WEST SETI WATERSHED PROFILE

STATUS, CHALLANGES AND OPPORTUNITIES FOR IMPROVED WATERSHED MANAGEMENT

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USAID PAANI PROGRAM

युएसएड पानी परियोजना

Cover photo: A view of the Weti Seti watershed and river from Bajhang

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WEST SETI

WATERSHED PROFILE:

STATUS, CHALLENGES AND OPPORTUNITIES FOR IMPROVED WATER RESOURCE MANAGEMENT

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ABBREVIATIONS

BCTS	:	Brahmin/Chhetri/Thakuri/Sanyasi caste
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	:	Civil Society Organizations
DADO	:	District Agriculture Development Office
DAKC	:	District Agriculture Knowledge Center Development
DCC	:	District Coordination Committee
DDC	:	District Development Committee
DDRC	:	District Disaster Risk Reduction Committee
DEECC	:	District Environment and Energy Coordination Committee
DFO	:	Division Forest Office
DFRS	:	Department of Forest Research and Survey
DRCN	:	District Core Road Network
DSCO	:	District Soil Conservation Office/Officer
DSCWM	:	Department of Soil Conservation and Watershed Management
EAP	:	Emergency Action Plan
EIA	:	Environmental Impact Assessment
EWS	:	Early Warning System
FECOFUN	:	Federation of Community Forestry Users, Nepal
FEDWASUN	:	Federation of Drinking Water and Sanitation Users Nepal
FGD	:	Focus Group Discussion

GON	:	Government of Nepal
GP	:	Gaunpalika or rural municipality (new federal administrative unit; formerly Village Development Committee)
Ha	:	Hectare
HIMAWANTI	:	Himalayan Grassroots Women's Natural Resource Management Association
IEE	:	Initial Environmental Examination
IRBM	:	Integrated River Basin Management
IUCN	:	International Union for Conservation of Nature
KII	:	Key Informant Interview
km	:	Kilometer
KNP	:	Khaptad National Park
kw	:	Kilowatt
LAPA	:	Local Adaptation Plan of Action
LGOA	:	Local Government Operation Act 2017
LSGA	:	Local Self-Governance Act
MOE	:	Ministry of Energy
MOFSC	:	Ministry of Forest and Soil Conservation
MOAD	:	Ministry of Agriculture Development
MOE	:	Ministry of Environment
MOFALD	:	Ministry of Federal Affairs and Local Development,
MOI	:	Ministry of Irrigation
MOPPT	:	Ministry of Physical Planning and Transportation
MOFALD	:	Ministry of Federal Affairs and Local Development
mm	:	Millimeter
MSC	:	Multi-stakeholder Consultation
NEFIN	:	Nepal Federation of Indigenous Nationalities
NFIWUAN	:	National Federation of Irrigation and Water Users' Association
NP	:	Nagarpalika (new federal administrative unit; district level)
NPC	:	National Planning Commission
NRM	:	Natural resource management
NTFP	:	Non-timber forest products

PAANI	:	Program for Aquatic Natural Resource Improvement
Sec.	:	Second
USAID	:	United State Agency for International Development
VDC	:	Village Development Committee
VRCN	:	Village Core Road Network
WECS	:	Water and Energy Commission Secretariat
WWF	:	World Wildlife Fund
°C	:	Degree Celsius

ACKNOWLEDGEMENTS

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

This 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 cooperatives, forest user groups, water user groups, and, especially, the communities dependent on aquatic biodiversity and local water management. Leaders from Kedarsieu rural municipality, or *gaunpalika* (GP), Thalara GP, Chabispathivera GP, Khaptadchanna GP, Durgathali GP, Jayaprithvi NP, Surma GP, Talkot GP, and Saipal GP 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, SNV and NESS that works closely with Nepal's Water and Energy Commission Secretariat (WECS) and draws on support from the WECS' member agencies. Paani enriched the watershed profile by compiling and reviewing secondary data and by collaborating with HIMAWANTI who carried out surveys to assess community perceptions and biophysical conditions. Thanks are also due for several other collaborating government agencies, civil society organizations, and federations for their consistent cooperation and contributions to prepare this watershed profile. These groups include FECOFUN, FEDWASUN, NFIWUAN, NEFIN, and other government agencies who gave their full cooperation and support at the national, district and local levels. Any errors in this discussion document are those of the Paani team.

EXECUTIVE SUMMARY

This profile assesses the status, major challenges and opportunities for water resource management and aquatic biodiversity for the multiple users within the West Setii watershed, which lies fully within province 7, Sudarpaschim Pradesh.

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

This watershed profile provides critical baseline information for local government, community, civil society, and private sector stakeholders within the West Seti watershed to strengthen water resource management to benefit human development and protect the natural resource base upon which well-being depends. This profile also helps local stakeholders to design and test interventions to strengthen community resilience and conserve freshwater biodiversity, for which additional resources are available through the Paani local grants program.[1]

The West Seti watershed sits in the Karnali Basin in western Nepal (Figure 1). Ninety-seven percent of the watershed is contained in Bajhang district, with nominal parts located in neighboring Doti and Bajura. The total area of the West Seti watershed is 1,488 km^2 and its drainage density is 647 m^3. The total drainage length of the watershed is 963 km, as the many rivers of the watershed run southward to the confluence with the Karnali River and eventually the Ganges Basin in India.

Due to Nepal's unique altitudinal varation and geographic diversity, the West Seti watershed – like many watersheds in Nepal – contains a wide range of ecosystems, providing habitats to an impressive floral (567 species) and faunal diversity. As a reflection of more recent efforts to protect and conserve this diversity, the government of Nepal established Khaptad National Park (KNP) at the watershed's southern boundary in 1984. The park extends over four districts: Bajhang, Bajura, Doti and Achham. In addition to KNP's biological importance, the area also attracts religious devotees who visit the Shiva

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

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

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

shrine, the temple of Khaptad Mai, and the ashram of the Khaptad Swami. Full moons during July and August draw thousands of pilgrims from all over the country who come to worship Shiva.

According to the latest census in 2010, the population of the watershed is 130,539, of which 53% are female and 47% are male. Disaggregating the population for caste/ethnicity, 72.7% are Brahmin/Chhetri/Thakuri/Sanyasi (BCTS), 20.8% are Dalit, and the remainder (6.5%) are Janajati, or indigenous. The population density of the watershed is low: 88 persons/km^2.

The Seti River is the primary waterway of the area, a snow-fed river enriched by numerous tributaries that are both snow and rain fed. However, in recent years, residents in the areas have noted significant changes to the watershed's hydrological flow, changes they attribute to a range of causes, including increasing landslides and soil erosion, improper road construction, deforestation, and shifting cultivation practices on steep hillsides. The landslides and soil erosion in the area are exacerbated by increasingly erratic rainfall patterns.

Changes such as these invariably affect human settlement and degrade aquatic habitats in and along the rivers and streams of the watershed.

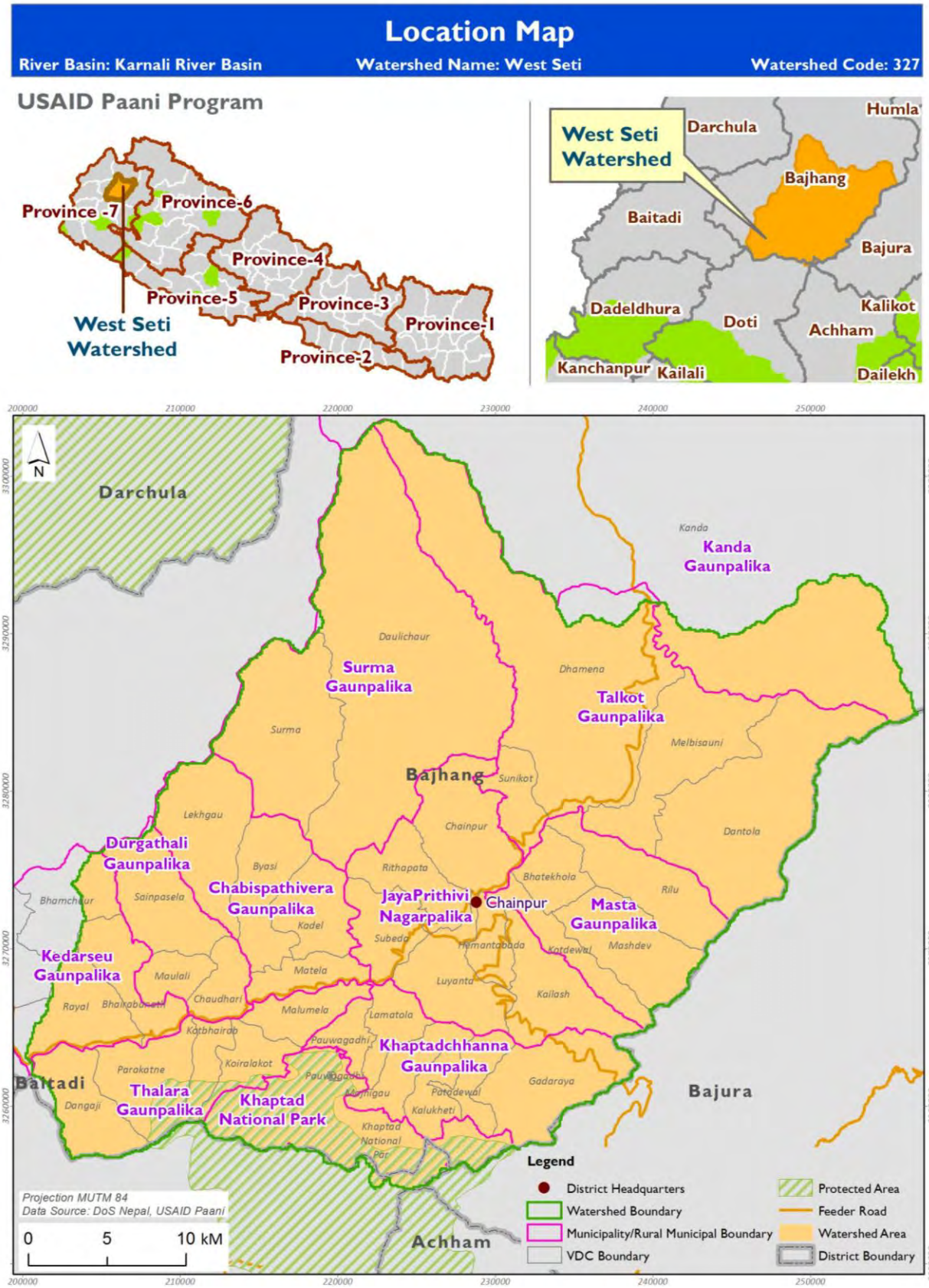


Figure 1: Map of the West Seti watershed, including administrative units

Priority Issues for the West Seti watershed

The following priority challenges in the West Seti watershed were identified through a series of data collecting methods, including a multi-stakeholder workshop, household surveys and field observations. The challenges are summarized in Table 1 and described below with recommendations for addressing each challenge. Figure 2 below maps the location where these threats were noted by stakeholders.

Table 1: Priority issues and threats to freshwater conservation and aquatic biodiversity in the West Seti watershed

SN	Issue or threats	Priority Rank	Remarks
1	Landslides, river cutting, flash floods and resultant sedimentation	I	
2	Improper rural road construction	II	
3	Degraded aquatic habitats and declining fish numbers	III	
4	Forest degradation and forest fires	IV	
5	Drying water sources	V	
6	Non-point source pollution and waste disposal in rivers and streams	VI	

Source: Entry multi-stakeholder workshop

1. Landslides, river cutting, flash floods and resultant sedimentation

Due to the steep topography and fragile slopes in West Seti, many areas of the watershed are prone to flooding and landslides. Human-induced pressures on these slopes in the form of cultivation and/or livestock grazing, exacerbate these conditions significantly. The sedimentation that accumulates in the wake of these events harms aquatic habitats and destroys local water sources. Unfortunately, few local governments have developed plans and modes of response in the case one of these hazards should occur. The West Seti watershed also lacks an early warning system, which could improve response times in the case of a flood or landslide.

Recommendations

- Identify and map areas prone to landslides, river cutting, flash floods, and sedimentation in consultation with local governments and stakeholders; and
- Develop local level adaptation and disaster risk response plans based on the existing national framework.

II. Improper rural road construction

The government of Nepal has increased the available budget for road construction substantially, particularly in rural areas. However, this rise in financial support has meant that many roads are built quickly and without proper environmental impact assessments beforehand. These roads, often built into steep hillsides, exacerbate the conditions for landslides and soil erosion, which put human settlements at risk for disaster, decimate available water sources, and degrade aquatic habitats.

Recommendations

- Promote bioengineering techniques for road building to protect water sources and mitigate the effects of potential disaster precipitated by improperly constructed roads;
- Build capacity in local residents to inspect and monitor road building practices;
- Develop long-term road network vision and guidelines for building these roads in accordance with policies requiring sufficient environmental assessment beforehand;

III. Degraded aquatic habitats and declining fish numbers

Human threats are affecting fish numbers in the West Seti watershed. A rise in the use of destructive fishing methods (e.g., poison, electric current) is not only pushing unsustainable harvest levels but also marginalizing traditional fishing communities that cannot compete with commercial interests. Furthermore, improper road building and climate-induced natural hazards (e.g., landslides) degrade aquatic habitats. Policy exists that prohibits destructive fishing methods, but enforcement in the watershed is low.

Recommendations:

- Disseminate and promote existing aquatic habitat policies through mass media;
- Promote awareness in local schools to increase sensitivity to aquatic habitats and the importance of conservation measures; and
- Encourage stronger enforcement of fish protection policies that prohibit illegal fishing practices and overharvesting.

IV. Forest degradation and forest fires

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.

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 in the national park and wherever else possible; and
- Establish community patrols during the dry season to warn about potential fire risk areas.

V. Drying water sources (and increasing water pollution)

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 that drying water sources are particularly acute in Deuda, Tamail, Chainpur, and Bhopur.

Recommendations

- Promote rainwater harvesting technologies;
- Map existing water sources to inform future conservation efforts;
- 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; and
- Encourage enforcement of existing laws and regulations related to watershed conservation and management.

