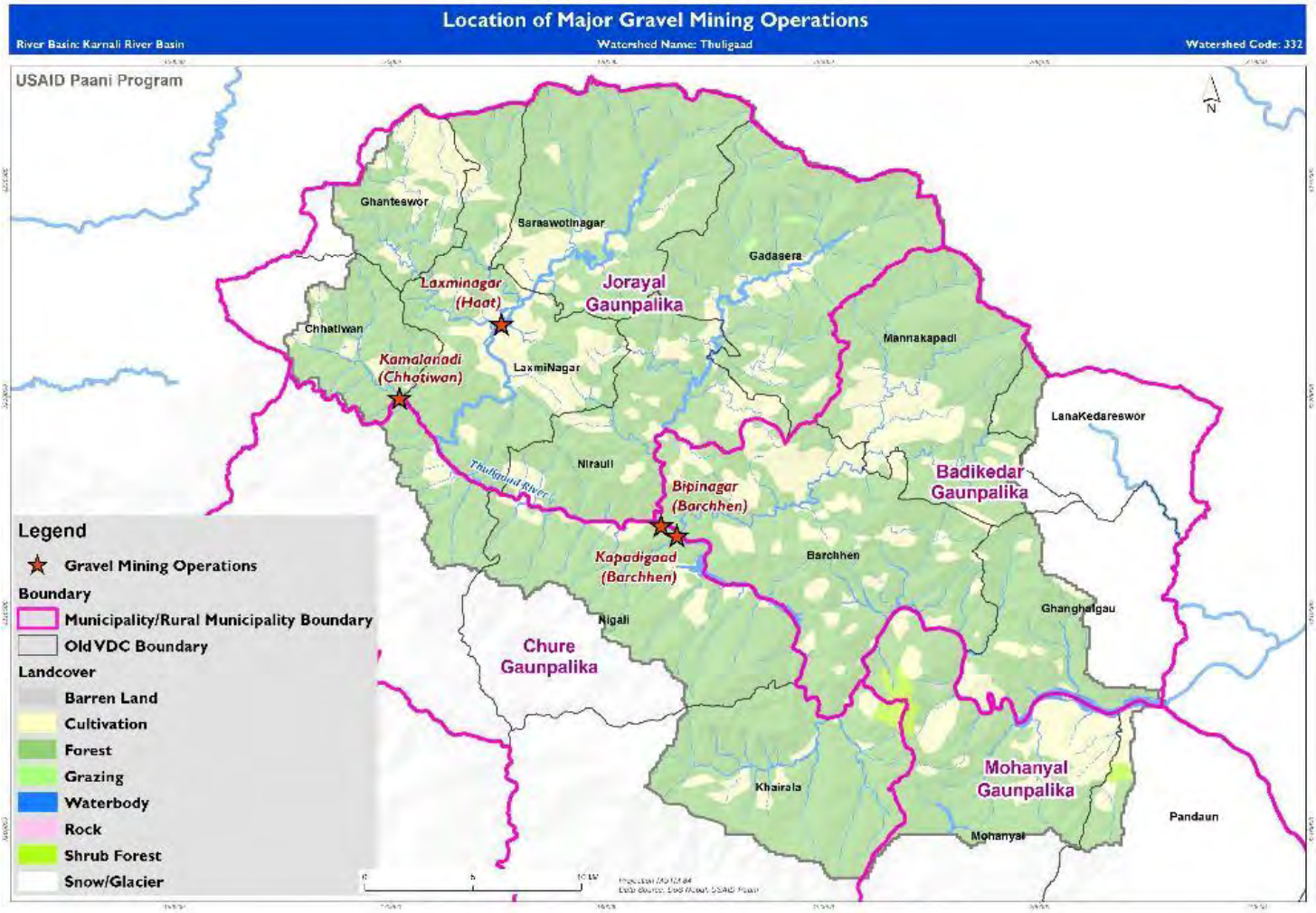

Figure 12: Locations of gravel mining operations in the Thuligaad watershed

Related annexes
Annex 17: Locations of gravel mining operations

3.3.3 ROADS

Bhimdutta Highway is a 50 km strategic road that passes through the watershed, tracking across some agricultural land and a few settlements (Sahajpur, Phaltude, Budar, Gaira, and Bhatkada). Rural roads in the watershed are more problematic. Residents say improperly constructed roads are triggering landslides, increasing river sedimentation, and negatively affecting local aquatic life. While rural road construction has expanded significantly over the past decade, poor and marginalized communities have been neglected in terms of access. The national government has issued standards for promoting safe and eco-friendly road construction, but these guidelines are not followed by contractors and rarely enforced.

Road building is a high priority throughout the watershed and a common first promise of the major political parties. The Division Road Office (in Doti) is currently preparing a master plan for the district and early drafts show that no roads will be built without assessing the potential watershed health issues.

Some households reported that existing roads had improved life for people in the watershed by reducing the time needed for work and travel.

Related annexes
Annex 12: Road networks

3.3.4 IRRIGATION

Streams and rivulets are the main sources of water used for drinking, irrigation, sanitation, energy and domestic purposes. Surveys reveal that water sources are drying out, and some areas (Mannakapadi, Ghagal, Kahirala, Mohanyal, Nirauli and Nigali) are facing acute water stress. Across households, accessing drinking water is most common through piped systems (72%) followed surface water harvesting (18%), waterfalls (4%), dug wells (2%), and tube well boring (1%).

In spite of some major irrigation canal construction in the watershed (e.g., Saraswotinagar, Jorayal), many Janajati and Dalits could not take advantage of this development because most are landless. Furthermore, few Janajati and Dalits were employed to help construct these projects.

There are both formally and informally managed community irrigation schemes in the watershed. The formal schemes can be reviewed in Annex 14. The informal schemes consist of traditional irrigation channels made from mud, stone, wood or plastic. The community collectively maintains the operation of the system through regulations agreed upon by the community. Details about the number and length of these system is not available, nor statistics about people served by irrigation by caste and ethnicity.

Related annexes
Annex 14: Irrigation projects

3.4 SOLID WASTE AND MANAGEMENT

Solid waste (e.g. garbage, plastics) in the watershed emanates from a number of sources, and the lack of sanitation systems (personal and village-wide) threatens water quality and aquatic life.

For garbage disposal, most households still incinerate (53%), while 14% discard refuse in the river, 15% use a local landfill, and 31% use it as compost. Kitchen wastewater was most commonly disposed to the family garden (81%), followed by the sewer (28%), rivers and ponds (18%) and the septic tank (3%).

Major sources of non-point source pollution include plastics, glass, paper, metals, kitchen waste, and animal carcasses. Agricultural runoff contaminated with agro-chemicals is a rising concern.

Village observations found no formal modes of garbage disposal in the watershed. Households reported taking daily waste to rivers and barren areas, or incinerating waste outside the home.

Major pollution points in the watershed include Budar, Sahajpur, Bipinagar, Gaira, Bhatkada, Khanidanda, Jorayal, Khimadi, Mohanyal, and Nigali (Figure 13).

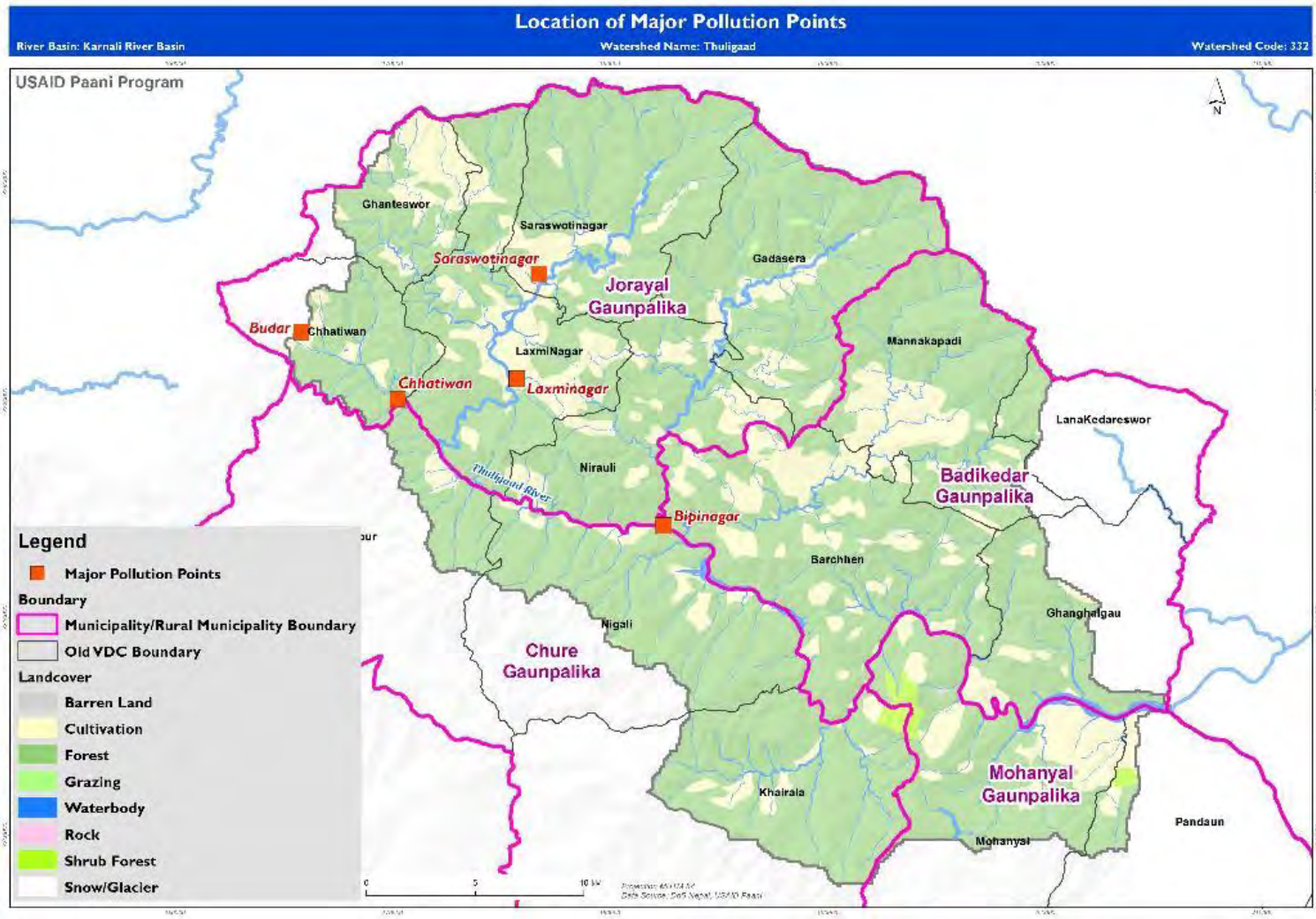

Figure 13: Major pollution points in the Thuligaad watershed

Related annexes

Annex 16: Major pollution points

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 Thuligaad watershed. Analysis indicates there is a need to better understand how current institutional arrangements related to, for example, fisheries and gravel mining are positioned (or not) to improve resource sustainability and benefit sharing with local populations.

Prior to the government's constitutionally-mandated switch to a federal structure and elections to the local government in 2017, the District Development Committee (DDC) oversaw leasing of ponds, lakes, and river stretches to private contractors for fishing and gravel mining. Today, that authority will rest with the local government.

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

4.1 ACCESS AND INCLUSION

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

4.1.1 ACCESS TO WATER FOR DOMESTIC AND AGRICULTURAL USE

Drying water sources are a major cause for concern in the Thuligaad watershed. While the issue of drying springs is still not perfectly understood, landslides, forest fires, eradicate many water sources and improperly constructed roads. Women who bear the burden for obtaining daily water and firewood for domestic use acutely feel the impact of drying water sources. Surveys revealed that women spend on average 1.5 or more hours per day in dry season than in the wet season obtaining water for their families.