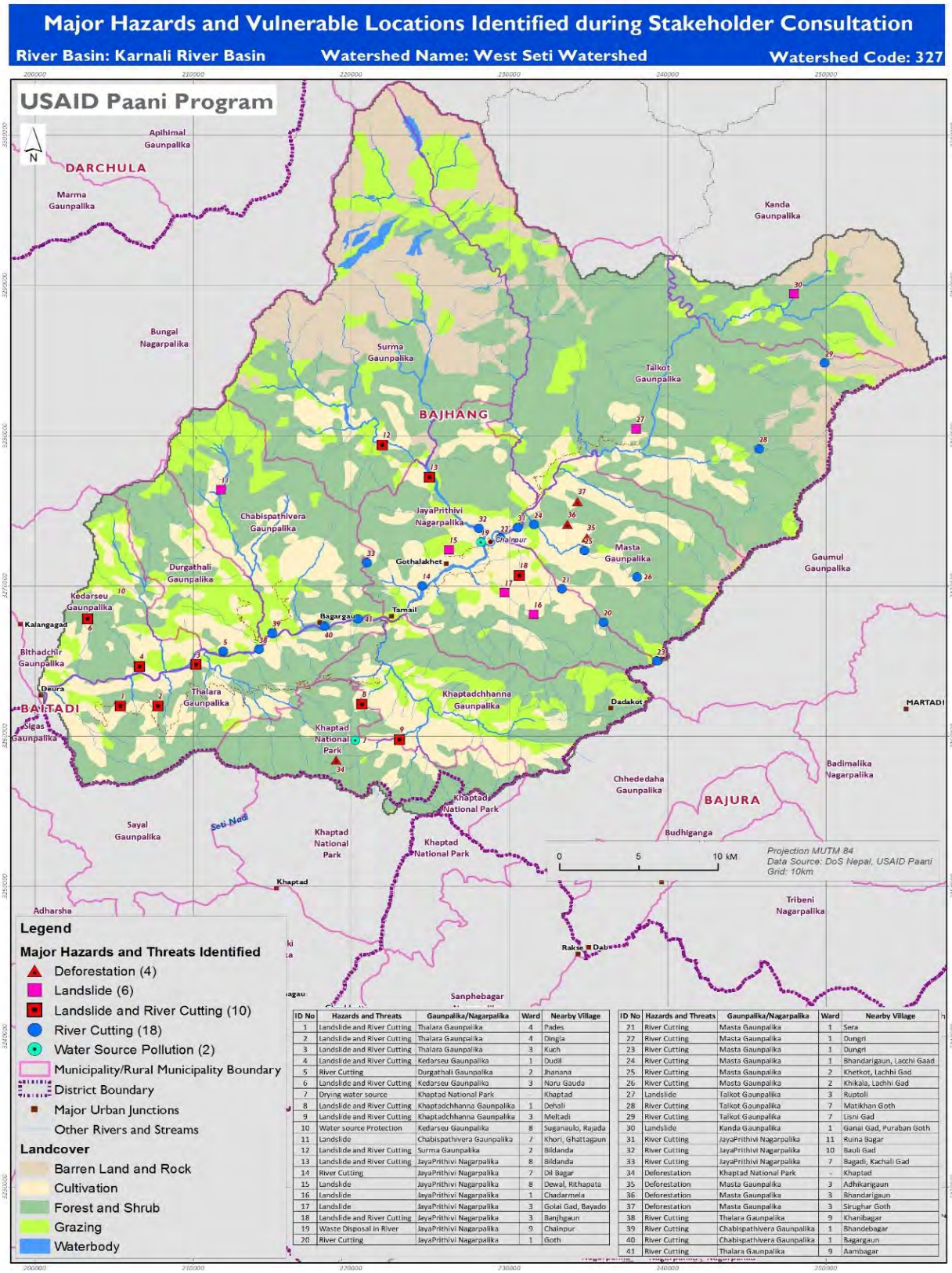
VI. Non-point source pollution and waste disposal in rivers and streams

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

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

Recommendations

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



ID No	Hazards and Threats	Gaunpalika/Nagarpalika	Ward	Nearby Village
1	Landslide and River Cutting	Thalara Gaunpalika	4	Pades
2	Landslide and River Cutting	Thalara Gaunpalika	4	Dingla
3	Landslide and River Cutting	Thalara Gaunpalika	3	Kuch
4	Landslide and River Cutting	Kedarseu Gaunpalika	1	Dudil
5	River Cutting	Durgathali Gaunpalika	2	Jhanana
6	Landslide and River Cutting	Kedarseu Gaunpalika	3	Naru Gauda
7	Drying water source	Khaptad National Park	-	Khaptad
8	Landslide and River Cutting	Khaptadchhanna Gaunpalika	1	Dehali
9	Landslide and River Cutting	Khaptadchhanna Gaunpalika	3	Meltadi
10	Water source Protection	Kedarseu Gaunpalika	8	Suganaulo, Rajada
11	Landslide	Chabispathivera Gaunpalika	7	Khori, Ghattagaun
12	Landslide and River Cutting	Surma Gaunpalika	2	Bildanda
13	Landslide and River Cutting	JayaPrithivi Nagarpalika	8	Bildanda
14	River Cutting	JayaPrithivi Nagarpalika	7	Dil Bagar
15	Landslide	JayaPrithivi Nagarpalika	8	Dewal, Rithapata
16	Landslide	JayaPrithivi Nagarpalika	1	Chadarmela
17	Landslide	JayaPrithivi Nagarpalika	3	Golai Gad, Bayado
18	Landslide and River Cutting	JayaPrithivi Nagarpalika	3	Banjhgaun
19	Waste Disposal in River	JayaPrithivi Nagarpalika	9	Chainpur
20	River Cutting	JayaPrithivi Nagarpalika	1	Goth

ID No	Hazards and Threats	Gaunpalika/Nagarpalika	Ward	Nearby Village
21	River Cutting	Masta Gaunpalika	1	Sera
22	River Cutting	Masta Gaunpalika	1	Dungri
23	River Cutting	Masta Gaunpalika	1	Dungri
24	River Cutting	Masta Gaunpalika	1	Bhandarigaun, Lacchi Gaad
25	River Cutting	Masta Gaunpalika	2	Khetkot, Lachhi Gad
26	River Cutting	Masta Gaunpalika	2	Khikala, Lachhi Gad
27	Landslide	Talkot Gaunpalika	3	Ruptoli
28	River Cutting	Talkot Gaunpalika	7	Matikhan Goth
29	River Cutting	Talkot Gaunpalika	7	Lisni Gad
30	Landslide	Kanda Gaunpalika	1	Ganai Gad, Puraban Goth
31	River Cutting	JayaPrithivi Nagarpalika	11	Ruina Bagar
32	River Cutting	JayaPrithivi Nagarpalika	10	Bauli Gad
33	River Cutting	JayaPrithivi Nagarpalika	7	Bagadi, Kachali Gad
34	Deforestation	Khaptad National Park	-	Khaptad
35	Deforestation	Masta Gaunpalika	3	Adhikarigaun
36	Deforestation	Masta Gaunpalika	3	Bhandarigaun
37	Deforestation	Masta Gaunpalika	3	Sirughar Goth
38	River Cutting	Thalara Gaunpalika	9	Khanibagar
39	River Cutting	Chabispathivera Gaunpalika	1	Bhandebagar
40	River Cutting	Chabispathivera Gaunpalika	1	Bagargaun
41	River Cutting	Thalara Gaunpalika	9	Aambagar

Figure 2: Major environmental issues in the West Seti watershed by location as identified by stakeholders

1. WEST SETI WATERSHED: NATURE, WEALTH AND POWER

This West Seti watershed profile is organized around three interrelated themes that influence the management and overall health of the watershed: **nature** (environment and natural resources), **wealth** (socioeconomics and infrastructure—the many ways that people use nature), and **power** (governance and institutions—the ways that the different people and groups make decisions together about the watershed and its uses) [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 2016-18, the Paani program conducted a series of literature reviews, household surveys, focus group discussions, and key informant interviews to characterize the watersheds, including the identification of priority threats and opportunities. Through exit workshops the Paani team shared preliminary results with multiple stakeholders, based on which priority issues and environmental assets were identified by location and impact groups. During the exit workshop, the Paani team also identified champions among stakeholders and local government agencies for leveraging funds and expertise to support water resources management initiatives.

Paani took the critical feedback and suggestions to identify priority issues and actions, 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

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

2.1 WEST SETI WATERSHED

The West Seti watershed sits almost entirely inside Bajhang district, with small parts extending into Doti and Bajura. The area is hilly and remote, ranging in altitude from 3,400 m to just 750 m in the southern reaches.

The watershed covers an area of 1,488 km^2 and is administered by ten local governments (Table 2) organized according to the new federal structure in Nepal, and the officers of Khaptad National Park. Bajhang district is a very impoverished area of Nepal, ranking 72nd out of 75 districts on the Human Development Index. Income and nutritional security are perennial issues for households.

Most of the settlements in the watershed inhabit the plains along the Seti River Valley, between 750 m and 2,500 m. Within this range, two annual grain harvests are possible, depending on some geographical and environmental factors (e.g., sunlight, water availability, and soil fertility).

Table 2: Administrative units of the West Seti watershed, including area covered

Name	District	Nagarpalika (NP) or Gaunpalika (GP)	Total area of NP/GP (km^2)	Area of NP/GP contained in watershed (km^2)	Percentage of watershed covered by that NP/GP
West Seti	Bajura	Gaumul GP	315	2	1
	Doti	Khaptad National Park	95	7	7
	Bajhang	Chabispathivera GP	116	116	99
		Durgathali GP	62	61	99
		Jaya Prithivi NP	167	167	100
		Kanda GP	1,413	86	6
		Kedarseu GP	114	59	52
		Khaptad National Park	70	70	100
		Khaptadchhanna GP	114	113	100
		Masta GP	109	109	100
		Surma GP	271	268	99

		Talkot GP	335	324	97
		Thalara GP	106	103	98
Total			**23,841**	**9,097**	**38**

Land, water and forests are the major natural resources, providing essential materials and ecosystem services to humans and wildlife alike. Many stakeholders voiced concern about sustaining local forests because fuelwood is still the most common energy source for households, and more families are searching to increase their agricultural holdings by taking down trees. The forest cover in West Seti provides 51% of the total land cover in the watershed, followed by agricultural cultivation (20%), grazing land or pasture (15%), barren land (13%), and rivers and streams (2%).

2.2 WATER AVAILABILITY AND QUALITY

The West Seti watershed features a river system fed by rain and snow and comprised of both perennial and seasonal streams throughout. The watershed contains 151 rivers and streams, and seven sub-watersheds with a combined total drainage density of 647 m^3. The total drainage length of the watershed is 963 km, as the many rivers of the watershed run southward to the confluence with the Karnali River and eventually the Ganges Basin in India (Figure 3).

Major rivers of the watershed include Kalanga Khola, Bauligaad, Tarugaad, Sunigaad, Talkotgaad, Thalairgaad, Jadarigaad, Bhayagutegaad, and Listigaad. The most important lake in the watershed is Dau Lake, located at 2,233 meters near Surma GP, which provides water for domestic and agricultural needs. Other key lakes include Timadaha, Khaptad Tal, Lokund Daha, and Khapar Daha.

Surveys conducted in 2018 (n=1,016) found that 76.5% of households obtain sufficient daily water within 30 minutes of home, while 5.3% require between 30-60 minutes, and 5.3% require more than an hour. Twelve percent of families have private taps, therefore no travel is necessary for collection. A large majority of water is provided to households through piped systems (76.3%), followed by river withdrawal (11.2%), and stone taps (9.4%). The water supply for the piped systems comes primarily from springs (89.3%) while another 10.7% draw piped water directly from the river.

In terms of water access, 92% of the respondents said they had equal access to available sources. Nearly 10% of Dalit households said they did not have equal access. Ninety percent of water sources are public, and the rest are private.

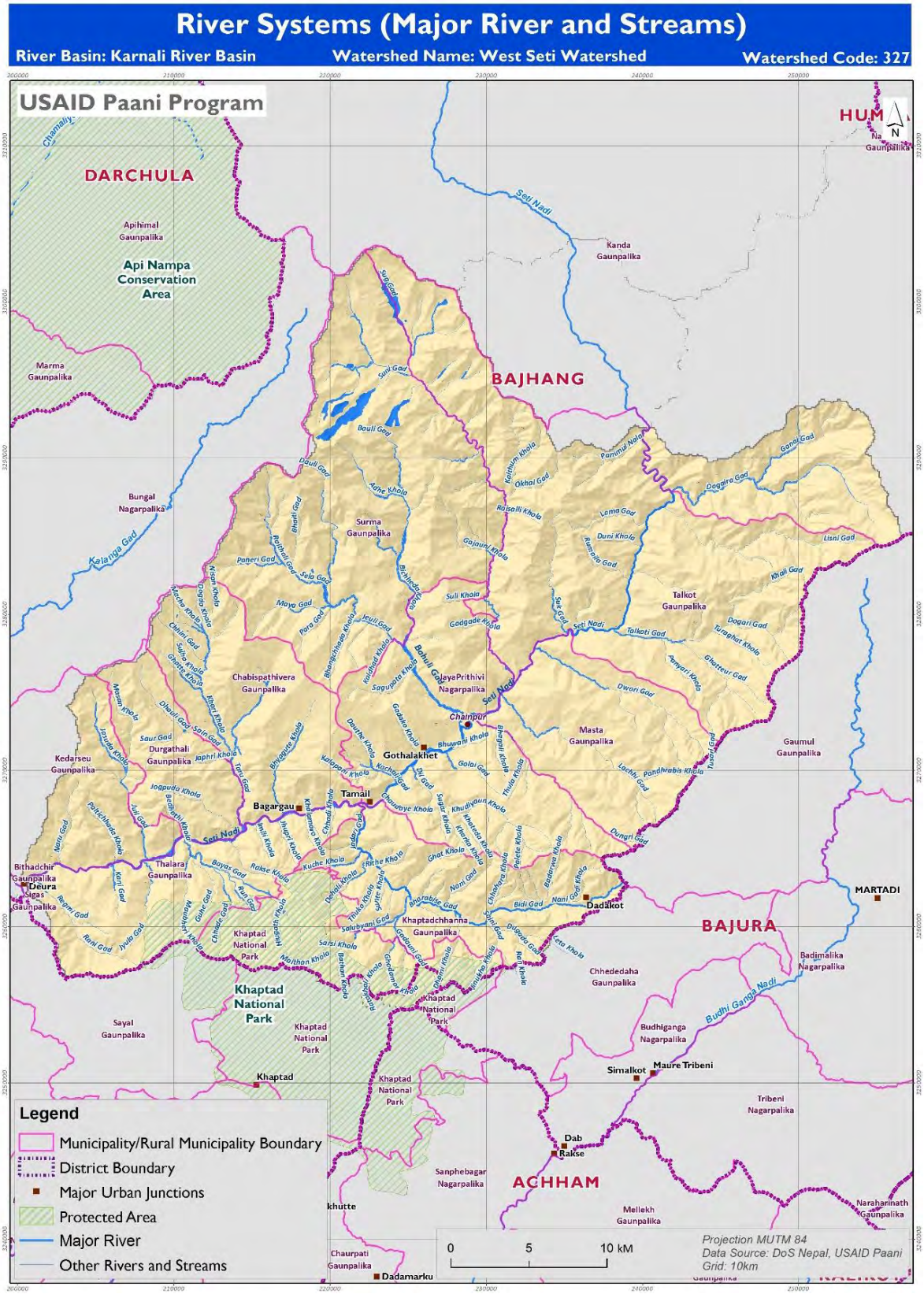


Figure 3: River network of the West Seti watershed

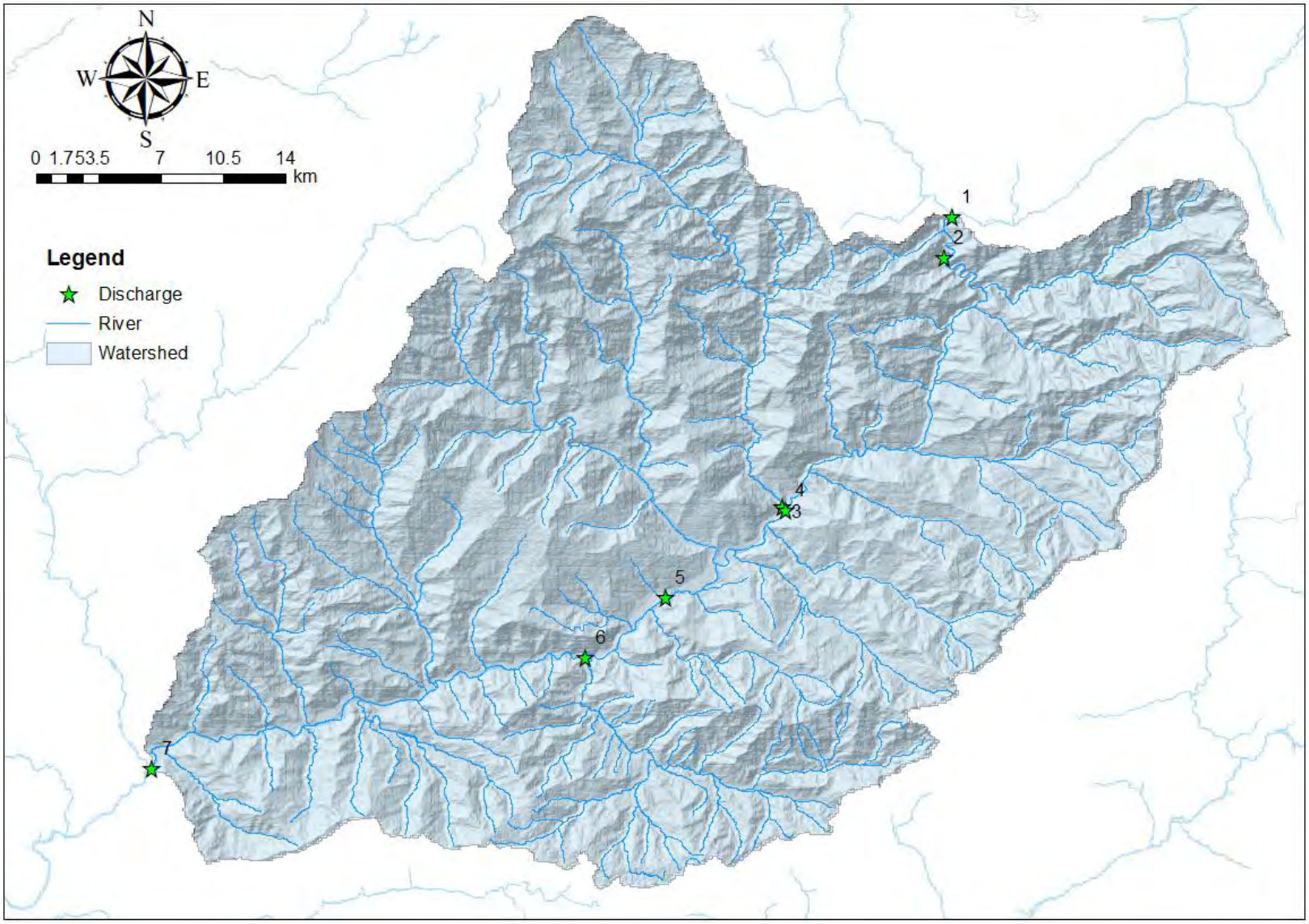


Figure 4: Location of points of discharge estimation in West Seti watershed, using SWAT hydrological model

The Seti Nadi is the primary waterway of the watershed, originating high in the northern reaches and flowing through the middle valley. Whlie there are no government gauges in the area to measure long-term discharge rates, Paani measured river flow at seven points (Figure 4) to establish a mean monthly estimation of flow rates, illustrated in Figure 5.