Access to water issues also create conflict, particularly in regard to caste-based discrimination, which forbids lower castes from taking water from taps and sources used by higher caste families. We did learn of one police case filed by Dalit families that was eventually remediated through negotiation. One family sought remedy against the discrimination and/or untouchability perpetuated against him and his family, which is prohibited by article (24) (1) of the Constitution Nepal[3].

[3] Article 24 (1) reads:

> No person shall be subjected to any form of untouchability or discrimination in any private or public places on grounds of his or her origin, caste, tribe, community, profession, occupation or physical condition.

The Constitution of Nepal stipulates that the federal, state, and local levels of government exercise the power of the State of Nepal pursuant to article 56(2). Certain legislative and executive powers have been vested in local level government (*nagar palika* and *gaun palika*), such as environmental conservation and biodiversity, local roads, agriculture, irrigation, drinking water supply, small hydropower, disaster risk reduction, and conservation of watersheds and wildlife (Schedule 8). At the same time, the federal, state, and local levels of government hold concurrent power on a range of other issues, including forest and jungle management, water use, ecology and biodiversity (Schedule 9). The willingness and ability of government entities to exercise these powers within the cooperative model of federalism has significant implications for the conversation of freshwater biodiversity and community resilience.

These new governance responsibilities suggest the time is appropriate to work closely with local authorities to develop plans to promote improved watershed health. The following 19 agencies are the main agencies responsible in the Thuligaad watershed for water resource management:

- Two District Coordination Committees (Doti, Kailali)
- Four Rural Municipalities (Jorayal, Badikedar in Doti; Chure and Mohanyal in Kailali)
- Two Irrigation Development Divisions (Doti, Kailali)
- Two Water Supply and Sanitation Division Offices (Doti, Kailali)
- Two District Soil Conservation Offices (Doti, Kailali)
- Two District Forest Offices (Doti, Kailali)
- Two District Agriculture Development Offices (Doti, Kailali)
- Two District Administration Offices (Doti, Kailali)
- One District Plant Resource Office (Kailali)

While there is no existing inventory of water sources for the watershed, household surveys and focus group discussions revealed that water sources were drying up and the amount of water available in operating springs had decreased.

Related annexes
Annex 20: Irrigation user groups
Annex 21: Water and sanitation user groups

4.1.2 ACCESS TO EARLY WARNING SYSTEMS AND DISASTER RISK REDUCTION

There are no sufficient early warning systems (EWS) along the streams and waterways of the Thuligaad watershed, thus increasing the potential for loss of life and property in the event of a natural disaster. When hazards arise, the District Disaster Response Committee (DDRC) and District Administration Office (DAO) in Doti and Kailali broadcast alerts to the community via SMS, radio, television, telephones, and newspapers. The DAO instructs media to broadcast these messages for 24 hours as jingles, SMS and video clips, and mobilizes security forces for rescue and response.

Despite these efforts, most residents expressed concern that deadly disasters were likely in the future. Surveys reveal that only 14% of households say they have an EWS in their community, and of this group, 92% of households said they had access to it.

4.1.3 ACCESS AND INCLUSION IN LOCAL NATURAL RESOURCE MANAGEMENT PLANNING

The land, water, flora and gravel of the Thuligaad watershed comprise the major natural resources of the area. And each of these faces numerous threats from, deforestation, habitat degradation, unsustainable agricultural practices, and non-point source pollution, among others. These challenges are exacerbated by the watershed's steep topography and a general lack of suitable land for crops.

For these reasons, awareness, access and inclusion of local NRM planning is a strong indicator of watershed health.

In the Thuligaad watershed, 17% of households said they were aware of local level planning processes such as VDC planning, Local Adaptation Plans of Action (LAPAs) and Community Adaptation Plans of Action (CAPAs.)

Forty-three percent of respondents said they knew about NRM committees active in the community, such as community forest user groups (CFUG), farmer groups, and drinking water groups. Of this 43%, 44% belong to a CFUG, 30% belong to a drinking water group, and 21% belong to a farmers' group.

Guidelines for user groups, such as CFUGs stipulate that a woman must be elected or appointed at least to one of the leadership positions and that the executive committee needs to include representatives of persons from all castes and ethnicities in that area. Other provisions require that persons from marginalized groups be included in leadership posts.

Surveying NRM groups in Thuligaad, 7% of leadership positions were occupied by either women or a person from a marginalized group.

Almost 7% of the respondents belonging to women and marginalized groups were placed in leadership positions. In terms of access to decision making roles, 10.5% of respondents from BCTS hold leadership positions in contrast to only 4.8% of Dalit. Since only 7% of women and marginalized groups, and only 4.8% of Dalits hold decision making positions, their voices are not heard nor is their agency promoted. However, it should be noted that women play a significant decision-making role in household water management. In our survey, we found that 81% of women have that authority in the household. Meanwhile, looking at irrigation water management, we find that only 20% of women in our survey hold decision-making authority. This reality is also substantiated by the fact that only 31.5% of respondents reported having access to services from such committees. Local governments, CSOs, and citizen groups need to take this issue seriously and give priority to representation and participation of women and other marginalized groups in NRM planning and decision making. First, their representation needs to be increased in user groups, user committees and NGOs. This should be implemented during the nomination and/or election process to ensure they hold at least one of the leadership positions.

4.1.4 ACCESS TO BENEFIT SHARING IN THE WATERSHED

User groups for water and forests are entities that employ participatory practices to ensure equitable distribution of benefits derived from natural resources.

As more than 70% of Nepali households depend on agriculture, community management of forests has been a critically important, and largely successful, intervention in terms of forest restoration and developing broad strategies for livelihood improvement and poverty reduction.

The immediate livelihood benefits afforded by a community forest user group strengthen collective action to support sustainable harvesting of forest materials. These groups also foster a view to entrepreneurship as communities join together to add value to forest products by transforming raw materials into market-ready products that can fetch higher prices in the market place.

Irrigation development is another benefit that can be fraught with conflict. For example, major irrigation canals were built in Sarawotinagar (Joyayal GP), but few Janajati and Dalits were able to take advantage, as they are landless. Furthermore, few members of these groups were employed to help construct this project. Given their landless status, one equitable gesture would be to give Janajati and Dalit priority for jobs in construction projects like these.

Related annexes
Annex 18: Community user forest groups
Annex 20: Irrigation user groups
Annex 21: Water and sanitation user groups

4.2 COMMUNITY ACTION AND RESPONSE

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

4.2.1 CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

As a majority of the population in Thuligaad is still dependent on climate-sensitive agriculture, variations in temperature and precipitation are causing serious livelihood distress to communities in the watershed. To adapt to these changes, many farmers have adopted climate-smart technologies to strengthen their crops and livestock and to promote resilient food systems. Some of these technologies include solar-powered irrigation pumps, plastic water storage ponds, drip irrigation, and conservation farming techniques that do not require tillage for plantation of seeds.

At the policy level, the government of Nepal has developed a National Adaptation Plan of Action (NAPA), while delegating authority to the VDCs and rural municipalities to develop Local Adaptation Plans of Action (LAPA) and Community Adaptation Plans of Actions (CAPA). Nepal's current NAPA promotes climate-smart technologies as described above and advocates for building capacity in rural districts to diversify livelihoods and income sources as another source of buffer against future shocks.

Preparation and implementation of LAPAs and CAPAs in the Thuligaad watershed has been slow and uneven. LAPAs have been prepared for Ghanteshwor and Laxminagar VDCs (in Jorayal), but updates are needed and implementation has been sluggish, according to local representatives. More information is available in Annex 22.

Related annexes
Annex 22: Areas with prepared LAPAs
Annex 23: Statuses of existing environment management plans

4.2.2 NATURAL RESOURCE MANAGEMENT GROUPS AND ACTIVITIES

As water resources are a shared resource, the formation of user groups to collectively manage these resources has become common in Thuligaad. These user groups serve under various government authorities (e.g., DDC, DFO, DADO) and seek to improve water use and management.

Numerous irrigation, water, and sanitation user groups function the Thuligaad watershed. Nine irrigation groups cover 305 hectares in the watershed and affiliate with the district chapter of the Nepal Federation of Irrigation Water Users' Network (NFIWUAN). Six water and sanitation user groups cover 70 hectares and work closely with the district office of the Federation of Drinking Water and Sanitation Users Nepal (FEDWASUN). The Nepal Federation of Indigenous Nationalities (NEFIN) works closely with both forms of user groups to ensure that rights-based issues on natural resource access are addressed.

Community forest user groups (CFUGs) are extremely active in the Thuligaad watershed: 65 groups representing 5,800 households manage more than 19,380 hectares of forest.

These groups face numerous challenges for improving their effectiveness. Some of these challenges include limited resources and knowledge, remote locations that inhibit idea-sharing with other user groups, changing environmental policies at the government level, and areas of forest that are too large to manage (only in the case of CFUGs).

Related annexes
Annex 18: Community user forest groups
Annex 20: Irrigation user groups
Annex 21: Water and sanitation user groups

4.2.3 COMPLIANCE WITH LAWS AND POLICY PROVISIONS

Surveys and focus groups revealed a generally low knowledge of existing environmental policies and provisions, and an equally low compliance with these regulations where they were known. The primary reason for this is the remote location of many communities in the Thuligaad watershed where they have limited interaction with government officials and representatives. As a result, creating a culture of environmental conservation and a shared interest in promoting watershed health will require significant outreach to equip citizens with relevant information.

For example, despite the fact that the Aquatic Animals Protection Act forbids harmful non-traditional forms of fishing, 69% of households in our survey said that fish numbers were declining due to these practices.

4.3 GOVERNANCE

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

Through FGDs and KIIs, respondents expressed their growing awareness of the need to develop stronger relations between upstream and downstream communities. In spite of the many regulations providing

vision on issues related to watershed health, there was a general consensus that the lack of implementation would lead to conflict between communities on issues of fish, forests, and water. Moreover, the growing amount of infrastructure development, in the form roads and micro hydro, has raised general concern about e-flows and maintaining sustainable agricultural production.

Survey responses indicate that government efforts have focused primarily on watershed management in Thuligaad but not on biodiversity conversation and disaster risk management.

If we look at the level of awareness among communities regarding local level planning processes, we find that governance is poor, as only 10% of households claimed to know about VDC planning. Only 43% of households knew which NRM committees were active in their communities. This lack of public awareness undercuts to some degree the purpose of these various committees, which were formed to provide increased popular representation on issues such as forests, water, and irrigation.

Related annexes

Annex 19: Existing policy provisions and status of enforcement
Annex 24: Key stakeholders – organizations and offices

5. PRIORITIZING MAJOR THREATS AND ISSUES

Stakeholders in the Thuligaad watershed were asked to list their environmental concerns, particularly in relation to associated anxieties related to sustainability and livelihoods. As many rural Nepalis depend more closely than most on natural resources to support their households, stakeholders cited the loss of labor (to migration) and advancing degradation of water, forests, and aquatic habitats as major concerns. The full summary of environmental priorities is presented in Table 6.

Table 6: Environmental issues by priority

SN	Issues	Female	Male	Total	Ranking
1	Unplanned expansion of rural roads	4	20	24	Very high
2	Droughts and diminishing water sources	9	14	23	Very high
3	Degradation of fish habitats; decline in number and species of fish	9	8	17	Very high
4	Forest degradation due to open grazing and forest fires	2	12	14	Very high
5	Destructive fishing practices	5	7	12	High
6	Loss of agriculture due to landslides and river cutting	1	9	10	High
7	Unsustainable resin collection	1	8	9	High
8	Gravel mining and collection	1	7	8	High
9	Loss of property due to landslides	6	2	8	High
10	Threats to traditional livelihoods of Dalit communities	3	3	6	Medium
11	Conflicts over water use	2	4	6	Medium
12	No collaboration between upstream and downstream communities	1	4	5	Medium
13	Excessive use of pesticides	0	3	3	Low
14	Unmanaged solid waste and drainage system	0	3	3	Low

(**NOTE**: these priorities were determined through a workshop with stakeholders in Doti)

This table presents issues identified by 62 participants in a community survey, whose responses were later validated during the multi-stakeholder consultation (MSC) exit workshop. The participants were selected from a wide range of backgrounds representing local residents, civil society groups, and government agencies.