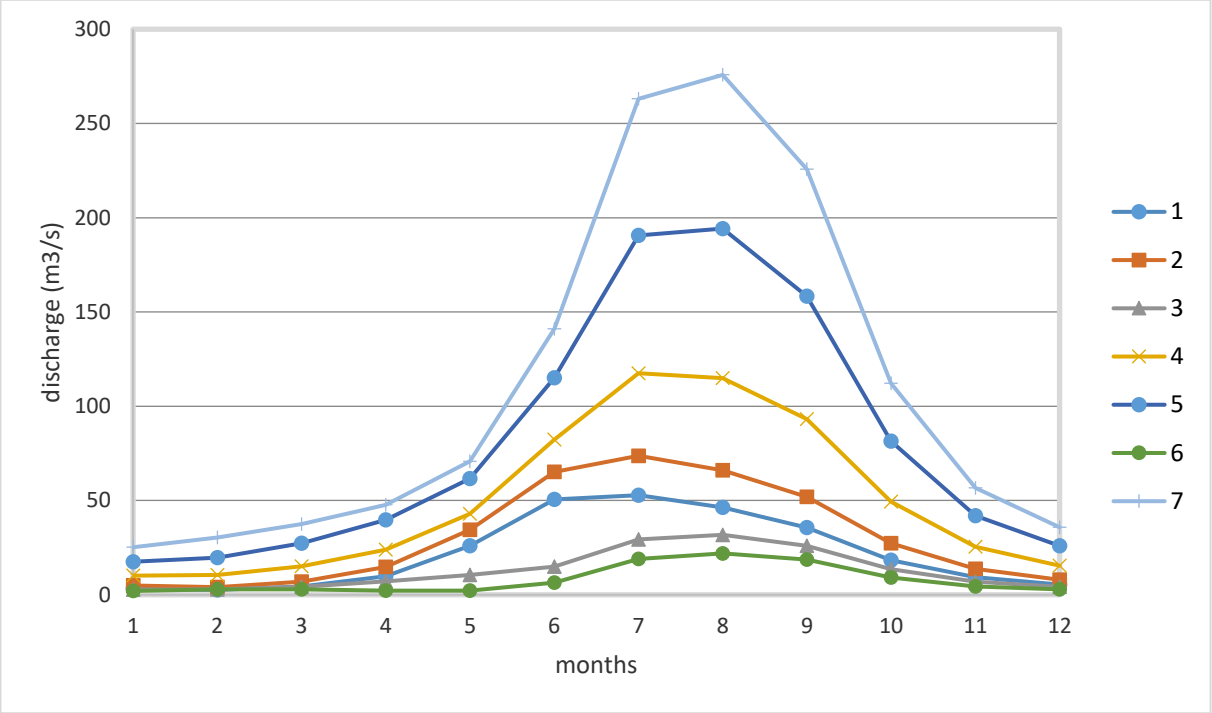


Figure 5: Long-term mean monthly discharge of Seti River at different locations in the West-Seti Nadi watershed, estimated based on SWAT modelling by the IWMI

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

Gender and Social Inclusion (GESI) issues: Many areas of the West Seti watershed have no perennial springs for drinking water, and the community relies on water from distant rivers to meet daily needs. In places such as Dungri (Jaya Privthi GP), Juwada, and Kagunadi (Kedarsiue GP), girls and women bear responsibility for the procurement of daily water. This work can require several hours a day in some parts of the watershed, and the opportunity costs on women's lives is significant. Plus, with so many men now migrating for work outside the watershed, this responsibility is heaped on top of an already considerable workload.

Related annexes

Annex 3: Temperature and precipitation

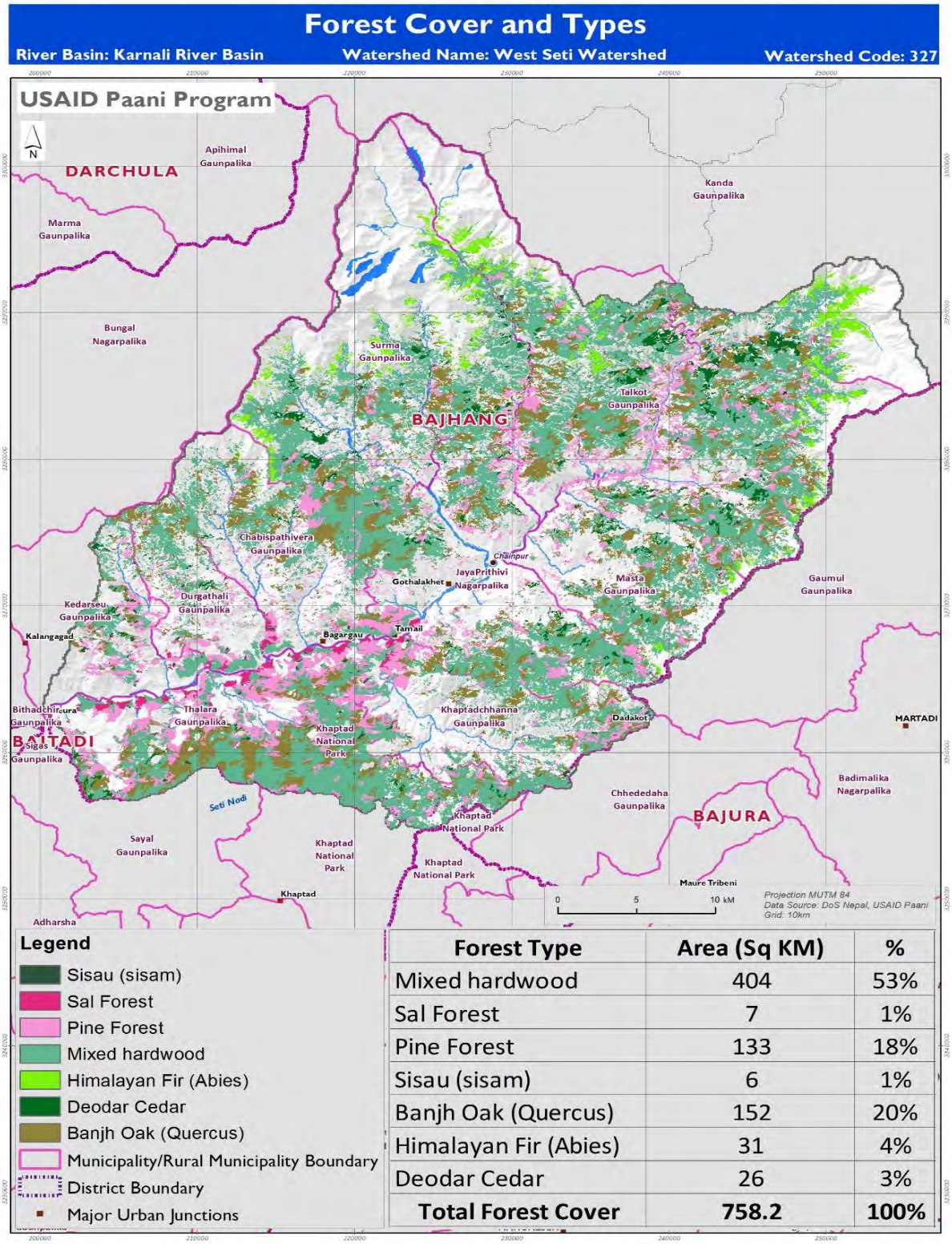
Annex 14: Water quality

2.3 LAND USE AND LAND COVER

Given its high mountain location, land cover in the West Seti watershed (Table 3) is primarily forest and shrubland (51%), followed by cultivation (20%), barren land (13%), and rivers and streams (2%). The forest is the primary natural resource for the area, providing timber and numerous non-timber forest products (NTFPs), such as medicinal and aromatic plants. In the forest cover, mixed hardwoods are most common (53%), followed by Banjh oak (20%), pine (18%), fir (4%), Deodar cedar (3%), and Sal and Sisau (1% each). Figure 6 illustrates the forest cover by species.

Table 3: Land cover by area and percentage in the West Seti watershed

Type	Area (km^2)	Percentage
Agriculture	295.8	20
Forest and shrub land	758.2	51
Pasture for grazing	220.1	15
River, streams, lakes and ponds	22.4	2
Barren land	191.0	13
Total	**1,487.5**	**100**



Forest Type	Area (Sq KM)	%
Mixed hardwood	404	53%
Sal Forest	7	1%
Pine Forest	133	18%
Sisau (sisam)	6	1%
Banjh Oak (Quercus)	152	20%
Himalayan Fir (Abies)	31	4%
Deodar Cedar	26	3%
Total Forest Cover	**758.2**	**100%**

Figure 6: Forest cover by type and percentage in the West Seti watershed

From 2000-2016, forest cover declined slightly (Figure 7). According to data from Global Forest Watch, the watershed has lost 4,299 hectares of forest (5.6%) while gaining only 840 hectares (1.1.%) in other areas. Open grazing and excessive firewood collection are the most significant concerns about local forests, while increasing dryness in the region also suggests forest fire awareness is warranted in the future.

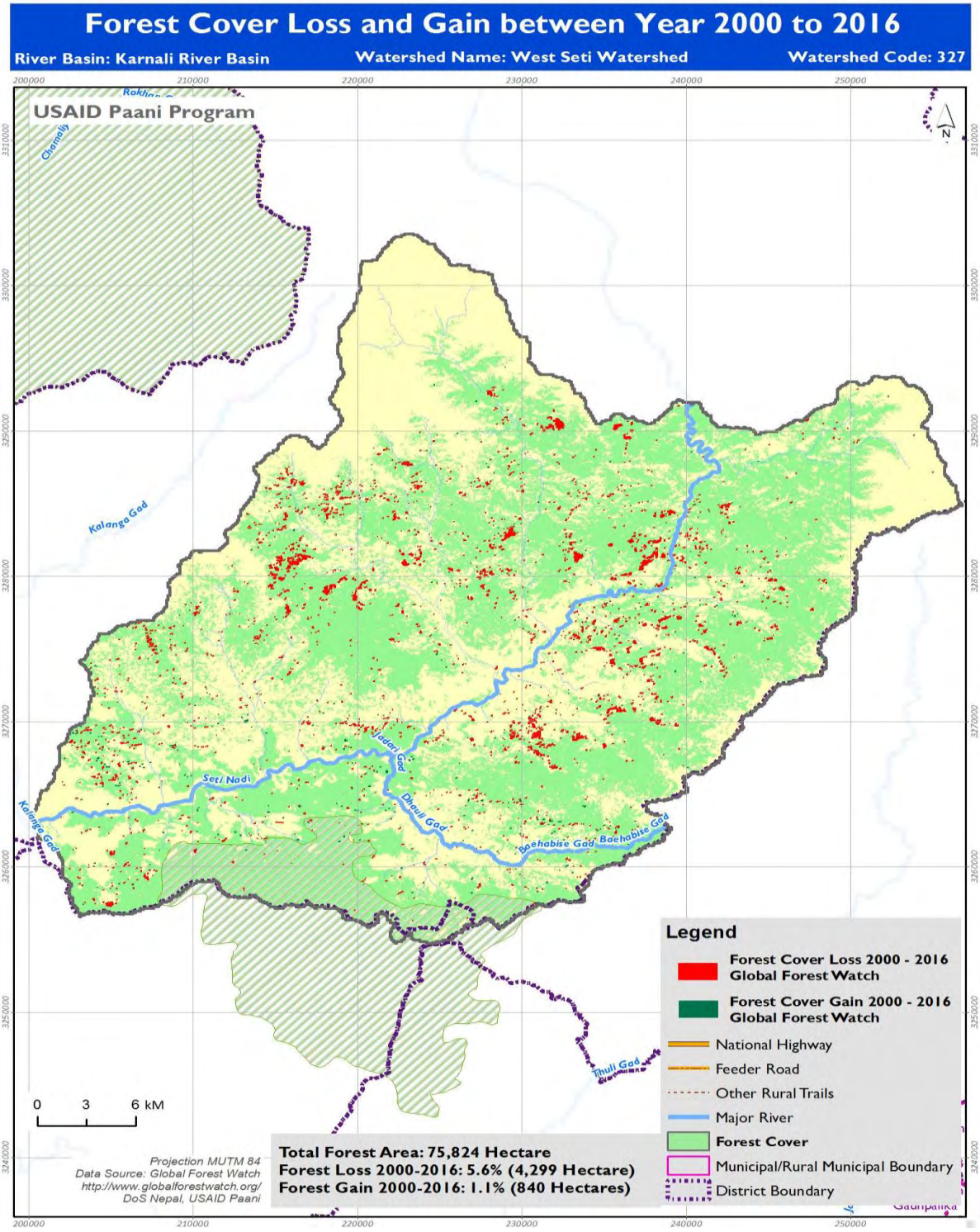


Figure 7: Forest loss and gain in the West Seti watershed, 2000-2016

Related annexes
Annex 2: Land cover and land use
Annex 6: Forests and plant life

2.4 BIODIVERSITY AND INVASIVE SPECIES

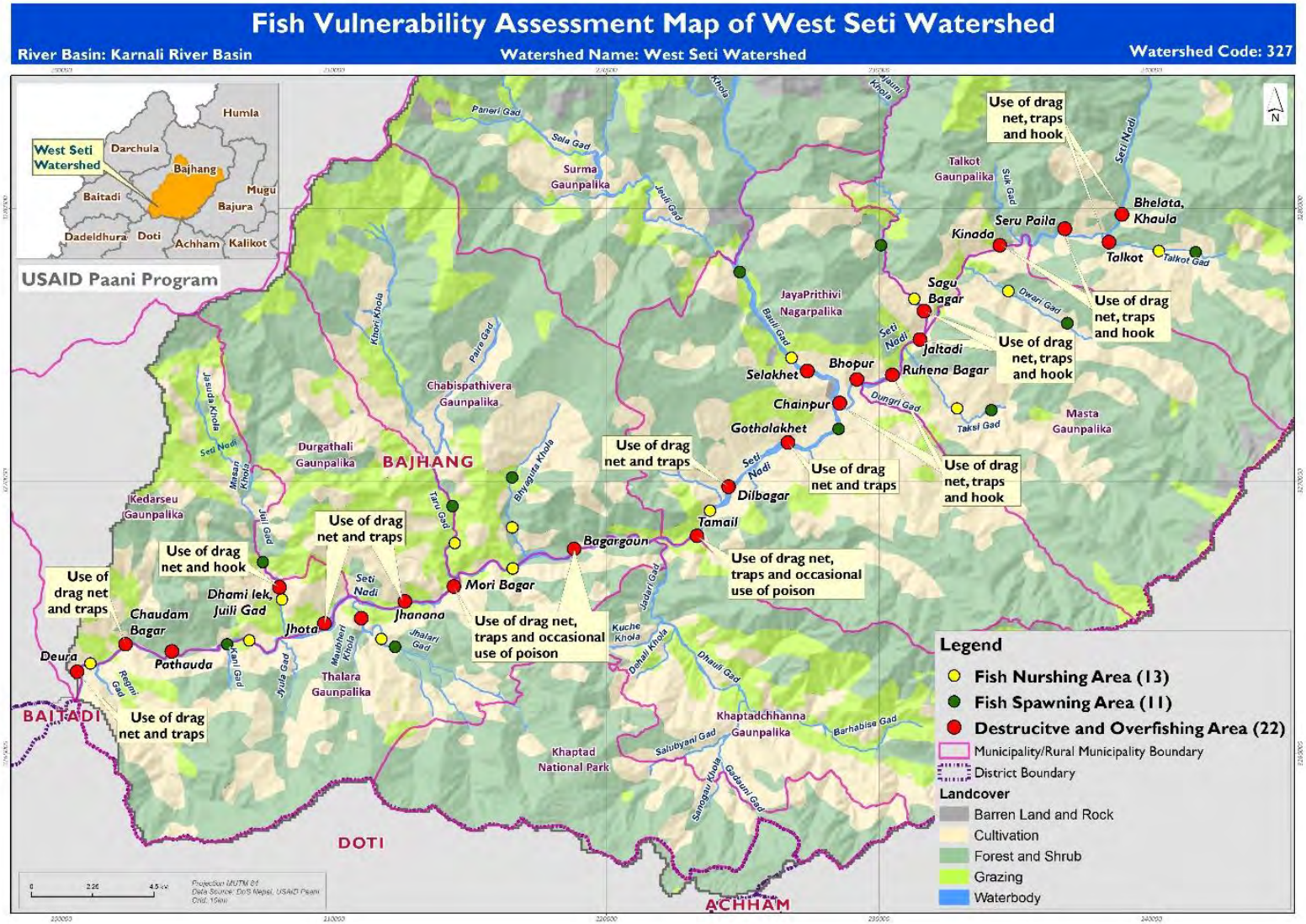
The West Seti watershed contains diverse habitats for aquatic and terrestrial species among its various ecological zones. The Khaptad National Park along the southern border offers sanctuary to a large diversity of floral species (567) and fauna, including 217 bird species. Some of the more common tree species include Chir pine, spruce, fir, maple, bird, alder, and rhododendron. Dense stands of bamboom and several medical herbs – such as Bojho (Acorus calamus), Chutro (Berberis), Eklevir (Lobelia pyramidalis) and Bhojpatra (Betula utilis) – that are cultivated for personal use and sale.

Twenty-two tributaries, the Seti River, and numerous ponds provide plentiful freshwater for fish habitats. The largest lake in the watershed is Khaptad Lake which sis at 3,050 m in the eastern part of KNP. Thirteen species of fish have been identified in the watershed, and the major species include Asala (Schizothorax), Kathyal (Acrossocheilus hexagonolepis), and Sahar (Tor). In the dry season, fishing groups harvest approximately 40-50 kg per person, much of which is sold in markets at Chainpur, Tamail, and Deuda.

Raadi
Chyaude
Thale
Chimti
Chieu

Generally, however, there is little researched-backed information about fish in the watershed. A fish vulnerability study was conducted in February 2019 in which stakeholders identified locations where fish spawn and nurse their young, and where overfishing was present (figure 8). Maps such as these will help build a foundation of aquatic knowledge that can be used to inform long-term conservation planning. During fish vulnerability Assessment (FVA), community people listed fishes include Paap, Raadi, Chyaude, Thale, Chimti, Chieu, they are yet to validate in terms of their common as well scientific names. The other fishes that could be characterized their taxonomic classes are presented in Annex- Table 15.

Figure 8: Fish vulnerability map for the West Seti watershed



Related annexes
Annex 7: Fish and aquatic life
Annex 8: Mammals
Annex 9: Reptiles
Annex 10: Birds

2.5 CLIMATE AND PHYSIOGRAPHY

There are four prominent climatic seasons in Nepal: winter (Dec-Feb), spring/pre-monsoon (Mar-May), summer/monsoon (Jun-Sept) and autumn/post-monsoon (Oct-Nov). Temperature and rainfall variations persist not only by season but also by altitudinal gradients.

2.5.1 TEMPERATURE

Long-term temperature records are available for West Seti only at Chainpur (Figure 9); thus, additional records were taken from Silgadi, which lies the southwest of the watershed.

In addition to the seasonal temperature variations (Figure 10), differences in topography also induce spatial variations of temperature in the watershed. Long-term temperature data recorded in the Rapti, Karnali and the Mahakali River basins were used to determine the temperature change rate with respect to the elevation change. Temperature was observed to decrease at a mean rate of 4.4 °C, 4.6◦C, 4.6◦C and 4.8◦C per 1 km rise in altitude in winter, pre-monsoon, monsoon and the post-monsoon seasons, respectively. Similarly, the annual mean temperature is observed to decrease at the rate of 4.9 ◦C per 1 km rise in altitude.

Long-term mean monthly temperature variation (daily mean) in West Seti watershed is shown in Figure 11. The mean monthly temperature of the watershed varies from 12 ◦C, in winter, to approximately 26 ◦C in summer. Similarly, the maximum and minimum monthly temperature varies from 4◦C to 19 ◦C in winter and from 19 ◦C to 32 ◦C in summer.

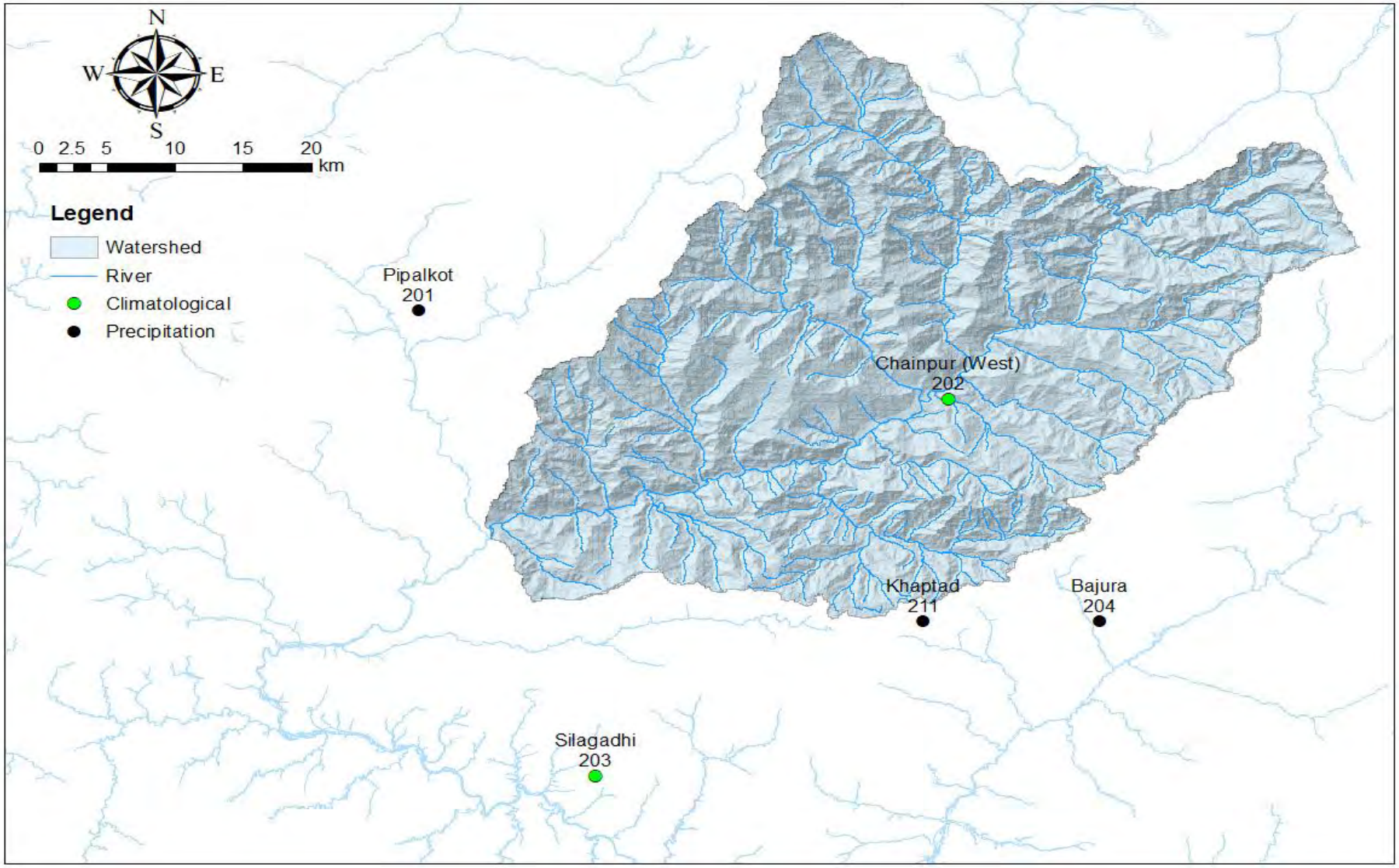


Figure 9: Meteorological stations used to estimate rainfall and temperature for the West Seti watershed

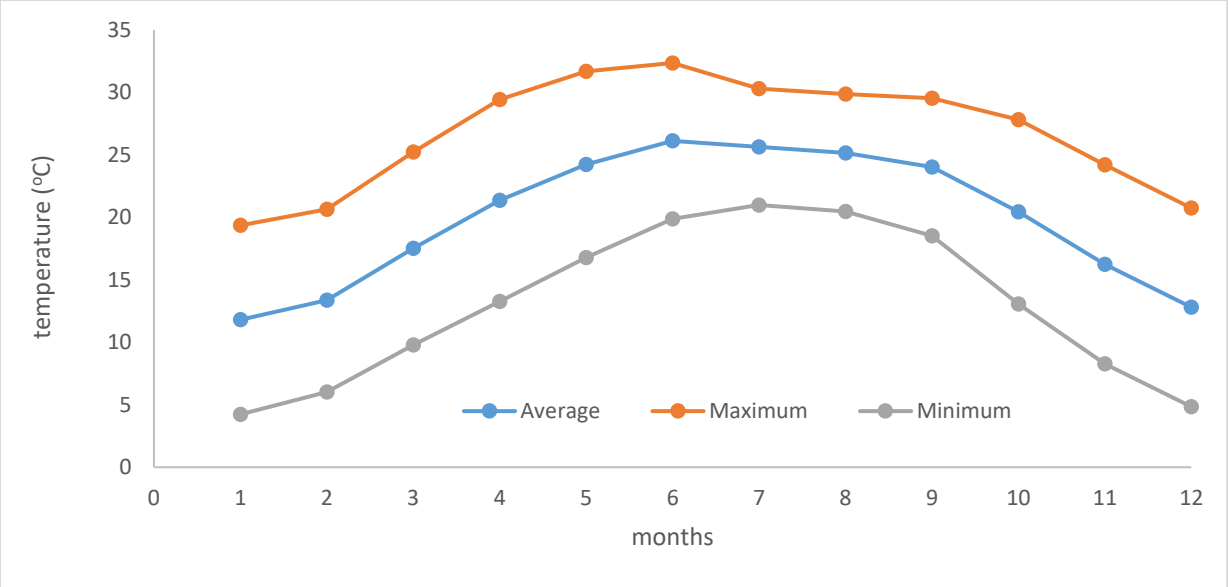


Figure 10: Average temperatures by month for the West Seti watershed

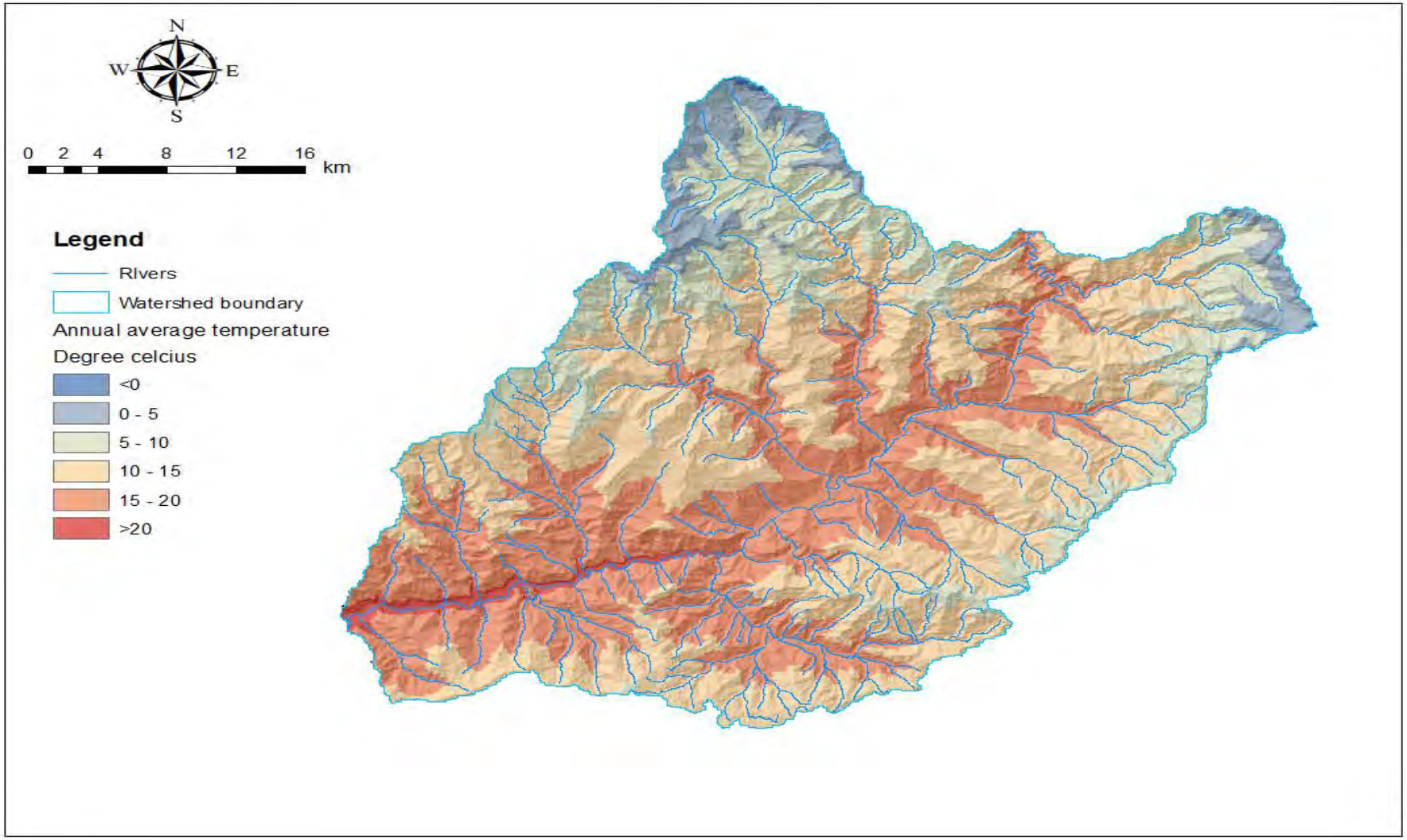


Figure 11: Mean annual temperature (°C) distribution in the West Seti watershed

2.5.2 RAINFALL

Within West Seti, long-term records are available only at Chainpur. Therefore, additional data from Pipalkot, Silgadi, Khaptad, and Bajura was used to derive a fuller picture of rainfall in the watershed. Monthly averages from the individual stations compared to the full watershed monthly averages are shown in Figure 12.