After creating a full list of environmental challenges, including issues related to scope, severity and local interest, participants were asked to vote for issues based on their perceptions of urgency in the need to address. Each participant was allowed to vote up to three issues, although many chose to cast only two or one vote. Men and women were asked to vote separately to avoid the potential for vote influence across gender.

The exercise revealed that local stakeholders in Thuligaad have significant concern for water availability, unplanned expansion of rural roads, and the degradation of fish habitats and populations.

6. TURNING THREATS INTO OPPORTUNITY

During the MSC exit workshop, participants also listed the major threats, challenges, and opportunities for watershed health in Thuligaad. Their comments are summarized in Table 7.

Table 7: Threats, challenges, and opportunities for improved watershed health

Threats and challenges	Opportunities
• Boundary disputes in new federal system for resource conservation and utilization • Changing climate causes increase in epidemics, drought, disasters, disease, migration, environmental deterioration, and scarcity of water • Over-exploitation of resources • Lack of well-defined sustainability plans for projects • Unplanned construction of physical infrastructure and rapid urbanization • Limited coordination and collaboration between projects and government line agencies • Limited implementation of policy provisions • Unsustainable collection of resin • Weak implementation of laws and poor monitoring and evaluation • All concerned governmental organizations seek only to establish their rights and control over water resources rather than plan for improved conservation • Low priority from government agencies for conserving wetland and freshwater biodiversity	• Economic development and employment opportunities through management of irrigation, ecotourism, and water quality • Support from government and donor agencies • Optimizing the inclusive provisions of the 2015 Constitution • Coordinating with newly-elected local government representatives • Building community ownership and readiness • Developing disaster management and relief programs at local level through various organizations. • Developing disaster risk management guidelines at local level • Preparing and implementing LAPAs, LDRMPs, and WUMPs • DDRC working as rescue and relief agency in the district • Innovating new technologies such as drip irrigation, rainwater harvesting, and plastic pond • Increase in management regimes as community leasehold and private forests • Reclamation of degraded land with fruit tree cultivation, river bed farming, agroforestry systems, and cultivation of high value crops

7. VISION AND MISSION OF THULIGAAD WATERSHED

This Thuligaad 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 THULIGAAD WATERSHED

A two-day vision-building session was organized in Doti in August 2017. The participants were divided into five groups to draft their own vision statement for the watershed 20 years from now. The five statements were then collected and synthesized into the following:

"To conserve aquatic biodiversity and promote watershed health while ensuring equitable access to rivers, wetlands, and ponds and for all."

7.2 COMMITMENT TO CONSERVE THE THULIGAAD WATERSHED

Using the threats, challenges, and opportunities to watershed health (Table 7), participants at the exit workshop described what they intended to do within their capacity to act (i.e., as resident, government official, or NGO representative) and the outcomes expected from this activity. These ideas have been organized by watershed health theme in Table 8.

Table 8: Action commitments and expected outcomes by theme

SN	Theme	Major Activities	Expected outcomes
1	Climate change and aquatic biodiversity conservation	• Check construction of dams and embankments • Use of bioengineered and low-cost technologies • Reclaim exposed lands through replantation • Exercise tighter controls on open grazing • Form user committees for water, sanitation, forests, and irrigation	• Improved regeneration of forests and biodiversity • Strengthened cooperation between upstream and downstream communities • Improved support for sustainable resource management • Improved fish populations and fish species diversity • Improved resilience to climate change impacts

		• Explore artificial breeding potential for rare species of fish • Conserve aquatic habitats and fish species	• Improved waste sanitation in the watershed
2	Physical infrastructure and disaster management	• Check dam and spur construction • Prepare master plan for rural road construction • Implement building codes • Prepare LAPAs, LDRMPs, and WUMPs	• Enhanced plant and forest cover and hillside stability • Improved responsiveness to disaster management • Increased capacity to adapt to climate change impacts
3	Water availability and water quality	• Protect and improve water sources • Conserve natural ponds and construct artificial ponds and rainwater harvesting systems • Employ more solar pumps • Use Dhiki pumps • Promote defecation free zones • Manage waste and sludge disposal • Strengthen forest management and forest fire control • Reuse kitchen water	• Increased access to water and more sustainable use of water • Fewer conflicts over water use • Improved water quantity and quality • Fewer water-borne diseases • Increased ground water availability • Increased food production • Improved food security nutrition status for all families
4	Livelihoods	• Engage stakeholders to minimize flood and landslide risks • Prepare mining guidelines at local level • Promote awareness about the long-term impacts of pesticide use • Provide training on composting manure • Conserve traditional skills and livelihood options • Develop commercial potential of traditional skills	• Incomes of fish-dependent communities will improve between 1.5%-3% • Sharp reduction in destructive fishing methods • Decreased use of pesticides • Improved watershed and human health • Increased employment opportunities • Protection and development of traditional

			skills to seam with current markets
5	Governance, policy, and gender and social inclusion (GESI)	• Promote sustainable fishing practices • Form policy and guidelines at local level for biodiversity conservation and climate change adaptation • Form a joint committee of the watershed's four rural municipalities to discuss watershed health-related issues • Conduct more studies on impacts of sand and gravel mining in the watershed	• Greater implementation of policy and guidelines • More evidence-based studies to inform policy-making • Formal policy to create joint watershed team formalized • A common understanding of conservation issues and watershed health developed

8. RECOMMENDATIONS

The Thuligaad watershed profile assesses the status, major challenges and opportunities facing water resources management for the multiple users located within the region. These recommendations were conceived and compiled based on input from all the participants at the exit MSC workshop, seeking to improve climate change adaptation and freshwater biodiversity in the watershed:

- Assess areas of known knowledge gaps to develop fish inventory guidelines for regulated harvesting, legal protections and appropriate capacity building measures.
- Facilitate engagement of local government in developing and integrating plans related to water governance and aquatic biodiversity management.
- Mainstream conservation initiatives into local planning and advocate for budget allocation for subsequent implementation.
- Support sustainable management of aquatic biodiversity through effective implementation of policy provisions, appreciating local norms and standards, and devising strong monitoring mechanisms.
- Support local initiatives to improve livelihoods of rural and marginalized people who depend on traditional practices (e.g., capture fisheries) or labor-intensive livelihoods (e.g., river bed mining).
- Raise awareness on ways to improve forest fire prevention and reduce open grazing through trainings to community forest user groups and resin collection groups that can directly contribute to maintaining or improving watershed health.
- Produce and disseminate behavior change communication materials (e.g., radio programs) for publicizing watershed management friendly practices, such as solar water pumps, drip irrigation, and disaster risk reduction ideas.
- Implement low-cost stabilization techniques for slopes and river banks, such as layered plantation.
- Develop georeferenced information on aquatic biodiversity and fishery hotspots to guide management of river and fishery resources.
- Encourage research, conservation and governance initiatives to integrate gender and social inclusion into all programs.
- Develop and support implementation of green infrastructure guidelines with reference for the proper construction of rural roads, hydropower, and water management

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ANNEXES

Annex 1: Profile methodology

The overall objective of the watershed profiling process is to develop and enrich a shared understanding among key stakeholders about the major issues that affect local watershed health and water resource management. This watershed profile reflects the collective understanding and aspirations of people in the Thuligaad 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 Thuligaad watershed's stakeholders on the current situation and future;
- Establishing a benchmark for activities targeting human and ecological communities in the watershed by describing the existing interaction between people and nature;
- Identifying potential priority areas for stakeholders to plan and work together on local-level activities to improve watershed management of the Thuligaad area where PANI and other projects can provide support; and
- Providing a platform for consultation and advocacy for Thuligaad watershed stakeholders through which they can participate in decision-making at the river basin and policy levels.

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

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

2. An entry multi-stakeholders consultation (MSC) conducted to

a) Share preliminary sharing results consolidated from the review of literatures, data analyze from secondary sources to multi-stakeholder participants invited to orient and assess the condition of watershed health

b) Identify priority threats, vulnerabilities, and biodiversity values over the watershed areas location and impact groups

c) Prepare detailed plans to carry out

- key informant interviews (KII),
- focal group discussions (FGD), and
- testing 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

Key Informant Interviews [KII] were conducted with specialists and champions to explore the causes and intensity of the particular environmental issues more deeply in the watershed. The team designed some checklists to capture the cause and effects dynamics around Paani focal interest areas, cross cutting areas including governance, gender and social inclusion and policy. The consolidated analytic results produced through i] Review and analysis ii] Outcomes of threat and vulnerability analysis and targeting iii] and champions stakeholder consultation iii] community surveys iv] water quality and discharge measurement. These methods were 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 Thuligaad. We also used this information to identify possible solutions and champions for leveraging knowledge and support through partnerships with local agencies and organizations.

The HH survey data (Table 9) were organized into four broad categories: a) climate change and biodiversity; b) livelihoods and well-being; c) water sources; and d) water quality. The surveys were conducted in locations that were selected during the entry MSC as participants indicated specific issues and challenges appropriate to their respective areas.

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

Subject of HH survey	Number conducted
Biodiversity and climate change	526
Livelihoods and well-being	375
Water sources	416
Water quality	460
Total	**1,777**

To complement the surveys, we conducted 17 FGDs and 15 KIIs to investigate the key issues identified by households. Water quality and discharge were measured by Paani staff using the Akvo Flow Mobile App.4

The assessment results that inform the collected issues were shared during the exit MSC. The team presented preliminary findings and asked the participants to rank these issues in order of importance as well identify as potential actions and outcomes that can be taken to address these issues. The participants were divided into groups to generate potential mission statements for the watershed. We brought the various statements together and synthesized the ideas into the mission statement located at the front of this profile:

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

Mission statement: ***"Access to water sources like rivers, wetlands, and ponds for aquatic biodiversity and watershed conservation for establishment of model community by sustainable use and equal distribution of benefits."***

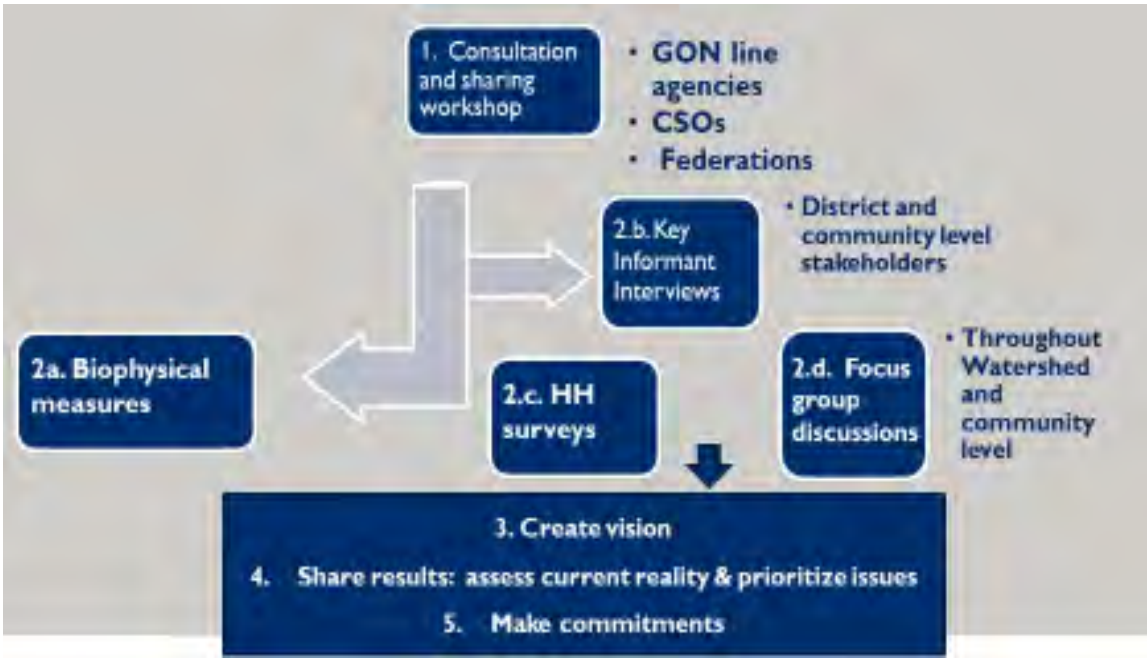

Figure 14: Methodological approach illustrated

Heath report development process

The watershed health report portrays the current condition of the natural resources and the quality of ecosystem services available for community use. The health report identifies the drivers that pose threats to peoples' livelihoods, fresh water biodiversity and natural habitats. The health report provides relevant information to strengthen informed decisions, take action to protect and restore the watershed, and to reduce risks and create sustainable economic opportunities. The report also provides opportunities to identify the drivers of watershed health degradation and explore the options to mitigate, correct and prevent them timely for sustainable watershed management. The health report thus serves as a planning tool.