The Theissen polygon method was used to estimate the mean rainfall of the West Seti watershed. The highest and lowest rainfall months in the watershed are observed in July and December, respectively. The mean rainfall during winter (Dec – Feb), pre-monsoon (Mar – May), monsoon (June – September) weas estimated as 136 mm, 193 mm, 1408 mm and 64 mm, respectively. The mean annual rainfall is estimated at 1,800 mm.

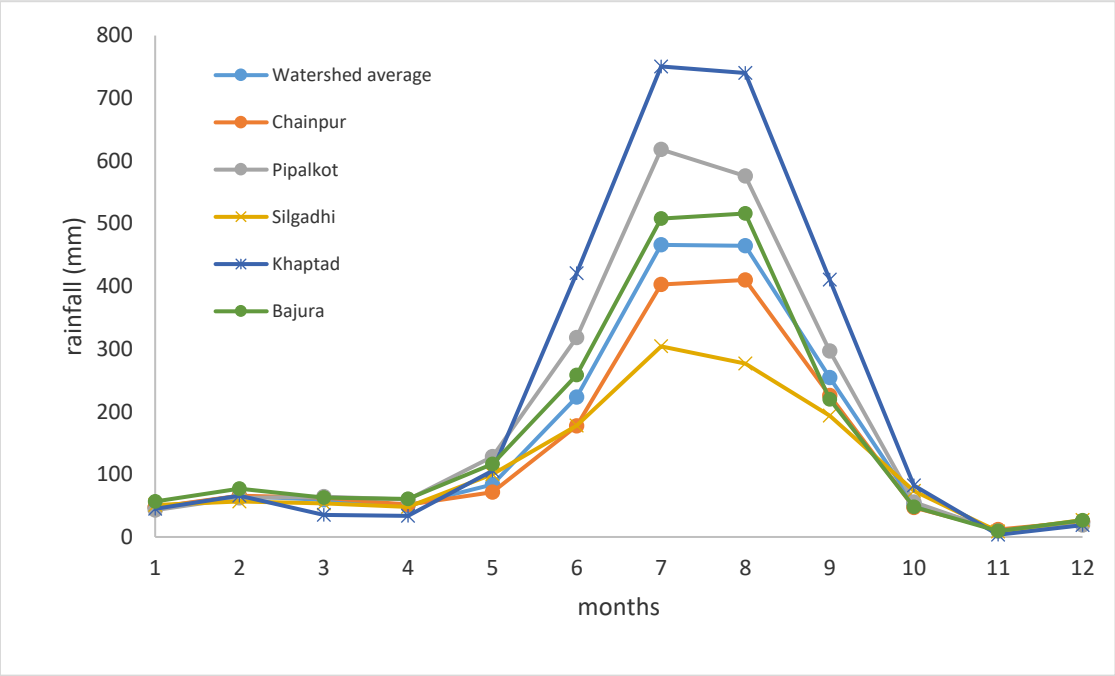


Figure 12: Long-term monthly rainfall (in mm) in the West Seti watershed

2.5.3 CLIMATE CHANGE

Analysis of tempearature trends (supplemented by 2009 climate change reporting from Practical Action Nepal) indicates an overall cooling trend with spatial and seasonal variation (Figures 13 and 14). Winter and monsoon are cooling at 0.02ºC /year since 1976, while pre-monsoon tempeatures are decreasing at 0.04◦C/year and post-monsoon temperatures decreasing at a maximum rate of 0.06 ◦C/year. The average annual temperatures have been observed to be decreasing for the entire watershed at 0.02ºC/year.

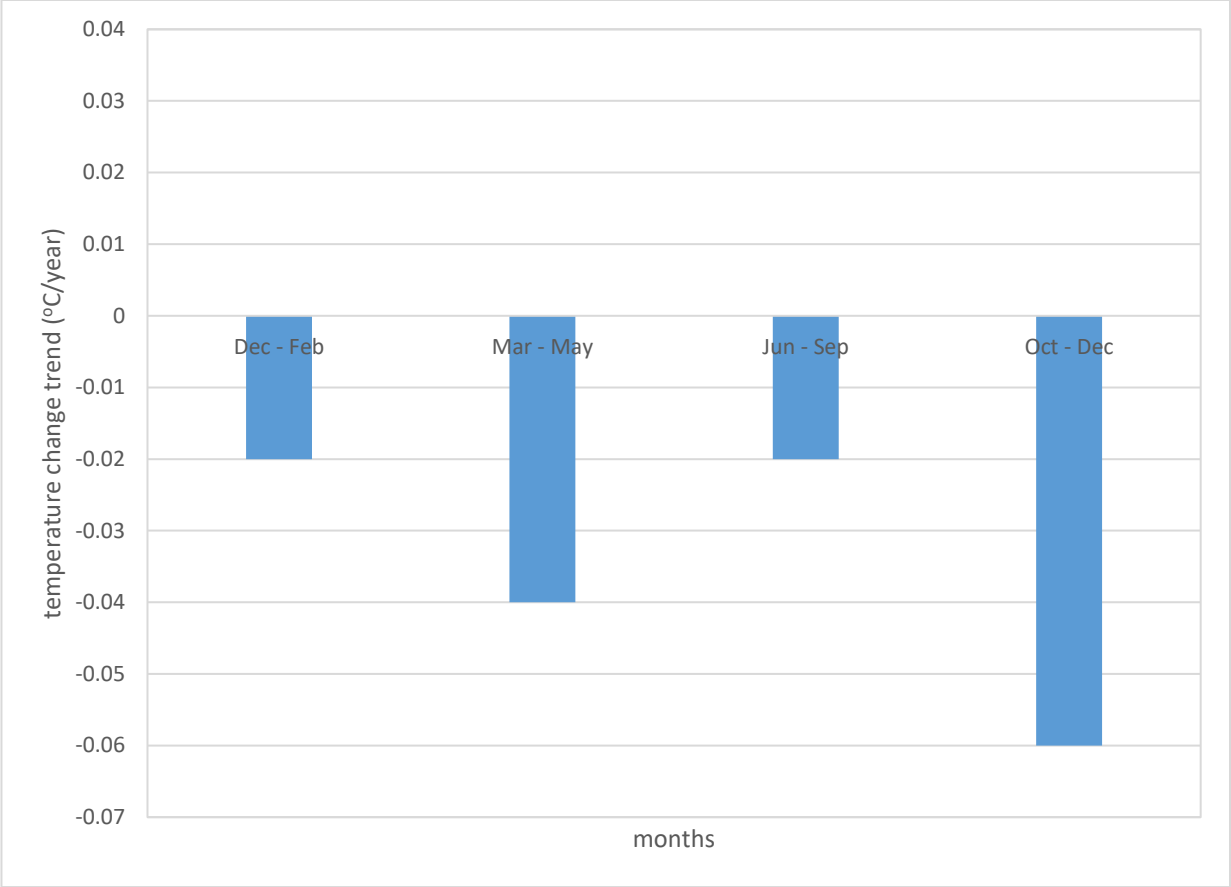


Figure 13: Seasonal temperature change trend (°C/year) observed in West Seti watershed

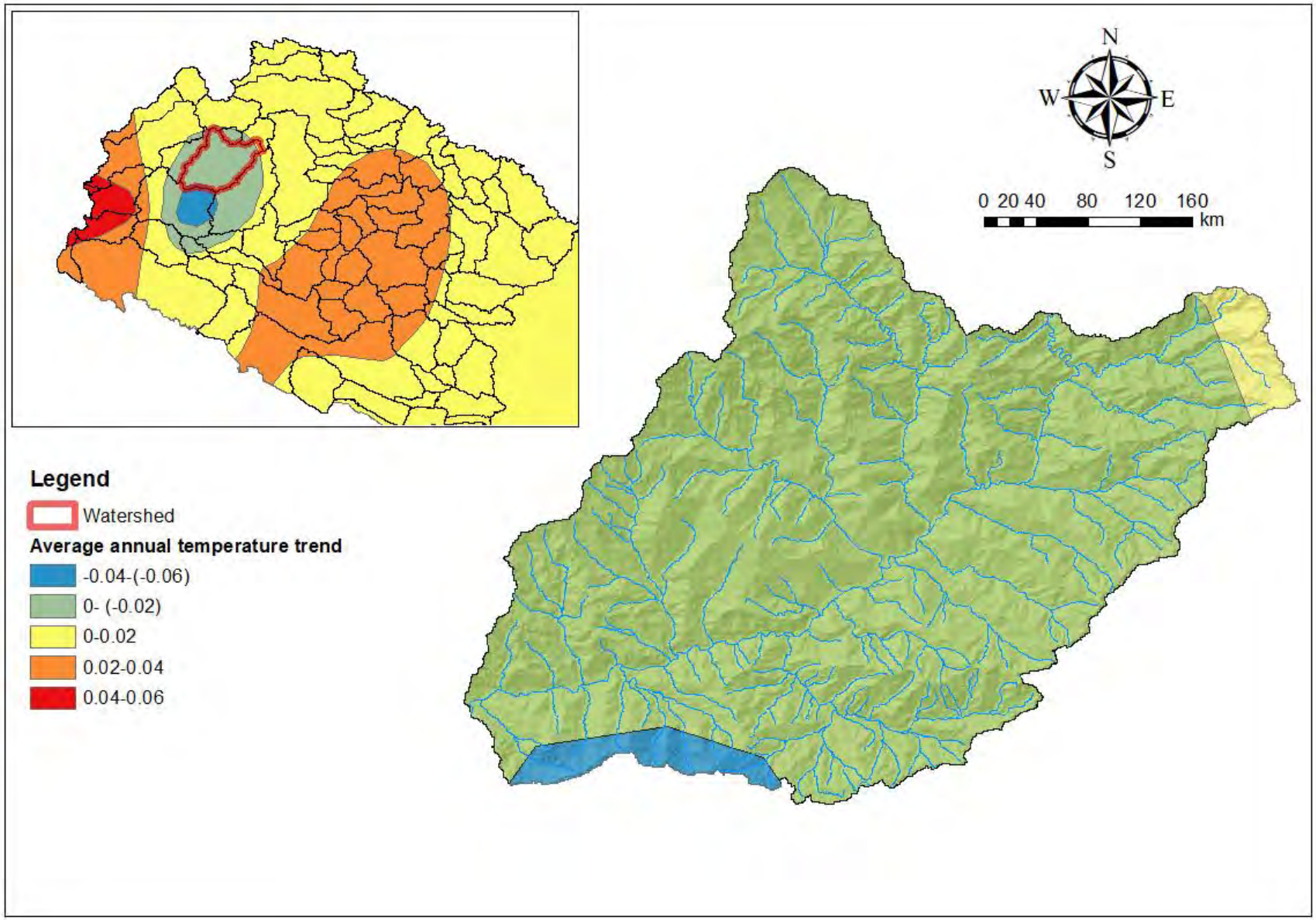


Figure 14: Seasonal temperature change trend (°C/year) observed in West Seti watershed

Spatial and seasonal variations in rainfall are presented in Table 4. Annual and monsoon rainfall is increasing at a maximum rate of 10 mm/year (Figure 15). But this rate of change is not consistent throughout the watershed. Mean winter rainfall (Dec-Feb) is increasing at a maximum rate of 1.6 mm/year, whereas pre-monsoon (Mar-May) and post-monsoon rainfalls are decreasing at a maxmim rate of 4 and 2 mm/year, respectively.

Table 4: Summary of seasonal rainifall trends observed in the West Seti watershed

Season	**Months**	**Rainfall change rate mm /year**	**Remarks**
Winter	Dec – Feb	0 to 0.8	*Northern part of watershed*
		0.8 to 1.6	*Southern part of watershed*
Pre-monsoon	Mar – May	-4 to -3	*Entire watershed*
Monsoon	Jun – Sep	0 to 10	*Entire watershed*
Post-monsoon	Oct – Nov	-2 to -1	*Western part of watershed*
		-1 to 0	*Eastern part of watershed*
Annul mean	-	0 – 10	*Entire watershed*

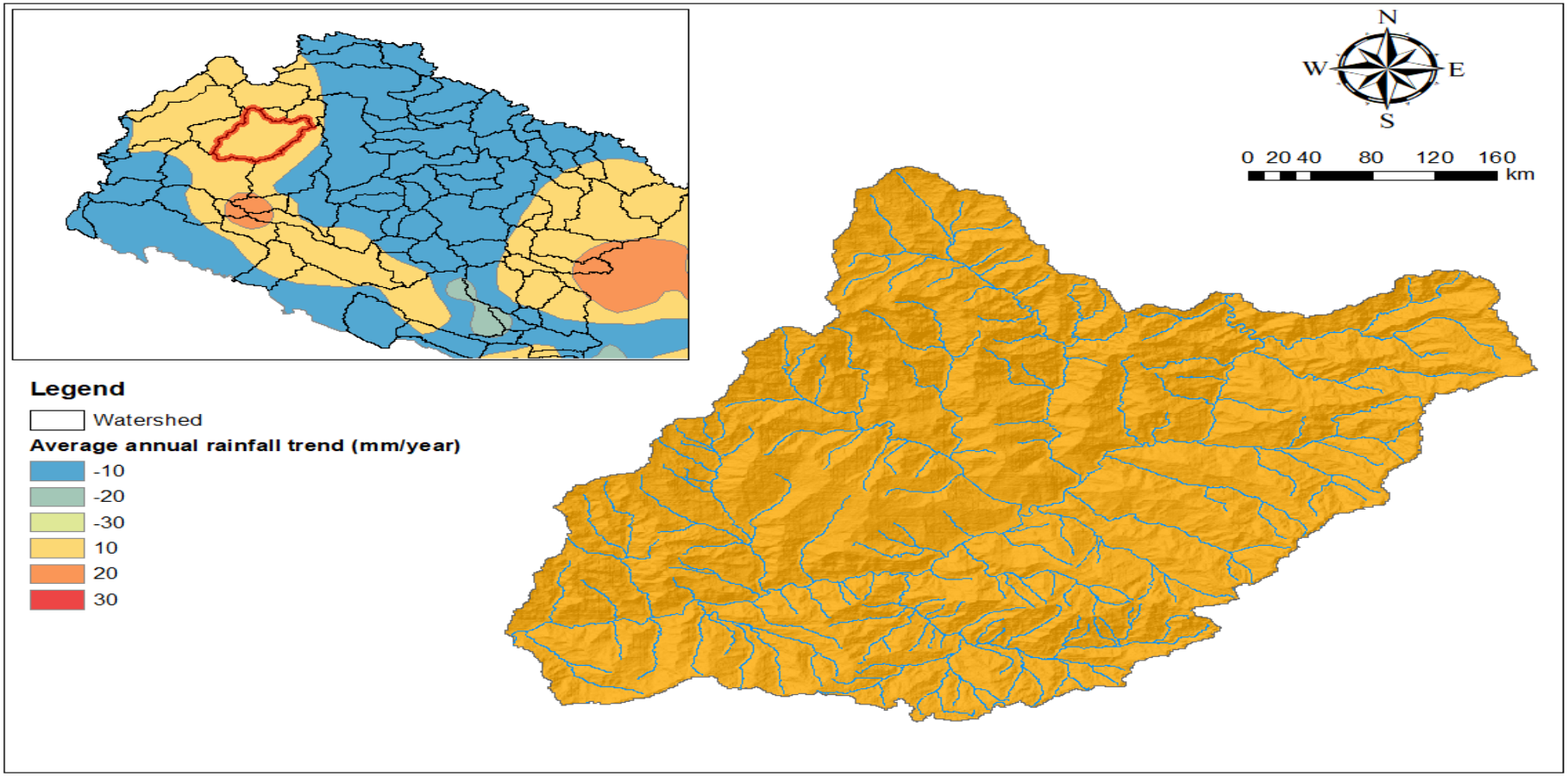


Figure 15: Long-term annual mean rainfall trend (mm/year) observed in West Seti watershed