The watershed health report was developed drawing on information gathered during the watershed profiling process. The health report 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. Multi-stakeholder consultation (MSC) conducted to

- Draft health report with provisional indicators consolidated from the review of literature and data analyzed from secondary sources. MSC participants are invited to assess the condition of watershed health. Key indicators are arranged under three broad themes – nature, wealth and power.

- Identify priority threats, vulnerabilities and biodiversity values in the watershed area
- Share and discuss the consolidated analytic results of community surveys, including water quality tests and discharge measurements of major streams and rivers
- Identified and agree on the proposed provisional indicators and evaluation methods

3. After sharing the priority health indicators, MSC participant discuss and agree on the indicators, along with associated impacted groups and locations of issues within the watershed. The workshop participants review indicators and assess their condition. They then rank each indicator according to threat levels, which are designated a color, e.g. high (red), medium (yellow) and green (low)..

4. The draft health report is then widely shared with key stakeholders, including government line departments, CSOs and local governments for their feedback before producing a final version.

Annex 2: Land use and land cover

Type	Area (sq km)	Percentage
Cultivation	167	19
Forest	695	78
Grassland	1	<1
River/Streams	17	2
Shrub Forest	5	1
Total	**885.98**	**100**

Table 10: Land use by area and percentage in the Thuligaad watershed

Annex 3: Population

Municipality and Rural Municipality	Badikedar Gaunpalika	Chure Gaunpalika	Jorayal Gaunpalika	Mohanyal Gaunpalika	Total Thuligaad Watershed
Male	5,587	4,280	9,204	1,676	**20,747**
Female	5,784	4,485	9,653	1,608	**21,530**
Total Population	**11,371**	**8,765**	**18,857**	**3,284**	**42,277**
Aadiwasi/Janajati-Hill	-	1,417	460	81	**2,411**
Aadiwasi/Janajati-Terai	-	1,166	-	2,733	**7,717**
BCTS-Hill	7,808	4,433	12,897	311	**22,534**
BCTS-Terai	-	-	-	-	**-**
Dalit-Hill	3,073	1,686	5,191	152	**8,970**
Dalit-Terai	-	27	7	4	**48**
Madeshi	-	5	-	-	**6**
Muslim	-	-	-	-	**-**
Newar	-	-	38	-	**36**
OBC-T(Other backward casts-Terai)	489	31	264	4	**553**

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

Annex 4: Temperature and precipitation

Month	Max. temp (°C)	Min. temp (°C)	Avg temp (°C)	Monthly avg. precip. (mm)
January	21.4	5.9	13.7	42.0
February	25.7	7.4	16.6	49.8
March	30.7	11.3	21.0	39.3
April	33.6	15.7	24.7	38.5
May	38.6	19.3	29.0	90.3
June	40.5	24.1	32.3	155.7
July	33.7	24.7	29.2	238.6
August	33.8	24.0	28.9	243.2
September	33.3	22.9	28.1	140.9
October	31.2	15.3	23.3	45.8
November	27.1	9.1	18.1	6.3
December	23.3	5.5	14.4	31.2

Source: District Profile, DDC, Doti, 2070

Table 12: Detailed temperature and precipitation figures

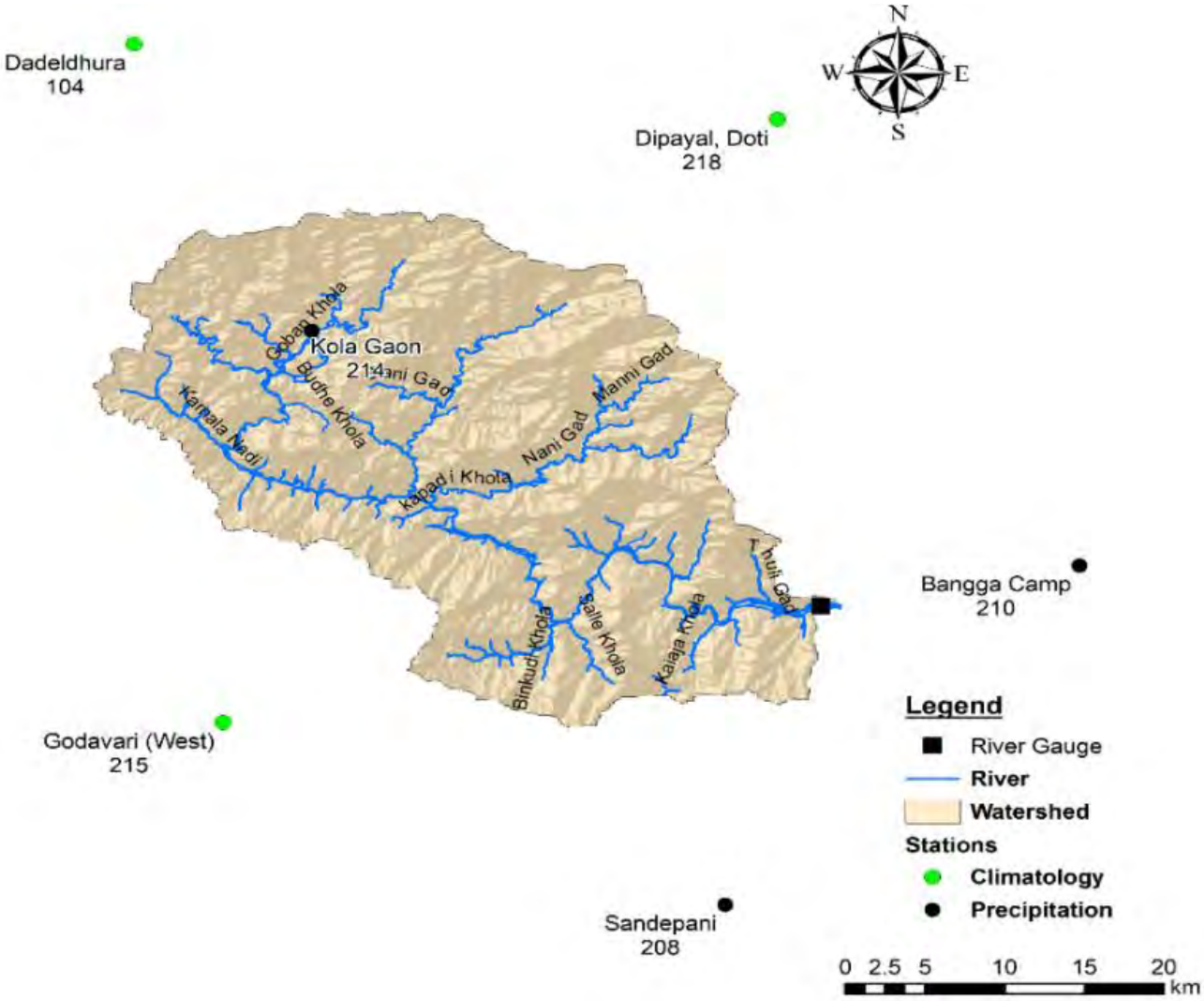

Figure 15: Hydrological and meteorological stations near Thuligaad

In the mountainous regions of Nepal, topographic variation has a profound effect on the spatial distribution of rainfall. Long-term rainfall data records in Thuligaad watershed are available at Kola Gaon (214), which lies in the northwestern part of the watershed. The stations at Dadeldhura (104), Dipayal (218), Banga Camp (210), Sandepani (208) and Godavari (215) located in border areas of the watershed were used to capture spatial variation (Figure 15). The Theissen polygon method was used to analyze rainfall trend for the watershed. The comparison between the estimated average monthly rainfall in the watershed and the observed average monthly rainfall at Kola Gaon rain gauge station as shown in Figure 16.

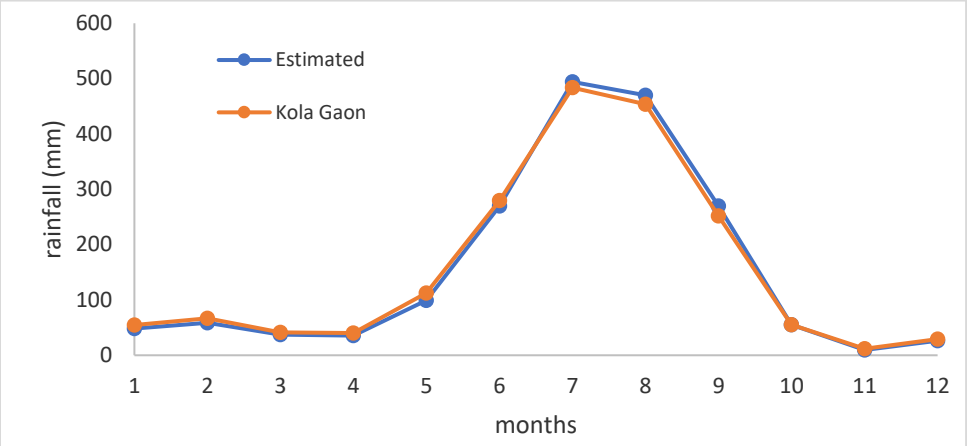

Figure 16: Long-term average monthly rainfall (in mm) estimated in Thuligaad against observations at the Kola Gaon rain gauge station

The estimated rainfall of the basin is similar to the rainfall observed at Kola Gaon (Figure 16). Highest and lowest rainfall in the watershed are observed in the months of July and December respectively. The dry season rainfall (Nov.–May), monsoon rainfall (June – October), and the annual rainfall were estimated as 314 mm, 1,558 mm and 1,873 mm, respectively.

Temperatures were 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 the winter, pre-monsoon, monsoon, and post-monsoon seasons, respectively. Similarly, annual average temperatures were observed to decrease at the rate of 4.9°C per km rise in altitude. Long-term average monthly temperature variations for the Thuligaad watershed are shown in Figure 17. The average monthly temperature of the watershed varies from 9.25°C, in winter, to approximately 25°C in summer. Similarly, the maximum and minimum monthly temperature varies from 4°C to 16.5°C in winter, and from 20°C and 31°C, in summer. The average annual temperature varies from 12°C in the north to 24.5°C in the southeast (Figure 17).