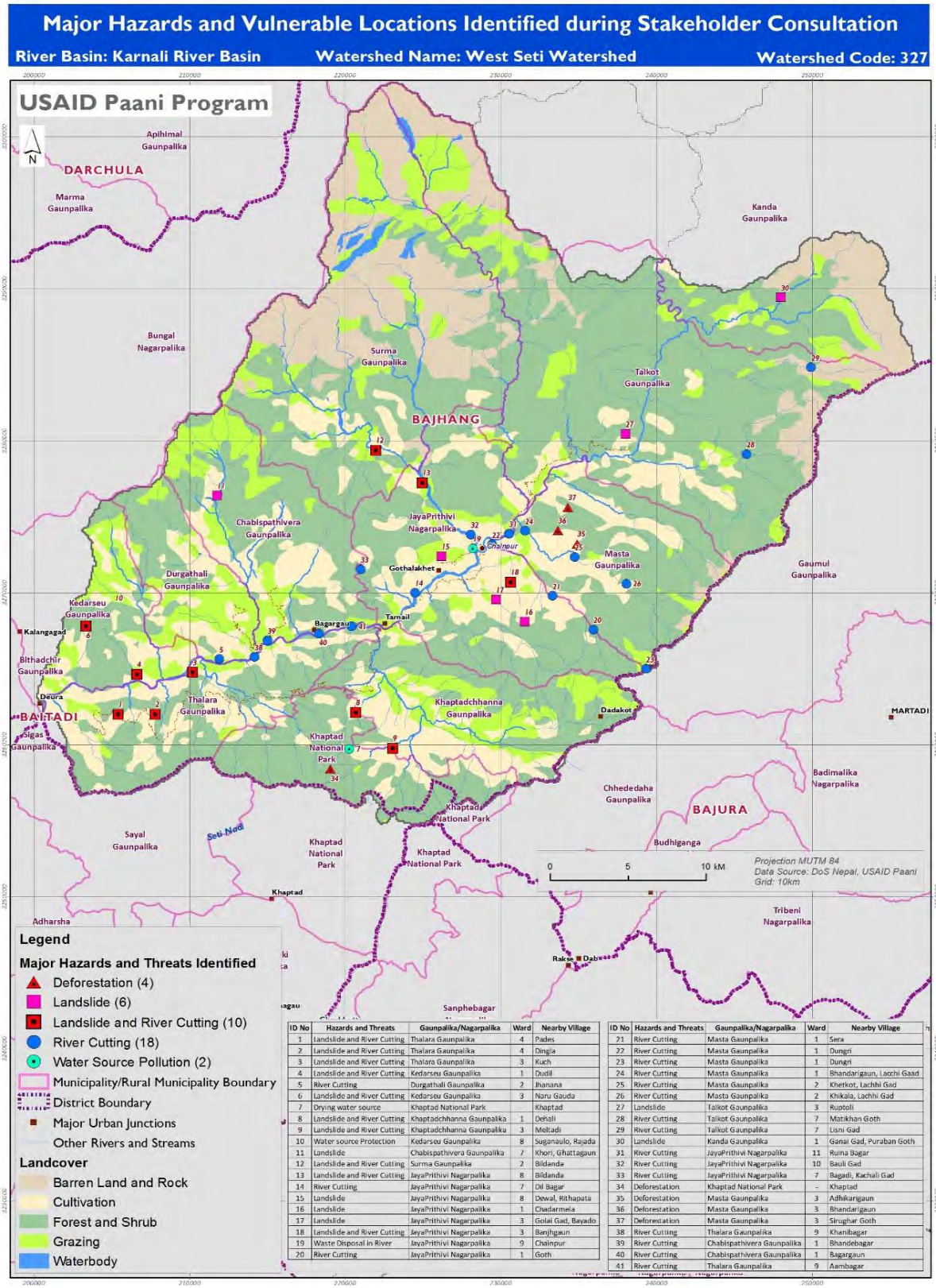
Related annexes

Annex 4: Temperature and precipitation

2.6 CLIMATE CHANGE AND DISASTER RISK REDUCTION

Climate change compounded by an increasing rate of infrastructure development in West Seti is intensifying the frequency and intensity of natural hazards in the watershed. Factors work in combination: soil erosion due to increased farming and rural road building exacerbate the conditions and occurrence of landslides, for example. Stakeholders from West Seti were asked to identify and map these natural hazard "hotspots" for the watershed. They are presented in Figure 16.

An early warning system might mitigate some of the effects of natural hazards to the wildlife and households in West Seti. However, surveys found that only 14.3% of households have access to early warning information.



ID No	Hazards and Threats	Gaunpalika/Nagarpalika	Ward	Nearby Village
1	Landslide and River Cutting	Thalara Gaunpalika	4	Pades
2	Landslide and River Cutting	Thalara Gaunpalika	4	Dingla
3	Landslide and River Cutting	Thalara Gaunpalika	3	Kuch
4	Landslide and River Cutting	Kedarseu Gaunpalika	1	Dudil
5	River Cutting	Durgathali Gaunpalika	2	Jhanana
6	Landslide and River Cutting	Kedarseu Gaunpalika	3	Naru Gauda
7	Drying water source	Khaptad National Park	-	Khaptad
8	Landslide and River Cutting	Khaptadchhanna Gaunpalika	1	Dehali
9	Landslide and River Cutting	Khaptadchhanna Gaunpalika	3	Meltadi
10	Water source Protection	Kedarseu Gaunpalika	8	Suganaulo, Rajada
11	Landslide	Chabispathivera Gaunpalika	7	Khori, Ghattagaun
12	Landslide and River Cutting	Surma Gaunpalika	2	Bildanda
13	Landslide and River Cutting	JayaPrithivi Nagarpalika	8	Bildanda
14	River Cutting	JayaPrithivi Nagarpalika	7	Dil Bagar
15	Landslide	JayaPrithivi Nagarpalika	8	Dewal, Rithapata
16	Landslide	JayaPrithivi Nagarpalika	1	Chadarmela
17	Landslide	JayaPrithivi Nagarpalika	3	Golai Gad, Bayado
18	Landslide and River Cutting	JayaPrithivi Nagarpalika	3	Banjhgaun
19	Waste Disposal in River	JayaPrithivi Nagarpalika	9	Chainpur
20	River Cutting	JayaPrithivi Nagarpalika	1	Goth

ID No	Hazards and Threats	Gaunpalika/Nagarpalika	Ward	Nearby Village
21	River Cutting	Masta Gaunpalika	1	Sera
22	River Cutting	Masta Gaunpalika	1	Dungri
23	River Cutting	Masta Gaunpalika	1	Dungri
24	River Cutting	Masta Gaunpalika	1	Bhandarigaun, Lacchi Gaad
25	River Cutting	Masta Gaunpalika	2	Khetkot, Lachhi Gad
26	River Cutting	Masta Gaunpalika	2	Khikala, Lachhi Gad
27	Landslide	Talkot Gaunpalika	3	Ruptoli
28	River Cutting	Talkot Gaunpalika	7	Matikhan Goth
29	River Cutting	Talkot Gaunpalika	7	Lisni Gad
30	Landslide	Kanda Gaunpalika	1	Ganai Gad, Puraban Goth
31	River Cutting	JayaPrithivi Nagarpalika	11	Ruina Bagar
32	River Cutting	JayaPrithivi Nagarpalika	10	Bauli Gad
33	River Cutting	JayaPrithivi Nagarpalika	7	Bagadi, Kachali Gad
34	Deforestation	Khaptad National Park	-	Khaptad
35	Deforestation	Masta Gaunpalika	3	Adhikarigaun
36	Deforestation	Masta Gaunpalika	3	Bhandarigaun
37	Deforestation	Masta Gaunpalika	3	Sirughar Goth
38	River Cutting	Thalara Gaunpalika	9	Khanibagar
39	River Cutting	Chabispathivera Gaunpalika	1	Bhandebagar
40	River Cutting	Chabispathivera Gaunpalika	1	Bagargaun
41	River Cutting	Thalara Gaunpalika	9	Aambagar

Figure 16: Major climatic hazards and vulnerable locations as identified by stakeholders in the West Seti watershed

3. WEALTH

The total population of the West Seti watershed is 130,593: 61,423 male and 69,116 female. The watershed is sparsely population at just 88 people per km^2. Agriculture is the primary livelihood source in the watershed (83.9%), followed by wage labor (4%), traditional occupations, such as smithing (3.3%), and service jobs (2.8%). However, as in many parts of the country, many households require additional jobs to make ends meet. In West Seti, 69.3% of household surveyed claimed a second job to sustain their livelihood.

The soil is fertile in West Seti, comprised of mostly black and sandy soils, and clay. The land along the rivers is especially productive. However, despite these favorable conditions, food security remains a major challenge in the watershed, as nearly 80% of families lack food reserves beyond six months (Table 5).

Table 5: Food security levels by household in the West Seti watershed

Indicators	Range	Percentage
% of respondents reporting of agricultural income sufficiency (n = 1,016)	< 3 months	34.16
	4-6 months	43.32
	7-9 months	11.51
	10-12 months	11.01

Source: Paani Household Survey 2018

Regular use of banking and financial institutions in the watershed is presently increasing, though participation is low overall. Surveys found that only 46.1% of households held a bank account. This number was even lower for Dalit families (40%). The most frequently cited reason for not having a bank account was lack of money (65%), followed by long distances to banks (31%), which are located only in the Chainpur. This situation could change dramatically as financial institutions look to increase their presence in rural areas following the federal restructuring of government. More power bestowed upon local governments means banks and cooperatives will have more initiative to serve these communities in the coming years.

When looking at issues of financial authority in the household, women are greatly disadvantaged: only 39% of women surveyed said they had any say in decisions about money. However, this dynamic could change in the coming years as more men go abroad for work, leaving women to manage domestic expenses.

Climate-smart practices and technologies (e.g., rainwater harvesting tanks) offer households additional support to protect unforeseen changes in agricultural productivity and/or natural resource availability. In the West Seti watershed, adoption of such technologies is low and concentrated in the few who pursue these options, such as plastic ponds, Gabion boxes, drip irrigation, improved hybrid seeds, and tunnel farming for vegetables, among others. Surveys found that 17.4% of households adopted three or more technologies, while 9.9% adopted two, and 2.8% adopted only one. Of the households adopting a climate-smart technology or practice, 74% practiced reforestation, while 63.7% used water source conservation, and 36.6% built irrigation canals.

Technical help for agriculture is available at the District Agriculture Knowledge Center in Chainpur. This institution has implemented the Prime Minister's Agriculture Modernization Program to promote water-smart management ideas and improve the access of marginalized groups to water and irrigation.

3.1 FISHING PRACTICES

Fishing in West Seti is characterized by a mix of traditional and non-traditional methods. Many fishermen still prefer time-tested tools such as gill nets, fishing hooks and casting. However, the increasing market demand for fish has inspired some to adopt more harmful practices such as explosives and electric current. FGD partcipants reported in 2018 that one person died of electrofishing in Juli Gad. The Paani survey of fishermen found that they catch up to 2 kg per day and 190 kg per year.

Fears of fish number declines are also well-founded. Sixty-two percent of households reported that fish stocks had decreased over the past decade, and 58% said fish species had also declined. When probing these questions in focus group discussions, the following reasons were offered to explain these trends:

- Rise in the number of new fishermen;
- Increased use of pesticides and electric current;
- Increased use of small mesh nets;
- Changes in aquatic habitats due to landslides and solid waste disposal; and
- Hydropower projects restricting water flow.

3.2 AGRICULTURE PRODUCTIVITY

As noted above, agriculture is overwhelmingly the most common livelihood in the watershed. In spite of the high altitudinal variation in West Seti, more and more subsistence farmers have attempted to move to commercial modes of farming and with the support of local governments and NGOs.

There are 28,240 hectares of cultivated land in West Seti, and approximately 35.3% is irrigated. However, in terms of households, 41% have access to irrigation. Major crops in the area vary by altitude and include maize, millet, barley, wheat, potatoes, lentils, and soybean.

Concerns about production levels are high. Eighty-one percent of households said productivity had declined over the past decade, and climate change was the most commonly cited reason for this. Accordingly, nearly 87% of households said soil fertility had also declined over the same period.

Farmers that produce a surplus have many options for markets to sell their products. Road connectivity is good in the watershed for this purpose.

3.2.1 SOIL MANAGEMENT AND FERTILITY

Due to the steep topography of the watershed, soil loss and soil fertility rates in West Seti tend to lag behind national averages. Furthermore, the rising outmigration of men from the watershed means fewer human resources are available for agricultural work, including soil management. Deforestation and shifting cultivation are two additional challenges to soil retention and fertility. Government initiatives, such as the Prime Minister's Agriculture Promotion Program are active in West Seti and raise awareness and build capacity for farmers to maintain more sustainable farming practices.

As we saw in terms of agricultural productivity, local impressions about soil fertility are also highly discouraged: 86.9% of households say soil fertility has declined over the past decade.

To compensate for these declines, more farmers are turning to pesticides and other modern inputs to shore up production levels. However, reliance on organic pesticides remains the preferred mode of pest control (90%).

3.3 INFRASTRUCTURE

The design and construction of infrastructure, such as roads and hydropower plants, have an impact on the health of the watershed if appropriate preventive, mitigated and control measures are not adopted on time. For example, poorly designed rural roads on steep slopes can increase soil erosion and landslides. Similarly, hydropower plants that divert or impound water will restrict the amount of water available for aquatic life that people depend on for their livelihoods. Irrigation canals, while bringing benefits to one group of farmers, can also reduce the amount of water available to other farmers. As demonstrated by these examples, it is important that the design, construction and operation of infrastructure projects account for the full range of social, economic, and environmental impacts within the watershed. Sustainable infrastructure should provide equitable distribution of benefits with minimal long-term, environmental impacts.

3.3.1 HYDROPOWER

West Seti has long been the focus of hydropower development, as its remote location and large valleys along the Seti River made it a favorable location for a storage dam. However, political instability and a lack of financial resources have deterred the construction of such a dam. In 2013, a Chinese hydropower company secured the license to build a 750 MW storage dam in West Seti, but to date the start of construction has been delayed numerous times. The pros and cons for this project are many. The revenue from hydroelectric sales could promise high revenues for local governments and the dam itself would electrify a significant part of the watershed. However, the dam would displace 1,000 households, and the environmental impact would be high, as the storage reservoir would alter water flows up and down river.

Apart from the West Seti project, there are eight smaller schemes currently licensed in the watershed, but not yet operational (Table 6; Figure 17). It should be noted here that the district micro-hydropower office in Chainpur has been closed since the transition to the federal system. Officials have not yet revealed which office will take responsibility for hydropower oversight, and this absence deprives locals of an important outlet with which they can communicate their concerns.