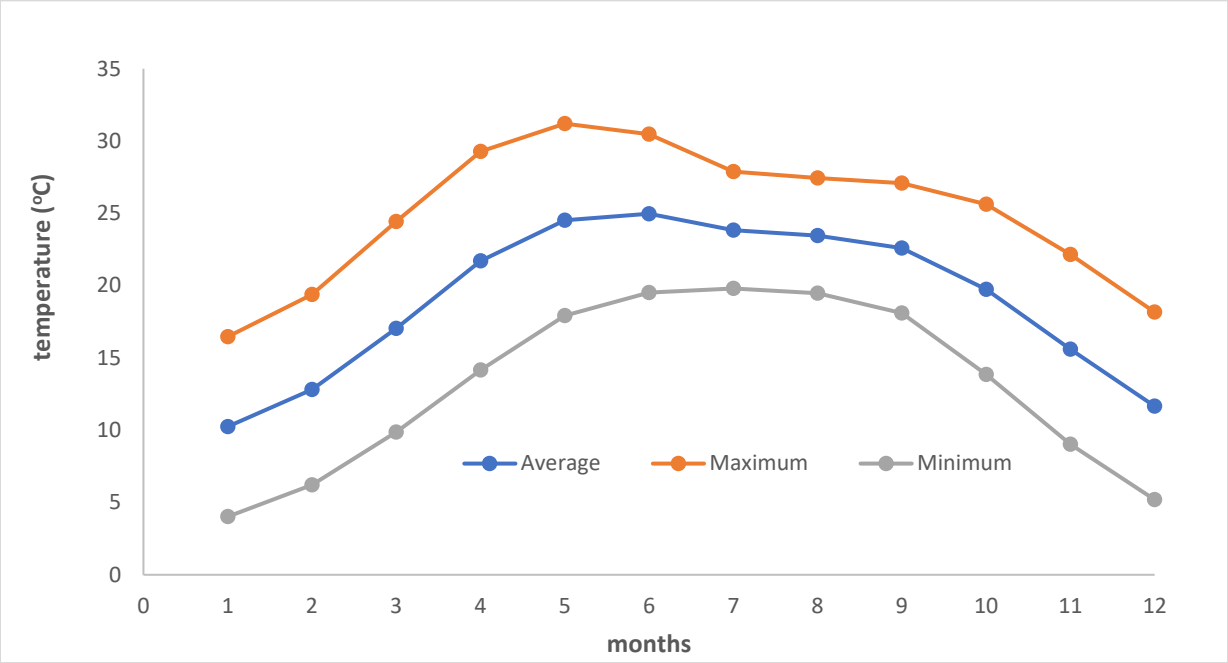

Figure 17: Maximum, minimum and average long-term monthly temperatures (^{0}C) in the Thuligaad watershed

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

Table 13: Types of water bodies in Thuligaad watershed

SN	Water Bodies	Description
1	Rivers	The Thuligaad River is a large, spring-fed river system that emanates from Saraswotinagar mountain. The flow is maximum in rainy season and minimum in dry season. Two micro-hydropower have been established on the river at Chankatte. Large rivers have permanent flow most suitable for hydropower and large scale irrigation and provide habitats for several migratory aquatic species.
2	Small rivers	Kamala Nadi, Gadseri Gad, Kapadi Gad, Aladi Gad, and Dhannasa Khola are small rivers in the watershed. Landslides, river cutting and silt deposition affect their flow and water quality. These rivers supply much-needed water for agriculture, livestock, and domestic uses.
3	Head water streams	There are 17 major headwater streams, including Karnaso, Garserigad, Kapadi Gad, Kamala Gad, Aladi Gad, Gabusaini, Alyari, Mohanyal and 156 small rivulets. Locally originated, these stream are ephemeral and seasonal source of water for recharge and rice farming.
4	Wetlands	Chhatiban Tal, Rangeni Tal, Raxchas Tal, Jwalaban Tal, Jwalaban Jharna are major wetlands in the watershed area that support aquatic biodiversity and natural systems. Wetlands provide water for use, recharge, irrigation, and domestic use.

The discharge of streams in the Thuligaad watershed (1970 – 2007) at Khanyatal station was analyzed for four seasons (pre-monsoon, monsoon, post-monsoon and winter) as well as average of annual discharge. In general, the long term data on flow discharge showed a decreasing trend.

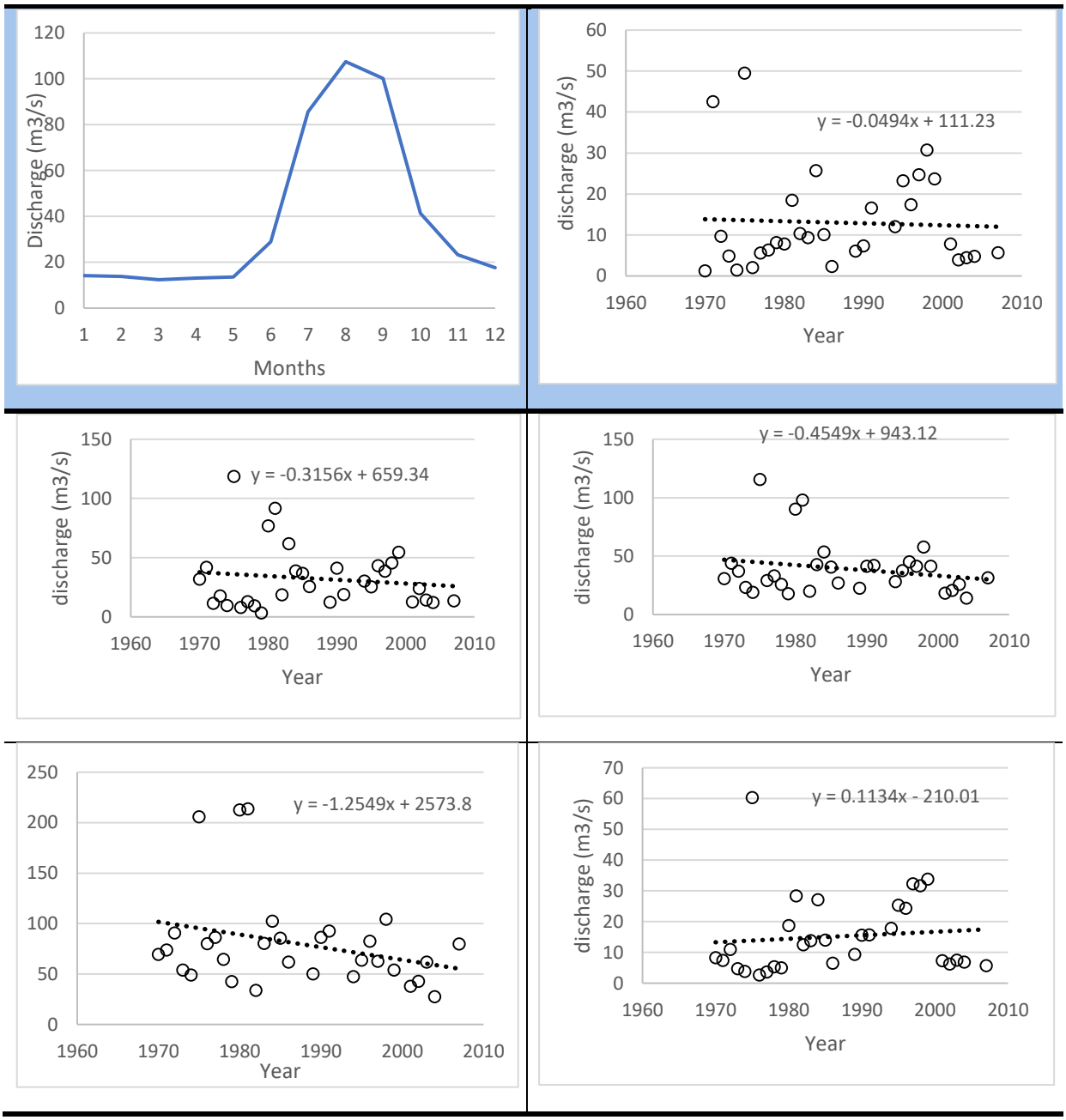

Figure 18: Rates of stream discharge at various temporal scales

These charts (Figure 18) show that average annual discharge of the stream is decreasing by 0.45 m^3/s, whereas average winter discharge of the stream is increasing by 0.11 m^3/s. Pre-monsoon, monsoon, and post monsoon discharge of the stream is also decreasing at a rate of 0.049 m^3/s, 1.25 m^3/s and 0.31m^3/s, respectively. In our surveys, a majority of households said they believed that stream flow amounts had decreased in recent years.

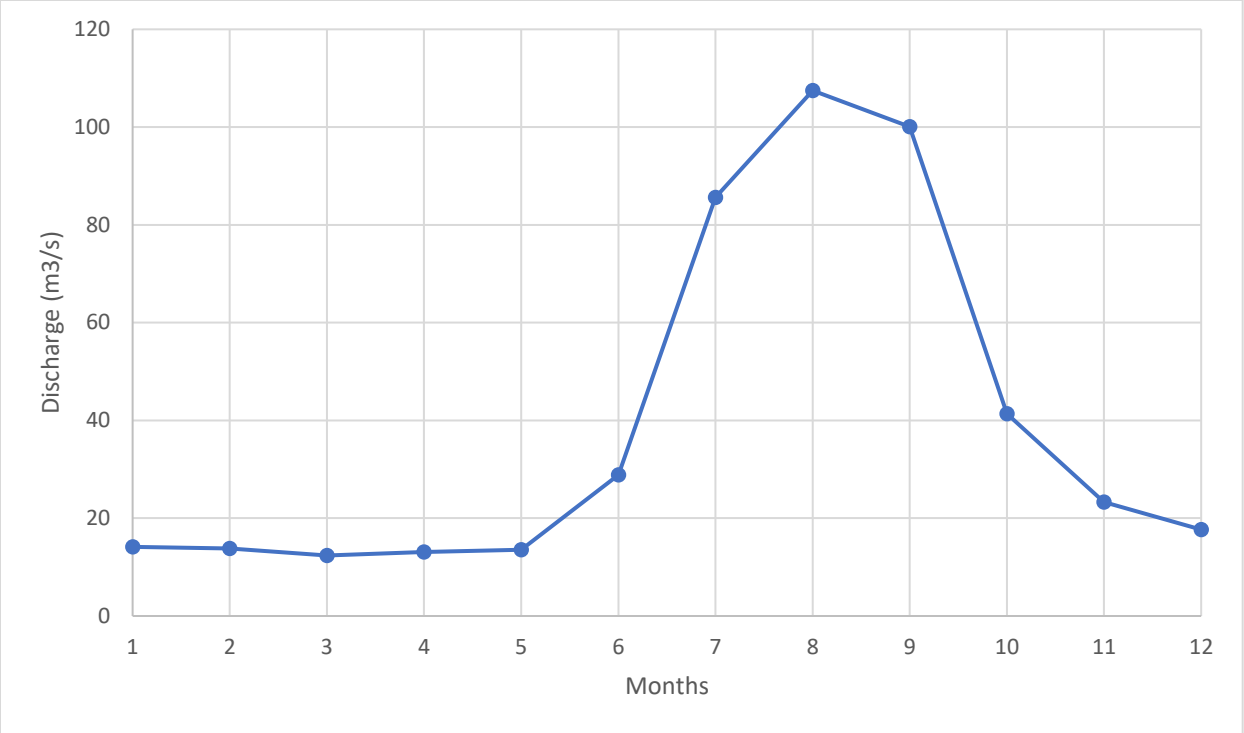

Figure 19: Average monthly flow measured in the Thuligaad River at Khanyatal station (1970-2008)

Discharge measured at Khanyatal from 1970 to 2008 (Figure 19) shows that mean flow during pre-monsoon (Mar.-May), monsoon (June-Sep.), post-monsoon (Oct.-Nov.) and winter (Dec.-Feb.) seasons were 13 m^3/s, 80.5 m^3/s, 32.3 m^3/s, 15.2 m^3/s and 39.3 m^3/s, respectively. The observed long-term average annual discharge shows a decreasing trend at the rate of 0.45 m^3/s/year (Figure 20).

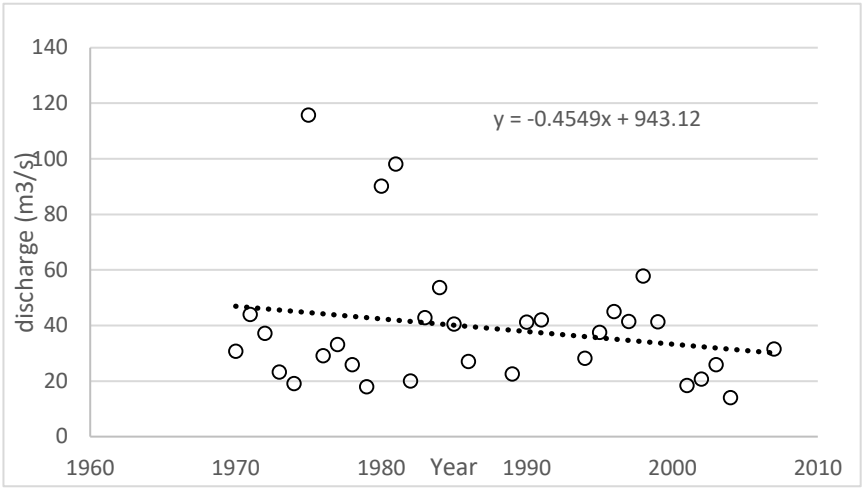

Figure 20: Long-term average annual discharge of Thuligaad River at Khanyatal station (1970-2008)

Table 14: List of identified sub-watersheds in the Thuligaad watershed

Watershed	Area (km^2)	VDC	Rank
Naukunda Khola	29.14	Laxminagar, Saraswotinagar	53
Aladigad	38.83	Gadsera, Saraswotinagar	51
Gabusainigad	37.49	Gadsera, Saraswotinagar	25
Gadserigad	26.93	Gadsera, Saraswotinagar	45
Gairigad	37.96	Gadsera, Mannakapadi	39
Kanerigad	40.24	Gadsera, Mannakapadi	26
Gorka Khola	36.23	Ghagal	49
Kotkena Khola	43.47	Ghagal, Barchhen	30
Binesaun Khola	29.77	Barchhen	43
Kapadi Khola	38.67	Mannakapadi, Barchhen	15
Gadsarigad	35.60	Nirauli, Barchhen, Sarasotinagar	48
Silgad	48.12	Niroli, Barchhen, Gadsera	46
Laxminagar	38.35	Sarsotinagar, Barchhen, Gadsera	33
Kumaragad	37.80	Sarasotinagar, Chahtiwan, Laxminagar	22

Khaigad	27.96	Sarasotinagar, Gahnteshor, Chattiwan	34
Ghanteshwor	29.06	Chattiwan, Ghanteshwor	17
Chandekhola	33.79	Chattiwan, Ghanteshwor	29
Nigali, Khairala, Mohanyal	240.80	Nigali, Khairala, Mohanyal	-
Total	**850.21**		

Source: DSCO Report, 2016, Doti/Kailali

Annex 6: Forest types and composition

Table 15: Forest types by area and percentage

Forest type	Area (sq km)	Percentage
Mixed hardwood	298	43
Sal	79	11
Pine	260	37
Sisau (sisam)	9	1
Banjh oak (Quercus)	45	6
Deodar cedar	4	1
Total	**695**	**100**

Source: DFO Report 2016, Doti

Annex 7: Climate change impacts: biodiversity and vulnerabilities

Table 16: **Climate change impacts and communities affected**

Vulnerability	Impacts and impacted communities	Major issues	Priority	Basis of prioritization
Unsustainable resin collection practices	Forest degradation in Haat and Kafali of Luxminagar and in Chamkatte of Sarswatinagar-4	Forest fire; loss of habitat; low soil moisture	Moderate	Field observation
Landslides, river cutting and water pollution	Fertile land degraded and water quality poor for drinking in Nirauli-7 and Barchhen-6	Water scarcity and diminished agricultural production	High	Field observation
Floods, soil erosion	Loss of cultivable land, drying up of water sources in Ghangal-3, Chachari and Simali	Diminished agricultural production and drinking water availability	Moderate	Field observation
Water scarcity	Prolonged droughts in Malakandi, Chhatiwan, and Saraswotinagar; Dalit and Janajati communities affected	Low drinking water availability	High	Field observation
Drought	Dharapani Tole of Chhativan; Khar, Puran, Patal of Barchhen; Thali and Alad of Laxminagar	Water scarcity	High	Field observation

Annex 8: Fish and aquatic life

Table 17: Types of fish and population status

Type of fish	Status
Rare and endemic fish	• Stakeholders in the watershed reported seven species of fish considered "rare and endangered" by the IUCN, including: *sahar, zebra machha, buche asla, asala soal, chuche asala, tite machha*, and *raja bam*. • 69% of respondents report native fish species have been decreasing, due perhaps to harmful fishing practices such as explosives and poisoning • 31% of respondents say no new species have appeared over the last decade
Commercially useful native fish	• *Sahar, zebra machha, buche asla, asala soal, chuche asala, and raja bam* are sought by fishers for market value.

Table 18: Species of fish commonly found in the Thuligaad watershed

SN	Local Name	Photo	Scientific Name
1	Bam machha		*Monopterus cuchia*
2	Gerudo machha		*Physoschistura elongata*
3	Dudhe machha sallesatto		*Rhinomugil corsula*

4	Sahar machha		*Tor putitora*
5	Radi machha		*Schistura rupecula*
8	Kalejunga		*Glyptothorax cavia*
9	Satta		*Hemibagrus menoda/ Mystus medona*
10	Roha, Rohu		*Labeo rohita*
11	Kalejunga		*Glyptothorax alaknandi*

12	Dhamimachha		*Glyptothorax cavia*
13	Asala machha		*Amblypharyngodon microlepis*
14	Kathyal		*Pseudecheneis sulcata*
15	Satto		*Mystus gulio*
16	Pugijhajha		*Clarias gariepinus*

Annex 9: Mammals and population trend

Table 19: Types of mammals, location, and population trend

Local Name	Type	Trend	Location
Sill fish (Salak)	Terrestrial	Decreasing	Chhatiwan and Ghanteshwor
Wild boar	Terrestrial	Increasing	Thuligaad watershed
Water cockcrows	Aquatic	Decreasing	Barchhen
Rabbit	Terrestrial	Decreasing	Thuligaad watershed
Charibag	Terrestrial	Decreasing	Thuligaad watershed
Deer	Terrestrial	Decreasing	Thuligaad watershed
Malsapro	Terrestrial	Decreasing	Laxminagar and Saraswotinagar
Fox	Terrestrial	Increasing	Thuligaad watershed
Elephant	Terrestrial	Increasing	Thuligaad watershed
Common leopard	Terrestrial	Decreasing	Thuligaad watershed
Jangali bandel	Terrestrial	Increasing	Thuligaad watershed
Bear	Terrestrial	Increasing	Thuligaad watershed
Nyaurimusa	Terrestrial	Increasing	Thuligaad watershed
Porcupine	Terrestrial	Decreasing	Thuligaad watershed
Musa	Terrestrial	Increasing	Thuligaad watershed
Ghoral	Terrestrial	Increasing	Thuligaad watershed
Tiger	Terrestrial	Decreasing	Mohanyal

Annex 10: Reptiles and population trend

Table 20: **Aquatic species, location and population trend in Thuligaad watershed**

Local name	Type	Trend	Species group
Green Snake	Aquatic / Terrestrial	Decreasing	Reptile
Tortoise	Aquatic / Terrestrial	Decreasing	Reptile
Boa Snakes	Aquatic / Terrestrial	Decreasing	Reptile
Cobra	Aquatic / Terrestrial	Decreasing	Reptile
Dhaman	Aquatic / Terrestrial	Decreasing	Reptile
Karet	Aquatic / Terrestrial	Decreasing	Reptile
Lizard	Terrestrial	Decreasing	Reptile
Frog	Aquatic / Terrestrial	Decreasing	Amphibian
Crocodile	Aquatic	Increasing	Large aquatic reptiles

Annex 11: Birds and population trend

Table 21: Bird species, location, and population trend

Name	Type	Trend	Location
Vulture	Terrestrial	Decreasing	Thuligaad watershed
Kukleruwa	Terrestrial	Decreasing	Thuligaad watershed
Woodpecker	Terrestrial	Decreasing	Thuligaad watershed
Dhukur	Terrestrial	Decreasing	Thuligaad watershed
Bhadrai	Terrestrial	Decreasing	Thuligaad watershed
Eagle	Terrestrial	Decreasing	Thuligaad watershed
Kalij	Terrestrial	Decreasing	Thuligaad watershed
Titra	Terrestrial	Decreasing	Thuligaad watershed
Bakulla	Wetland bird	Decreasing	Thuligaad watershed
Dhanesh	Terrestrial	Decreasing	Thuligaad watershed
Kalukhate	Terrestrial	Critically Endangered	Thuligaad watershed
Holeso	Terrestrial	Critically Endangered	Thuligaad watershed
Kokalsaro	Terrestrial	Critically Endangered	Thuligaad watershed
Kafalpakyo	Terrestrial	Disappear	Thuligaad watershed

Neula	Terrestrial	Decreasing	Thuligaad watershed
Bhyakura	Terrestrial	Decreasing	Thuligaad watershed
Fiste	Terrestrial	Decreasing	Thuligaad watershed
Ranicharo	Terrestrial	Decreasing	Thuligaad watershed
Danfe	Terrestrial	Decreasing	Thuligaad watershed
Munal	Terrestrial	Decreasing	Thuligaad watershed

Annex 12: Road networks

Table 22: Key roads in the watershed

Communities connected	Total (km)
Budar Laxminagar - Sarasotinagar - Mudbhara - Pachanali	45.82
Sahajpur – Boktan – Attarkanda	57
Khutiya - Bipinagar – Gadsera – Dipayal	8.64
Budar – Jorayal	12
Barchhen - Ghagal – Kedarakhada – Lodeghat	9.96
Suwakhan – Mannakapadi	2.83
Sahajpur – Laxminagar	0.20
Gaira – Ghanteshwor – Mudbhara	7.00
Khadeuli – Mannakapadi	9.00
Sahajpur – Nigali	20.83
Total	**173.28**