SN	Name	Capacity (MW)	River
1	Dhauligad Sunakhani Bagar	0.99	Dhauligaad
2	Lower Kalangagaad	8	Kalangagaad
3	Sunigaad	11.05	Sunigaad
4	Jeuligaad Cascade	2	Jeuligaad
5	Upper Sunigaad	8.42	Sunigaad
6	Chainpur Seti	210	Seti Khola
7	Seti Nadi - 3	165	Seti Khola

Table 6: Smaller hydropower schemes in the West Seti watershed

Related annexes

Annex 12: Hydropower

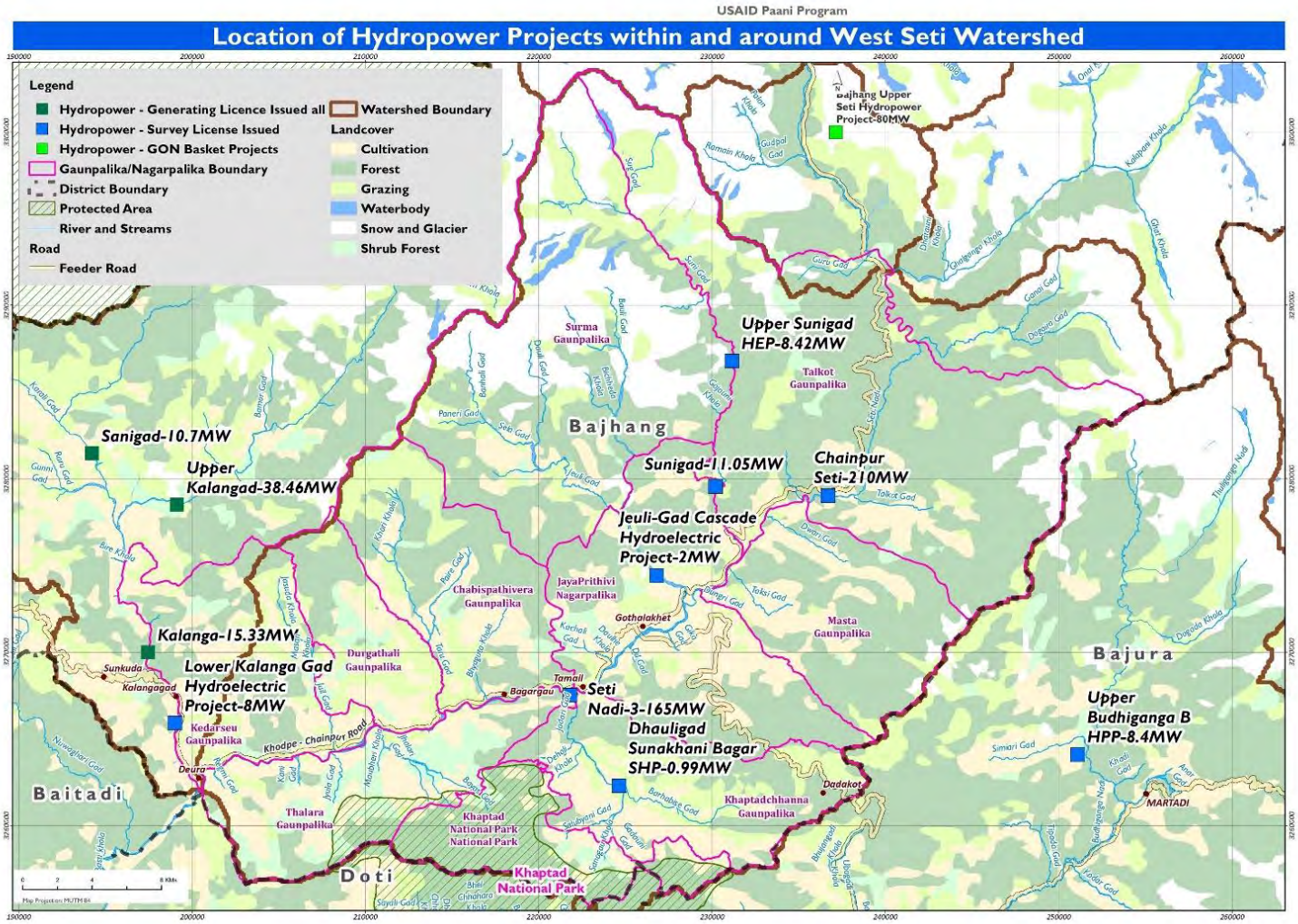


Figure 17: Map of hydropower operations in the West Seti watershed

3.3.2 MINING

The Seti River and its tributaries offer high volumes of mining materials that are in high demand for construction. Formerly, the District Development Committee (DDC) office issued licenses for this work, but under the new federal structure, that authority will rest with the nagarpalika (NP) and gaunpalika. Though revenues per truck of material were not available in all locations, in Mastha GP, local authorities are collecting 100 rupees for stone, 200 for sand, and 300 for gravel. In Jaya Privthi NP, where extraction rates are historically high, the local government collects 500 rupees for stone, 600 for gravel, and 500 for aggregate per truck. In Kedarsyu GP, officials reported that mining extraction was its largest single revenue source in 2018.

While the Environment Protection Rules 1997 require an environmental impact assessment prior to excavation in a new site, respondents in the watershed said this was not a regular practice.

3.3.3 ROADS

There are two major road networks in the West Seti watershed: the district core road network (DRCN) and village core road network (VRCN). These networks feature 106 and 107 kms of road, respectively.

Unsustainable and improper rural road building (VRCN) was a consistently-voiced concern among respondents throughout the watershed. Due to the steep togography in West Seti, landslides are more easily triggered by road construction compared to other parts of the country. These landslides decimate households and destroy water sources, and the sediment degrades aquatic habitats in the rivers below. Many respondents (in Kedarsue GP, Chhabis Pathibhera GP, and Khaptad Chhana GP) noted that road building firms are legally required to conduct environmental impact assessments prior to construction, but that low monitoring of the process meant few firms actually did.

Government regulations call for three percent of a road construction budget to be set aside for remediation work on slopes and hillsides, and each local government has authority to implement additional safeguards. For example, in Chhabis Pathibhera NP, the local government has allocated USD 500 to all wards to support proper planning in road construction.

In some cases, the capacity and/or skill sets needed to insure proper road construction are not available. In Kedarsue NP, local officials said they lacked sufficient support to insure proper drainage and road maintenance. Furthermore, they complained about lacking an engineer who would provide accurate forecasts of how new roads would impact local communities and habitats.

GESI issues: In several locations, including Khaptad Chhana GP, respondents complained that road construction was destroying local water sources, filling them up with improperly deposited excavation materials. As women and girls are most commonly tasked with obtaining daily water, this meant adding 20-30 minutes on their commutes to nearby water sources.

In Khatigaun and Baikatte, road construction has destroyed 40-50 households belonging to Mahila, Janajati and Dalit families. As many marginalized households are landless, they possess fewer options for relocating their settlement. On top of this threat, there is no clear-cut mechanism for compensating families whose houses and property may be destroyed by construction-induced landslides.

Related annexes

Annex 11: Roads

3.3.4 IRRIGATION

While irrigation is necessary to improve livelihoods and economic development in the watershed, the amount of water diverted directly affects aquatic life. The costs, benefits and trade-offs must be considered carefully.

In West Seti, fertile plots situated on low terrain land benefit from small and medium-sized irrigation schemes, which belong to either a modern or traditional system. The traditional irrigation schemes in West Seti date back to the previous century, built by local landlords and the request of land-owning elites. Irrigation at this time typically benefits BCTS farmers at the expense of Dalits and Janajatis. This particular history means that certain inequities in terms of access persist to modern times.

Thanks to government and international development efforts, the number of systems available to farmers has increased to 65. Through focus group discussions, repeated concerns about the effects of drying water sources and hydropower on existing schemes were voiced. These concerns were corroborated by Paani during a transect walk across the watershed.

More than half of the 65 irrigation schemes (51%) depend on rainfall as a water source, while 41% draw from nearby rivers, 3% use local ponds and lakes, 4% lack agricultural land to irrigate, and the remaining 1% use ground water.

Related annexes

Annex 13: Irrigation

3.4 SOLID WASTE AND MANAGEMENT

For many years, the West Seti watershed boasted pristine water resources due to a low population and reliance on organic and sustainable farming methods. However, as population has increased and urbanization has brought modern goods and farming inputs to the watershed, many local governments have been caught off-guard in devising plans and infrastructure to handle rising solid waste. Likewise, in Khaptad National Park, an increasing number of visitors (religious and otherwise) have placed more intense pressure on park officials to manage solid waste from nearby tea shops and other places of hospitality. An increasing hospitality sector in Deuda, Tamail, Chainpur and Bhopur is also credited for a rising solid waste problem in those areas.

At the household level, solid waste disposal also presented some troubling statistics. Fifty-nine percent of houseolds incinerate solid waste, while 39.5% use it for compost. Only 22.8% of households reported taking their waste to a landfill, while 14.4% dump directly into nearby water bodies.[3]

Infrastructure and implementation remain the largest challenges to improving waste disposal in the West Set watershed. The Solid Waste Management Act 2011 clearly stipulates that individuals and organizations (Section 5.1) bear responsibility for reducing the production of solid waste. Despite the intentions of this policy, many respondents point to the lack of organization related to waste disposal.

However, many local governments have taken encouraging first steps toward addressing solid waste issues in West Seti. The government in Talkot GP launched the "Plastics and Glass Free Campaign" in 2018, and in Jaya Privthi NP, a new annual tax levied on households (100 rupees), shops (200 rupees), and hotels (300 rupees) will be dedicated to waste management solutions. In Khaptad Channa GP, the government has decleared it will establish landfill sites in all of its wards.

[3] These numbers add up to more than 100 because respondents were allowed to give more than one answer.

Related annexes
Annex 15: Pollution

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 West Seti watershed. Analysis indicates there is a need to better understand how current institutional arrangements related to, for example, hydropower or rural road building are positioned (or not) to improve resource sustainability and benefit sharing with local populations.

4.1 ACCESS AND INCLUSION

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

4.1.1 ACCESS TO WATER FOR DOMESTIC AND AGRICULTURAL USE

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

Water accessibility indicates the degree of ease for users to obtain water. Obstacles to water accessibility can be physical (e.g., distance to water points) or cultural (e.g., water sources available only to certain castes), or both. Again, due to drying water sources, many communities reported varying degrees of access to springs and community spouts.

In the West Seti watershed, 9.7% of Dalit households and 7.5% of BCTS households reported unequal access to public water sources. Factors attributed to this inequality included caste discrimination, long distances to available water sources, and religious restrictions.

The Constitution of Nepal stipulates that the federal, state, and local levels of government exercise the power of the State of Nepal pursuant to article 56(2). Certain legislative and executive powers have been vested in local level government (*nagarpalika* [NP] and *gaunpalika* [GP]), such as environmental conservation 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 have significant implications for the conversation of freshwater biodiversity and community resilience.

These new governance responsibilities suggest the time is appropriate to work closely with local authorities to develop plans to promote improved watershed health (Table 7).

Table 7: Key organizations for water management in the West Seti watershed

Office	Location	Sample activities
Governmental organizations		
District Agriculture Development Office (DADO)	Bajhang	Working with capture fishery groups to develop sustainable harvesting practices
District Coordination Committee (DCC)	Bajhang	Coordinating with local leaders to facilitate improved natural resource sharing in West Seti
District Forest Office	Bajhang	Liaising with CFUGs to insure clear understanding and proper enforcement of use and conservation guidelines
Watershed Management Office (District Soil Conservation Office)	Bajhang	Turning focus to the effects of development activities on soil erosion and soil fertility
Non-governmental and community-based organizations		
Community forest user groups (CFUG)	More 300 CFUGs throughout the watershed	Sharing responsibility for sustainable use and management of community forests
Buffer zone community forest user groups	More than 200 buffer zone groups organized into 14 committees around the Khaptad National Park	Working as mediators for sustainable management of resources in protected areas
Social Development Center (SDC)	Bajhang	Lending expertise to discussions regarding equitable and just distribution of natural resource benefits
FECOFUN, FEDWASUN, HIMAWANTI	Bajhang	Advocating for proper management of common resources and the equitable distribution of resources

Encouragingly, many local governments have developed plans to improve water sharing and access. Authorities in Khaptad Channa GP have allocated 11 milliion rupees to improve drinking water access for its residents. Thalara GP has announced plans to establish a drinking water testing laboratory to improve water quality.

Related annexes

Annex 16: Forest management

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

The specific information regarding EWS is not available in secondary data analysis and field observation since there are no EWS system established in the watershed. However, local leaders and participants of workshops have demanded access to information on stream gauge stations, rain gauge stations, and flood warning systems.

Given the rising incidence and intensity of floods and landslides in the watershed, an EWS is highly recommended. Occasionally, the disaster risk information is broadcast over radio, but a more sophisticated and comprehensive system is needed.

4.1.3 ACCESS AND INCLUSION IN LOCAL NRM PLANNING

The land, water, flora and gravel of the West Seti watershed comprise the major natural resources of the area. In addition, each of these resources faces numerous threats from deforestation, habitat degradation, unsustainable agricultural practices, and improper road construction, among others. These challenges are exacerbated by the watershed's topography and soil erosion-related challenges.

The community-based forestry system instituted in the 1990s has been a large success in West Seti and across Nepal for promoting sustainable use of forest and NTFPs. As well, the guidelines for community foresty also mandate inclusive practices, ensuring that women and other marginalized groups have access to benefits and representation among leadership. For example, if a male is the chair of the group, one of the vice-chairs must be a woman, and 50% of overall membership in the group must be comprised of women and persons from marginalized groups. Currently in West Seti, women occupy only 17.5% of leadership positions in NRM-related groups.

However, in spite of these goals, FGDs about benefit sharing revealed that while women and Dalits are welcomed by community forest groups (and other NRM groups), their meaningful participation is limited, and traditional hierarchies of power persist within the groups' operations.

In regards to NRM-related planning processes at the government level (e.g., water supply, soil conservation), awareness and participation are low. Only 34.5% of households said they knew about NRM planning in their local government offices. Of that group, 82.6% of households said they did participate in these planning processes. Looking more closely at these households aware of NRM planning, only 24% of women claimed they knew about this work as compared to 43% of men. In terms of ethnicity almost 38% of BCTS reported knowled of government-level NRM planning as compared to 23.6% of Dalits. Only 17.5% of women and marginalized groups hold leadership positions.

Related annexes

Annex 16: Forest management

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 climate change impacts continue to influence freshwater conservation and biodiversity in the West Seti watershed (Figure 15 in Section 2.6), local governments and NGOs are stepping up to anticipate and address these challenges in the future. In addition to the government-level offices appointed to water, forests and soils, several civil society organizations have offered their resources to strengthen

livelihoods against threats of natural hazards and climatic variability. These organizations include:

United Nations Population Fund (UNFPA)
World Food Programme (WFP), Bajhang
United Missions to Nepal (UMN), Bajhang
Promoting Agriculture, Health, and Alternative Livelihoods (PAHAL)
Rural Village Water Resources Management Project (RVWRMP)
USAID– SUHAARA program
Group for Social and Technical Developmetn Service (GSTDS)
Social Development Center (SDC), Bajhang
Red Cross Society, Bajhang
Federation of Community Forest User Groups (FECOFUN)

At the government level, prior to the federal restructuring elected in 2015, local units were tasked with developing two types of plans to address climate change and disaster risk: Local Adaptation Plans of Action (LAPA) and Community Adaptation Plans of Action (CAPA). While 16 LAPAs and 30 CAPAs had been developed, local governments report that funding to implement these plans did not arrive prior to the federal restructure. They told Paani that more clarity is needed to know how these plans will be operationalized in the future under the federal form of governance.

At the budgetary level, interviews with local officials revealed that several government agencies had allocated funds to address water scarcity and irrigation issues in Kedarseu GP, Thalara, GP, Jaya Privthi NP, Khaptad Channa GP, and Chhabis Pathibhera GP.

Jaya Prithvi NP has announced plans to adopt disaster mitigation measures for each infrastructure project undertaken in the future. In other words, for every road built, the government will allocate money earmarked for erosion control measures such as Gabion boxes. Similarly, Khaptad Channa GP will devote 5-10% of its infrastructure development budget specifically to mitigation measures.

4.2.2 NATURAL RESOURCE MANAGEMENT (NRM) GROUPS AND ACTIVITIES

As forest and water resources are a shared resource, the formation of user groups to collectively manage these resources has become common in West Seti. These user groups serve under various government authorities (e.g., District Coordination Committee, Division Forest Office, District Agriculture Knowledge Center) and seek to improve sustainable use of water, timber, and non-timber forest products.

In West Seti, forests are managed under one of several modes (e.g., community, religious, leasehold, or protected) by a community forest user group, or CFUG. There are 315 CFUGs currently overseeing forests in the watershed. CFUGs are affiliated with the Federation for Community Forestry Users, Nepal, who represent their needs to the government at the national level.

Based on the availability of raw materials, CFUGs also foster a view to entrepreneurship as communities join together to add value process timber and NTFPs into final products for the marketplace. For buffer zone conservation groups along the boundaries of Khaptad National Park, 30-50% of annual park revenue must be spent on buffer zones to compensate for the restriction in those areas on gathering NTFPs and other materials.

By mandate, CFUGs must spend 25% of their revenue on management, protection, and forest development, and 35% must be allocated to livelihood-related activities for poor and margainalized groups, whose households are rated in participatory fashion for well-being and supported according to these ratings.