Source: Road Division Office, Dipayal, 2017

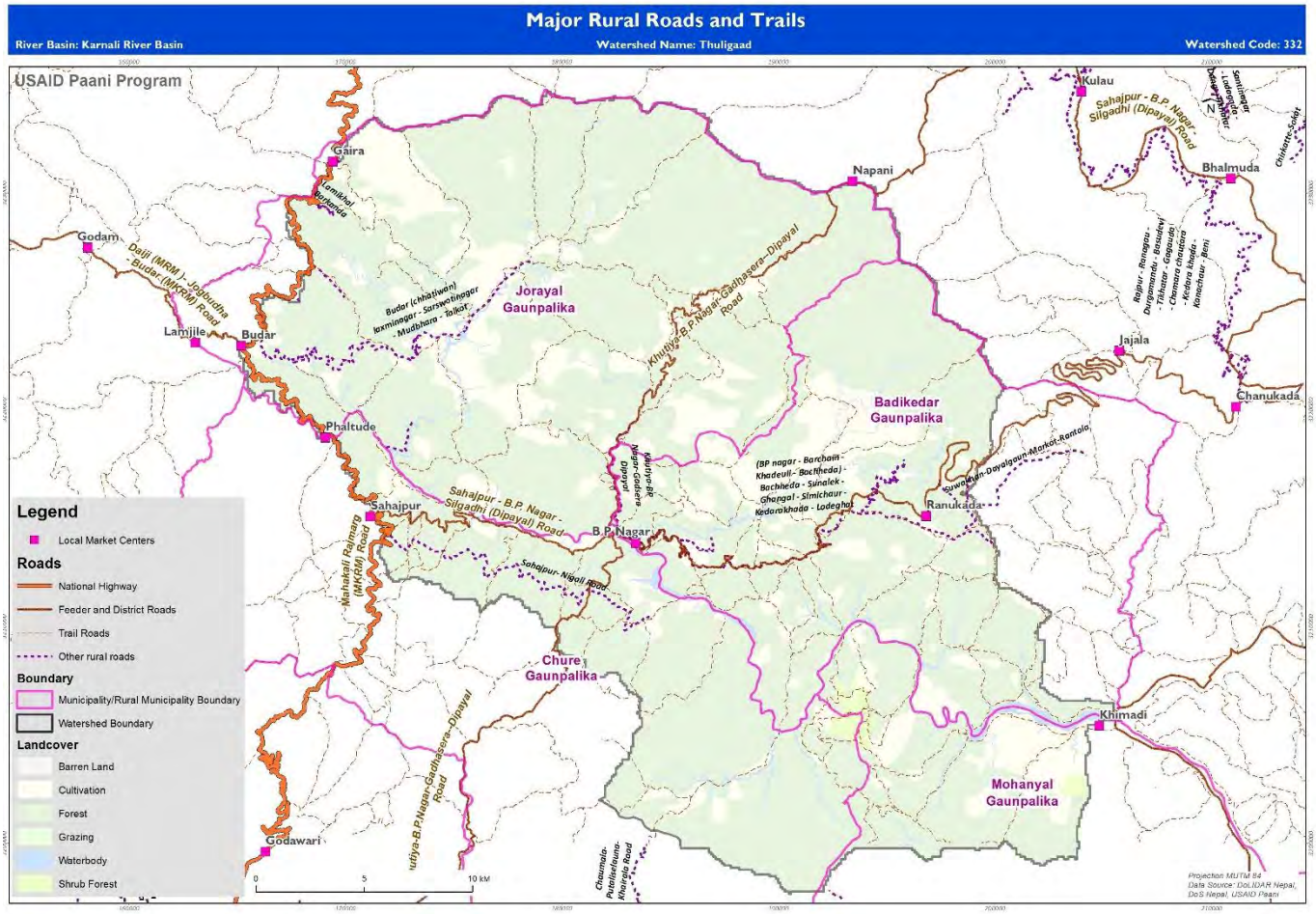

Figure 21: District and Village Road Core Networks (VRCN) in the Thuligaad watershed

(Source: DoLIDAR, DoR, Survey Department Nepal)

Annex 13: Micro hydropower – potential rivers

Table 23: Potential rivers for micro hydropower plants

VDCs	River	Discharge (lps)	Height (m)	Output (kw)	Coverage
Sugarkhal	Sagure	30	46	13.54	Ward-4
Mohanyal	Bhutka	8	52.8	4.14	Ward-9
Khairala	Ghatte	20	17	3.34	Ward-3
Nigali	Thuligaad	19	25	4.66	Wards-1, 2
			Total	**25.68**	

(Source: DEECC Section, Kailali, 2014.)

Annex 14: Irrigation projects

Table 24: List of irrigation projects by name, location, and area

SN	Project name and location	Area (ha)	HH benefiting	Pop.	Remarks
1	Dhanraskhet (Laxminagar-2)	2	50	235	
2	Haldegad (Mannakapadi - 4, 5, 7, 9)	65	192	1,243	
3	Chhinnigad (Gairagau, Ghanteshwor - 4, 8, 9)	40	122	710	
4	Pipalkot (Laxminagar - 2)	50	85	435	
5	Laskar (Sarasotinagar - 4)	31	50	293	
6	Gadsera (Irrigation - 2)	41	84	466	
7	Jajana (Chhtiwan - 5)	15	57	383	
8	Kafalikheti (Laxminagar)	30	121	633	
9	Pipaltola (Nirauli - 6)	31	44	272	
10	Jhadi Khet (Laxminagar - 6)	25	35	202	These projects are supported by DDC, Doti, under the Community
11	Daugad (Laxminagar - 3)	22	68	391	
12	Kola (Sarswatinagar - 2)	13	119	685	
13	Gallakhet (Laxminagar - 7)	20	61	351	
14	Kumarakhet (Laxminagar - 5)	18	86	495	

15	Pipalkanthe (Laxminagar - 8)	17	152	883	Irrigation Program (CIP)
16	Nugad Khet (Laxminagar - 9)	19	72	415	
	Total	**439**	**1,398**	**8,092**	

Annex 15: Water quality

Table 25: Water quality by river/stream and tested aspect

	Name of the river/stream					Water quality standards		
	Karnaso	Kapadi	Kamala	Thuligad	Gadseri	Drinking	Irrigation	Aquaculture
Type of ownership	Public	Public	Public	Public	Public			
Status	Natural	Natural	Natural	Natural	Natural			
Source Type	Perennial	Perennial	Perennial	Perennial	Perennial			
Conductivity (µS/cm)	NA	NA	NA	NA	NA	1500		
Temp. (°C)	NA	NA	NA	NA	NA			4 to 30
Iron (mg/L)	0	0	0	0	0	0.3 (3)	5	0.01
pH	6.3	6.9	6.9	6.4	6.9	6.5-8.5	6.5-8.5	6.5-9.0
Nitrate Nitrogen (mg/L)	0	0	0	0	0	50		<300
Nitrite Nitrogen (mg/L)	0	0	0	0	0		<5	
Ammonium (mg/L)						1.5		0.025
Phosphate (mg/L)								

Annex 16: Major pollution points in the Thuligaad watershed

Table 26: Major pollution points in the watershed (also shown on map, Section 3.4)

Major Points pollution	Settlements	Northing	Easting	Elevation (m)
Budar	Built up area, local market	29° 5'11.68"	80°34'4.09"	1,347
Laxminagar	Built up area, local market	29° 4'11.36"	80°40'12.17"	1125
Chhatiwan	Built up area, local market	28°58'6.86"	80°50'39.62"	739
Sarasotinagar	Built up area, local market	29° 6'48.40"	80°40'44.99"	1,124
Bipinagar	Built up area, local market	29° 0'38.52"	80°44'28.28"	768

Annex 17: Locations of gravel mining operations by geographic coordinates

Table 27: Locations of gravel mining operations

SN	Location	Northing	Easting	Elevation (m)
1	Laxmingar (Haat)	29.091	80.663058	1,074
2	Kamalanadi (Chhatiwan)	29.059	80.6158	996
3	Bipinagar (Barchhen)	29.009	80.741442	695
4	Kapadigaad (Barchhen)	29.005	80.7491	675

Annex 18: Community user forest groups

Table 28: Community user forest groups by location, area and representation

SN	Name	Address	Date of Handover (Nepali)	Area (ha)	HH	Exec comm members	Women on exec comm	Revision date (Nepali)
1	Suvash Mahila	Sarswatinagar – 7 (Jorayal GP)	3/30/2053	6.50	12	11	11	
2	Mahadev	Saraswatinagar (Jorayal GP)	3/30/2052	8.50	36	11		
3	Malika Kedarey Shon	Gadhasera - 7, 8, 9 (Baddikedar GP)	6/19/2061	818.45	165	17	4	
4	Gauri Shankar	Gadhasera - 3, 4, 5 (Baddikedar GP)	6/19/2061	1,044.00	200	15	5	
5	B.P. Nagar (Kh)	Nirauli (Jorayal GP)	3/30/2053	105.00	147	12	4	
6	Bhagawati	Nirauli – 4 (Jorayal GP)	3/30/2057	379.00	60	11	3	1/27/2061
7	Laliguras Janajagriti	Nirauli – 6 (Jorayal GP)	11/6/2064	93.70	64	13	3	
8	Ghanteshwar	Ghanteshwar – 1 (Jorayal GP)	3/30/2055	688.00	99	11		11/18/2060
9	Timuli	Ghanteshwar - 4, 5	3/30/2055	700.00	326	11	6	
10	Raniban	Ghanteshwar – 6 (Jorayal GP)	3/30/2057	782.76	101	9	3	3/15/2057
11	Kafal Lada	Ghanteshwar – 8 (Jorayal GP)	6/19/2061	263.00	36	11	2	
12	Dillasaini	Chhatiwan – 1 (Jorayal GP)	2055/02/30	244.50	194	15	5	5/28/2060
13	Parshuram	Chhatiwan – 9 (Jorayal GP)	3/30/2057	109.20	32	11	4	6/3/2057
14	Durga Devi	Chhatiwan – 7 (Jorayal GP)	3/12/2060	261.20	52	11	3	
15	Rani Pokhari	Chhatiwan – 4 (Jorayal GP)	7/3/2060	126.37	34	11	6	
16	Kafal Kattey	Chhatiwan – 3 (Jorayal GP)	6/19/2061	183.49	18	11	3	
17	Tribani	Chhatiwan – 5 (Jorayal GP)	6/19/2061	356.00	52	11	4	
18	Chhara	Chhatiwan – 3 (Jorayal GP)	10/28/2061	600.00	66	11	4	
19	Bghagashwor	Chhatiwan – 8 (Jorayal GP)	8/19/2062	85.31	40	11	4	
20	Manakamana	Chhatiwan – 4 (Jorayal GP)	5/11/2064	102.40	27	9	1	
21	Kedareshwar	Laxminagar – 8 (Jorayal GP)	3/30/2052	77.70	49	15	6	

22	Sodhar Dipendra	Laxminagar – 2 (Jorayal GP)	3/30/2052	21.43	39	15	7	9/2/2057
23	Mahadev	Laxminagar – 1 (Jorayal GP)	3/30/2052	8.50	36	11		
24	Masani	Laxminagar - 8 (Jorayal GP)	NA	312.25	77	11	4	2/21/2060
25	Mahendra	Laxminagar – 1 (Jorayal GP)	3/30/2057	12.86	36	11	11	12/20/2059
26	Lali Gurans	Laxminagar - 5, 6 (Jorayal GP)	12/27/2056	176.90	74	17	2	
27	Malika	Laxminagar - 6 (Jorayal GP)	2/30/2057	483.00	91	13	4	6/18/2061
28	Baseni	Laxminagar - 6/Chatiwan – 5 (Jorayal GP)	3/22/2060	237.76	74	13	5	
29	Samaijee	Laxminagar – 7 (Jorayal GP)	4/29/2064	87.61	40	9	2	
30	Dhami Danda	Mannaakapadi - 1, 2 (Baddikedar GP)	3/30/2049	65.00	69	9		
31	Beytal	Mannaakapadi – 7 (Baddikedar GP)	9/9/2060	197.87	36	15	3	
32	Mohanel Boytal	Mannaakapadi – 8, 9 (Baddikedar GP)	1/25/2061	551.00	74	13	4	
33	Melghadi	Mannaakapadi – 8 (Baddikedar GP)	11/25/2061	296.00	35	11	3	
34	Kalipal	Mannaakapadi – 6 (Baddikedar GP)	9/26/2064	197.43	75	19	5	
35	Kunthola Rani	Kedareshwar – 2 (Baddikedar GP)	3/30/2049	50.00	31	9		
36	Malika	Kedareshwar - 3, 7 (Baddikedar GP)	4/23/2051	120.00	120	16	4	
37	Dhari	Kedareshwar – 5 (Baddikedar GP)	4/23/2051	75.00	49	9	3	
38	Raniban	Kedarshwar - 1, 2, 3, 7 (Baddikedar GP)	4/23/2051	100.00	102	15	6	
39	Kedareshwar	Kedareshwar – 4 (Baddikedar GP)	4/23/2051	175.00	85	15	4	
40	Bidatopani	Kedareshwar - 3, 8 ,9 (Baddikedar GP)	4/23/2051	150.00	66	13	4	
41	B.P. Nagar	Berchen - 9/Niranli - 7, 8 (Baddikedar and Jorayal GP)	3/30/2050	2,050.00	451	29	4	3/30/2059
42	Mohanyateshwar	Berchhen – 6 (Baddikedar GP)	4/23/2051	1,448.08	108	13	4	12/31/2061
43	Masani Jana Kateyn	Berchhen – 5 (Baddikedar GP)	9/25/2057	500.00	51	11	3	3/20/2060
44	Nava Durga	Berchhen – 7 (Baddikedar GP)	1/15/2058	892.00	90	15		
45	Devi Durga	Berchhen - 1, 3 (Baddikedar GP)	1/30/2058	1,083.00	74	11	3	5/2/2058
46	Betal Baba	Berchhen – 5 (Baddikedar GP)	3/30/2059	0.00	0	9	0	
47	Samaiji	Khairala – 1 (Chure GP)	26/1/2070	132.13	108	621	321	

48	Hariyali	Mohanyal – 7 (Mohanyal GP)	14/2/2070	129.72	85	487	237	
49	Shivasakti	Khairala – 9 (Mohanyal GP)	22/2/2070	141.52	71	317	165	
50	Laliguras	Khairala – 3 (Mohanyal GP)	26/1/2070	165.76	85	405	151	
51	Masta	Khairalaa – 2 (Mohanyal GP)	29/1/2070	135.12	68	282	134	
52	Mahunyal	Mohanyal – 8 (Mohanyal GP)	27/1/2070	194.80	107	541	2,761	
53	Salleri	Mohhanyal – 6 (Mohanyal GP)	29/1/2070	115.50	62	316	160	
54	Sigasain	Mohhanyal – 7 (Mohanyal GP)	28/12/2069	111.81	58	323	157	
55	Kalika	Nigali – 5 (Chure GP)	8/25/2065	129.30	56	386	186	
56	Guptapani	Nigali – 1 (Chure GP)	9/7/2065	195.76	100	612	305	
57	Pragati	Nigali - 6, 7 (Chure GP)	9/7/2065	198.18	251	1,508	706	
58	Janakalyan	Nigali – 2 (Chure GP)	9/7/2065	198.29	150	625	311	
59	Bhagabati	Nigali – 4 (Chure GP)	9/7/2065	178.60	75	483	325	
60	Kedar	Nigali – 8 (Chure GP)	9/7/2065	152.80	84	461	227	
61	Thulikhali	Nigali – 2 (Chure GP)	9/7/2065	188.20	153	896	443	
62	Shivasakti	Nigali – 3 (Chure GP)	12/7/2065	190.73	86	543	247	
63	Kedar	Nigali – 5 (Chure GP)	12/7/2065	198.73	139	843	400	
64	Nabadurga	Nigali – 2 (Chure GP)	12/27/2065	197.20	199	1,159	629	
65	Bhagabati	Nigali – 4 (Chure GP)	12/27/2065	107.10	117	731	355	
	Total				5,847	12,119	8,386	

Annex 19: Existing policy provisions and status of enforcement

Table 29: Current policy provisions and relevant observations

Policy Provision	Ground Reality	Recommendations
Municipalities (local governments) are empowered to prepare and implement programs with regard to forests, vegetation, biodiversity, soil conservation, and environmental conservation in the village development area (per section 28(h) of the LSGA, 1999). Municipalities are required to assist environment conservation by managing air, land and water pollution within their jurisdiction; this work includes conserving forest, plants and other natural assets, and collecting, transporting, and disposing solid waste of the municipality area (per section 96(1)(c) of the LSGA).	Although the LSGA has been in force for the past 18 years, local bodies have not given priority to developing separate programs for conserving biodiversity. The municipalities in the watershed area have also focused limited energy on collecting and disposing waste. People not aware of the existing Aquatic Animal Protection Act, 1961.	Need greater focus on conservation of aquatic biodiversity through site-specific policy provisions in support of local communities and establishment of strong monitoring mechanisms. Awareness raising and formulation of local level by-laws and strict implementation are needed.
The National Park Regulations, 1974 provide detailed provisions for hunting license issuance (rules 5-13). However, these regulations do not make specific and separate provisions regarding fish; fish are subsumed under "wildlife."	Community Based Anti-poaching Units (CBAPU) and Rapid Response Teams (RRT) have been established in the watershed, but they require capacity building and support for greater effectiveness.	Conservation activities should be mainstreamed through development planning to ensure effective implementation.

Annex 20: Irrigation user groups

Table 30: Irrigation user groups by name, location and area

SN	Name	Location	Area (hectares)
1	Dhanraskhet	Laxminagar-2	2
2	Haldegad	Mannakapadi - 4, 5, 7, 9	65
3	Chhinnigad	Ghanteshwor - 4, 8, 9	40
4	Pipalkot	Laxminagar – 2	50
5	Laskar	Sarasotinagar – 4	31
6	Gadsera	Gadsera – 2	41
7	Jajana	Chhtiwan – 5	15
8	Kafalikheti	Laxminagar	30
9	Pipaltola	Nirauli – 6	31
		Total	**305**

Annex 21: Water supply and sanitation user groups

Table 31: Water supply and sanitation user groups by location and area

SN	Name	Address	Area (hectares)
1	Awasthigau Khanepani	Saraswotinagar – 3	5
2	Khara Botmare	Barchhain – 4	9
3	Kola Khanepania	Saraswotinagar – 3	15
4	Barchhain Khanepani	Barchhain – 2	11
5	Ghartis Khanepani	Laxminagar – 3	20
6	Garegada Khanepan	Lanakedareswor – 9	10
	Total		**70**

Annex 22: Areas with prepared LAPAs

Figure 22: Areas with prepared Local Adaptation Plans for Action (LAPAs)

Annex 23: Status of existing environment management plans

Table 32: Existing environment management plans by location, type, and current status

Community	WMP	CAPA	LAPA	WUMP	EFLG	LDRMP	Need of awareness
Saraswotinagar	2	2	2	2	2	1	Yes
Nigali	1	2	2	1	2	1	Yes
Mohanyal	1	2	2	1	2	1	Yes
Khairala	1	2	2	1	2	1	Yes
Laxminagar	2	2	1	2	2	1	Yes
Ghanteshwor	2	2	1	2	2	1	Yes

Legend: 1=in place; 2=not in place; 3=needs updating; 4=implemented; 5=not implemented (Source: Paani FGDs and KIIs, 2017).

Annex 24: Key stakeholders – organizations and offices

Table 33: Key organizations and offices relevant to watershed health

SN	Name	Address	Contact No.	Mobile No.
Government Organizations				
1	District Coordination Committee	Shilgadhi, Doti	094-420244	9858430222
2	District Soil Conservation Office	Shilgadhi, Doti	094-420258	9848662200
3	District Forest Office	Shilgadhi, Doti	094-420145	9858440145
4	District Agriculture Dev. Office	Shilgadhi, Doti	094-411126	9841418318
5	District Livestock Service Office	Shilgadhi, Doti	094-420114	9858440142
6	Division Irrigation	Rajpur, Doti	094-440168	9847858460
7	Women and Child Dev. Office	Shilgadhi, Doti	094-420078	9842670435
8	District Technical Office	Shilgadhi, Doti	094-420194	9858440194
9	Dipayal Silgadhi Municipality	Shilgadhi, Doti	094-420297	9848301476
10	Water Induced DC Division	Shilgadhi, Doti	094-440317	9858440317
11	Distrct Health Office	Shilgadhi, Doti	094-420043	9858440017
12	District Administration Office	Shilgadhi, Doti	094-420133	9858437777
13	Centre Beaure of Statistics	Rajpur, Doti	094-440153	9848450143
14	Road Division	Kulpate, Doti	094-440151	9759003487
15	Hydrology and Meteriology Office	Rajpur, Doti		
16	District Education Office	Shilgadhi, Doti	094-420135	9759003931
17	Silgadhi Water Users Commiittee	Shilgadhi, Doti	094-420607	9848597309
Non-government organizations				
1	KISAN	Shilgadhi, Doti		
2	Promoting Agriculture, Health and Alternative Livelihoods (PAHAL)	Shilgadhi, Doti		9868448374
3	Rural Village Water Resources Management Project (RVWRMP)	Shilgadhi, Doti	094-420166	
4	Rural Access Programme (RAP)	Shilgadhi, Doti		9741094824
5	Khapatad Tourism Board	Shilgadhi, Doti		98494808060
6	SUAAHARA - Good Nutrition	Shilgadhi, Doti		9848024247

7	Multi-sectoral Nutrition Plan (MSNP)	Shilgadhi, Doti		
8	Suklaphanta Wildlife Reserve Management Committee	Shilgadhi, Doti		
9	Curriculum Development Committee	Shilgadhi, Doti	094-420381	9848767391
10	Good Neighbours	Shilgadhi, Doti	094-420554	9858440002
11	Nepal Red Cross	Shilgadhi, Doti		9848414080
12	Rural Development Service Center (RDSC)	Dipayal, Doti		9849431462
13	Community Development Fund (CDF)	Shilgadhi, Doti	094-420020	9841674340
14	World Vision	Shilgadhi, Doti	094-420068	9858423406
15	United Missions to Nepal (UMN)	Shilgadhi, Doti	094-411220	9846080356
16	Energy Development Council (EDC)	Shilgadhi, Doti		9848431220
17	Source Nepal	Shilgadhi, Doti		9848438644
18	Feminist Dalit Organization (FEDO)	Shilgadhi, Doti	094-420002	9848434479
19	Samaj Sewa Doti	Shilgadhi, Doti	094-411020	9848474501
20	Rural Development Center	Shilgadhi, Doti	094-420340	9848438684
21	Integrated Social Development	Shilgadhi, Doti		9848431261
22	Disability Welfare Association	Shilgadhi, Doti	094-411093	9759000757
23	Society for Environmental and Economic Development	Shilgadhi, Doti		985844011
24	Nepal Environment and Education Development Center	Shilgadhi, Doti		9848797555
25	Local Initiatives for Biodiversity, Research and Development (LI-BIRD)	Shilgadhi, Doti	094-420601	9856036999
26	Family Planning Association	Shilgadhi, Doti	094-420042	
27	Nepal Federation of Irrigation Water Users' Association, Nepal (NFIWUAN)	Shilgadhi, Doti		9848474940
28	Nepal Federation of Indigenous Nationalities (NEFIN)	Shilgadhi, Doti		

29	Federation of Drinking Water and Sanitation Users, Nepal (FEDWASUN)	Shilgadhi, Doti		
30	Nepal Federation of Environmental Journalists (NEFEJ)	Shilgadhi, Doti		9848438644
31	Federation of Nepalese Chambers of Commerce and Industry (FNCCI)	Shilgadhi, Doti	094-440108	
32	Seti Technical Institute	Bhagetada, Doti	094-412176	
33	Nepal Electricity, Dipayal	Shilgadhi, Doti	094-412183	
34	Vijaya Development Resource Center (VDRC)	Shilgadhi, Doti		
35	Environment, Culture, Agriculture, Research and Development Society, Nepal (ECARDS)	Shilgadhi, Doti		
36	HELVETAS (Switzerland)	Shilgadhi, Doti		
37	Food and Agriculture Organization (FAO)	Shilgadhi, Doti		
38	Food First Information Network (FIAN)	Shilgadhi, Doti		9848624135
39	International Wheat and Maize Improvement Center (CIMMYT)	Shilgadhi, Doti		
40	Rural Prosperity Initiative	Shilgadhi, Doti		
41	World Food Programme (WFP)	Shilgadhi, Doti		9848524553
42	Kedar Rural Development Society	Shilgadhi, Doti		9848525522
43	Save the Children	Shilgadhi, Doti		9741065293

Annex 25: Vision building framework employed for compiling the Thuligaad watershed profile