Concerns about water access and sustainable water use also draw strong participation from watershed residents. In West Seti, water supply and sanitation are addressed through a variety of organizations:

Mothers' groups, savings and credit groups, agricultural groups, youth clubs, water user groups, and irrigation committees. In the watershed, 88% of households claimed membership in one of these water-related user groups.

However, focus group discussions revealed that these NRM groups face numerous challenges for improving their effectiveness, including limited resources and knowledge, remote locations that inhibit idea-sharing, and changing environmental policies that are not communicated to local levels.

Related annexes
Annex 16: Forest management

4.2.3 COMPLIANCE WITH LAWS AND POLICY PROVISIONS

Surveys and FGDs revealed a generally low knowledge of existing NRM 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 West Seti watershed, where they have limited interaction with government officials and representatives.

In particular, surveys and FGDs revealed that local residents had no knowledge of important water-related policies such as the Aquatic Animals Protection Act 1961, which prohibits certain modes of fishing. Furthermore, residents expressed confusion and apprehension when discussing how water would be managed under the new federal structure of government.

However, plans are in motion to improve policy compliance, at least with regard to solid waste management. As noted in section 3.4, Jaya Privthi NP and Khaptad Channa GP have implemented solid waste management plans and allocated budget in support of these measures. These authorities are attempting to bring their constituencies in line with the Solid Waste Management Act 2011, which requires the government to provide infrastructure (e.g., landfills) and services (e.g., waste collection).

Similarly, some locations have adopted disaster risk management policies that bring their administrations up to date with the provisions in the Disaster Risk Reducation and Management Act 2017.

Related annexes
Annex 17: Current policy provisions and relevant observations
Annex 18: Key stakeholders in West Seti watershed management groups

4.3 GOVERNANCE

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

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

The LGOA also provides NPs and GPs the authority to oversee management of forests, watersheds, wetlands, wildlife, birds, water use, and bi-diversity. However, given the current transition to this federal structure, some of these rights and duties have yet to be exercised and discharged by the local governments.

Through FGDs and KIIs, respondents expressed their growing awareness of the need to develop stronger relations between upstream, middle-stream and downstream communities, and to understand better the interconnection between surface and ground water. In spite of the many regulations providing vision on issues related to watershed health, there was general consensus that a lack of implementation could lead to conflict between communities on resources such as fish, forests and water. Moreover, increasing infrastructure development, in the form of roads, cities, and hydropower, has raised general concerns about e-flows and maintaining sustainable agricultural production.

Survey responses indicate that coordination among local governments, district coordination committees, and provincial levels of government is quite low. Women and marginalized persons are not well represented in formal and informal institutions and organizations in West Seti watershed. Even when included in these groups, their input and leadership is often not valued. Similarly, representation of poor and marginalized groups in local level planning and budgeting processes (e.g., LAPA, CAPA, WUMP) are very poor and neither inclusive nor participatory. Building consensus and ownership between government and citizens will improve the potential to create conditions favorable to conserving aquatic biodiversity and promoting community resilience.

5. PRIORITIZING STRENGTHS CHALLENGES, OPPORTUNITIES AND WEAKNESSES

Stakeholders in the West Seti watershed were asked to list their environmental concerns, including the strengths, opportunities, and weaknesses related to addressing each one (Table 8).

This list was compiled after Paani presented its initial major findings about the West Seti watershed to the attendees of a multi-stakeholder consultation (MSC) exit workshop. The workshop participants were selected from a wide range of backgrounds representing local residents, civil society groups, and government agencies.

Table 8: Threats, challenges and opportunities for improved freshwater and biodiversity conservation in the West Seti watershed

Area	Nature	Wealth	Power
Strength	Fertile land at river bank	Local level DRR committee	Infrastructure development (road, drinking water, irrigation canal) has reduced the work load and increased accessibility
	Limted use of chemical pesticides in the watershed	Gaunpalika-level sanitation conference each year	Watershed is popular as tourist destination
	Strong water availability	Initial environmental evaluation required for road construction	Increased awareness about NRM
	Expanding forest cover[4]	DRR funds at local level	
Challenges	Open grazing	Few women in leadership positions	Environmental issues associated with infrastructure development are ignored

[4] This finding represents public perception and is notable because it is at odds with data from Global Forest Watch (section 2.3) which reveals that forest cover in the watershed has actually declined since 2000.

	Lack of coordination between organizations	Low female participation in NRM groups	IEEs are not implemented properly
	Climate change impacts	Policy on the books but low implementation and enforcement	Increasing levels of sand and gravel extraction from rivers due to rising development projects and urbanization
Opportunity	Forest and water availability are supportive to balancing ecosystems	DRR committees at local levels have made relief distribution easier	Ample opportunity for hydropower development
	Possibility of ecotourism promotion through sustainable natural resources management	Funds have been allocated for DRR	Possibility for multipurpose water utilization
	NGOs and INGOs focus on environmental conservation	GP and NPs have developed 14-point sanitation plan	The biodiversity and cultural diversity of the area can be developed to improve local tourism
	Local governments recognize the importance of environmental issues	Some efforts to control mining have been initiated	
Weakness	Increasing floods and landslides	Women hold little influence in NRM decision making	Uncontrolled road building; improperly built roads
	Declining freshwater diversity	No equitable access to decision points	Infrastructure development does not follow guidelines
	Forest fires	Low policy knowledge on fishing restrictions	Lack of policy formation and implementation
	Sustainability issues are not taken seriously	Unmanaged solid waste management	Waste disposal in water sources
	Drying water resources		

Source: Exit MSC-West Seti, 2018

7. VISION OF WEST SETI WATERSHED

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

7.1 VISION STATEMENT FOR THE WEST SETI WATERSHED

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

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

"Natural resource management and sustainable development for a just and equitable West Seti watershed."

8. RECOMMENDATIONS

The West Seti watershed profile assesses the status, major challenges and opportunities facing multiple users of water located within the region. Based on discussions informed by project findings and contributions of many at the entry and exit workshops, stakeholders proposed the following recommendations to improve biodiversity and freshwater conservation in the West Seti watershed (Table 9).

Table 9: Recommendations for addressing primary challenges to biodiversity and freshwater conservation in the West Seti watershed

Issue	Recommendation
Landslides, river cutting, flash floods and resultant sedimentation	• Identify and map areas prone to landslides, river cutting, flash floods, and sedimentation in consultation with local governments and stakeholders; and • Develop local level adaptation and disaster risk response plans based on the existing national framework.
Improper rural road construction	• Promote bioengineering techniques for road building to protect water sources and mitigate the effects of potential disaster precipitated by improperly constructred roads; • Build capacity in local residents to inspect and monitor road building practices; • Develop long-term road network vision and guidelines for building these roads in accordance with policies requiring sufficient environmental assessment beforehand.
Degraded aquatic habitats and declining fish numbers	• Disseminate and promote existing aquatic habitat policies through mass media; • Promote awareness in local schools to increase sensitivity to aquatic habitats and the importance of conservation measures; and • Encourage stronger enforcement of fish protection policies that prohibit illegal fishing practices and overharvesting.
Forest degradation and forest fires	• 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 in the national park and wherever else possible; and • Establish community patrols during the dry season to warn about potential fire risk areas.
Drying water sources and increasing water pollution	• Promote rainwater harvesting technologies; • Map existing water sources to inform future conservation efforts; • Improve implementation of water use master plans (WUMPs);

Issue	Recommendation
	• 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; and • Encourage enforcement of existing laws and regulations related to watershed conservation and management.
Non-point source pollution and waste disposal in rivers and streams	• Improve waste management at local levels; • Promote awareness about dangers of waste dumping in rivers; • Construct drinking water tanks equipped with water purification technology; • Train government representatives in health and sanitation standards; and • Increase water quality monitoring of the Jhimruk River and tributaries.

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ANNEXES

Annex 1: 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 West Seti watershed and concerned institutions so they can provide baseline information to help identify priorities for project design and implementation. Moreover, the profile can support the development of tools for watershed planning and approaches for collaborative management moving forward. The profile serves as a foundation for:

- Building consensus and common understanding among the Phoksundo Suligaad watershed's stakeholders on the current 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 Phoksundo Suligaad area where the USAID Paani Program and other projects can provide support; and
- Providing a platform for consultation and advocacy for Phoksundo Suligaad watershed stakeholders through which they can participate in decision-making at the river basin and policy levels.

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

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

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

    a) Share preliminary results of watershed conditions;

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

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

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

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

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

The consolidated data collected through these methods were presented to group leaders at the exit MSC workshop to provide the participants with a share foundation for identifying and prioritizing watershed health issues in Phoksundo Suligaad watershed. We also used this information to identify

possible solutions and champions for leveraging knowledge and support through partnerships with local agencies and organizations.

All total 1,016 HHs surveys were conducted in locations that were selected during the entry MSC as participants indicated specific issues and challenges appropriate to their respective areas.

To complement the surveys, we conducted 16 FGDs and 12 KIIs to investigate the key issues identified by households. Citizen Scientist were mobilized for water quality test and discharge measurement.

Water quality tests examined pH values, iron, nitrogen nitrite, nitrite nitrate, ammonia, phosphate, and conductivity, turbidity, dissolved oxygen, temperature and discharge of water. Paani used different tools and methods for testing water quality and discharge. Paani used AKVO Flow application for testing water quality. For this purpose, Paani trained citizen scientists and then mobilized them to conduct the tests.

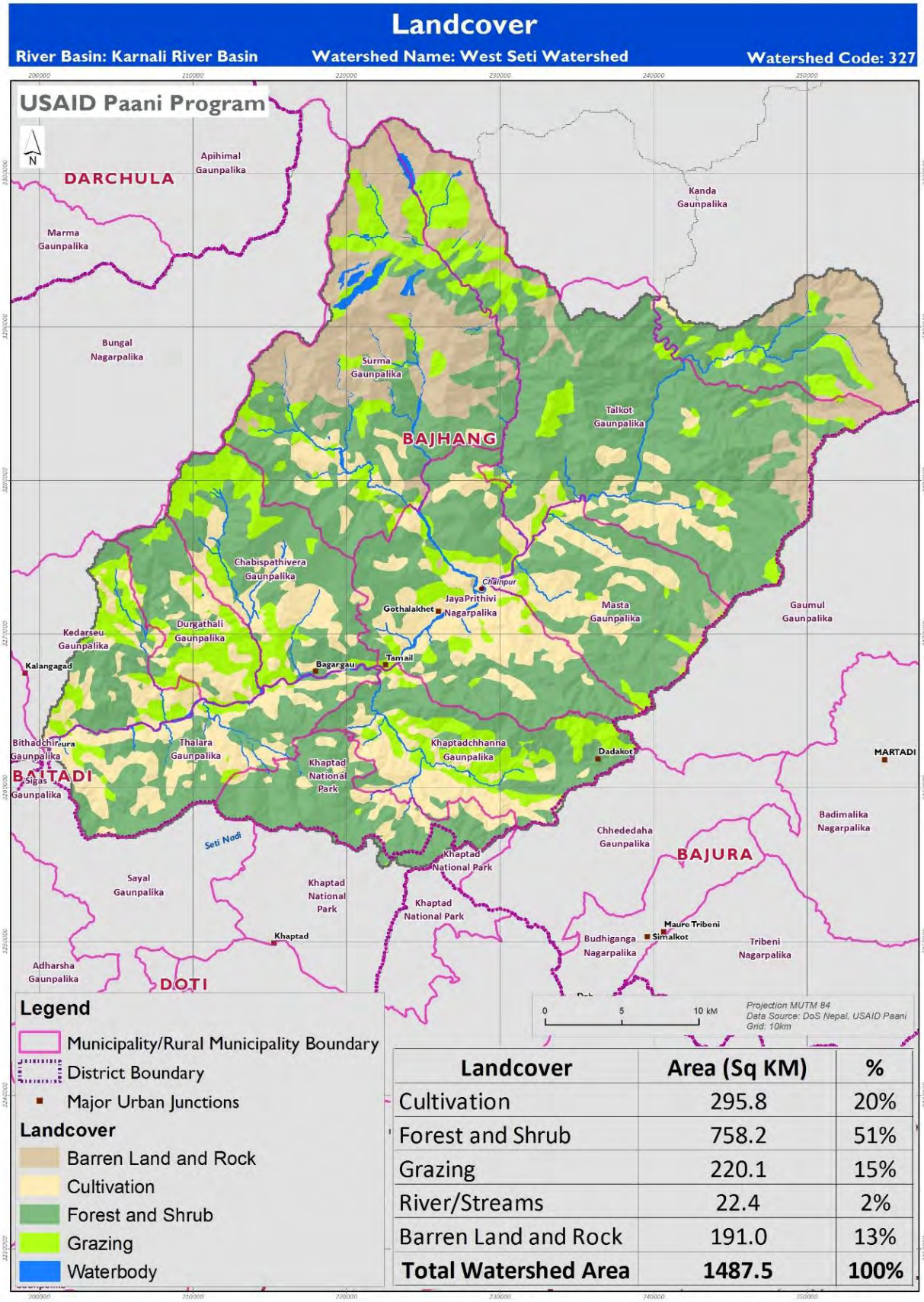
Table 10: Household (HH) surveys by caste/ethnicity

Group	Number of HH
Janajati	1
Dalit	237
BCTS	778
TOTAL	**1,016**

Annex 2: Land cover and land use

Table 11: Land use and land cover by percentage in the West Seti watershed

Type	Area (km^2)	%
Cultivation	295.8	20
Forest and Shrub	758.2	51
Grazing	220.1	15
River/Streams	22.4	2
Barren Land and Rock	191.0	13
Total	**1487.5**	**100**



Landcover	Area (Sq KM)	%
Cultivation	295.8	20%
Forest and Shrub	758.2	51%
Grazing	220.1	15%
River/Streams	22.4	2%
Barren Land and Rock	191.0	13%
Total Watershed Area	**1487.5**	**100%**

Figure 18: Land cover map of the West Seti watershed

Annex 3: Population

Table 12: Population by sex and caste/ethnicity in the West Seti watershed

Location	Population by sex		
Municipality	**Male**	**Female**	**Total**
Chabispathivera GP	7,679	8,617	16,296
Durgathali GP	5,915	7,057	12,972
Jaya Prithivi NP	10,655	11,536	22,191
Kanda GP	94	71	165
Kedarseu GP	4,470	5,070	9,540
Khaptad National Park	878	1,084	1,962
Khaptad Chhanna GP	6,272	7,659	13,931
Masta GP	7,111	7,840	14,951
Surma GP	4,547	4,475	9,022
Talkot GP	5,541	6,016	11,557
Thalara GP	8,261	9,691	17,952
Total	**61,423**	**69,116**	**130,539**

Location	Caste/ethnicity										
	Janajati -Hill	Janajati - Terai	BCTS - Hill	BCTS - Terai	Dalit - Hill	Dalit - Terai	Madeshi	Muslim	Newar	Other scheduled	Others
Chabispathivera GP	488	0	12,760	0	3,048	0	0	0	0	0	0
Durgathali GP	0	0	10,971	0	1,950	0	0	51	0	0	0
Jaya Prithivi NP	0	0	16,447	0	5,291	0	82	0	0	372	0
Kanda GP	0	0	117	0	48	0	0	0	0	0	0
Kedarseu GP	223	0	6,403	0	2,488	0	0	0	0	426	0
Khaptad National Park[5]											
Khaptad Chhanna GP	198	19	9,598	0	3,026	0	0	7	0	1,054	30

[5] Population breakdown by caste/ethnicity for Khaptad National Park was not available.

Masta GP	718	13	9,817	0	3,824	0	0	0	0	578	0
Surma GP	0	12	5,252	0	3,435	105	0	0	0	218	0
Talkot GP	0	0	9,635	0	1,922	0	0	0	0	0	0
Thalara GP	618	0	13,509	0	2,232	0	0	0	21	1,545	27
Total	**1,761**	**44**	**94,509**	**0**	**27,264**	**105**	**82**	**58**	**21**	**4193**	**57**

Annex 4: Temperature and precipitation

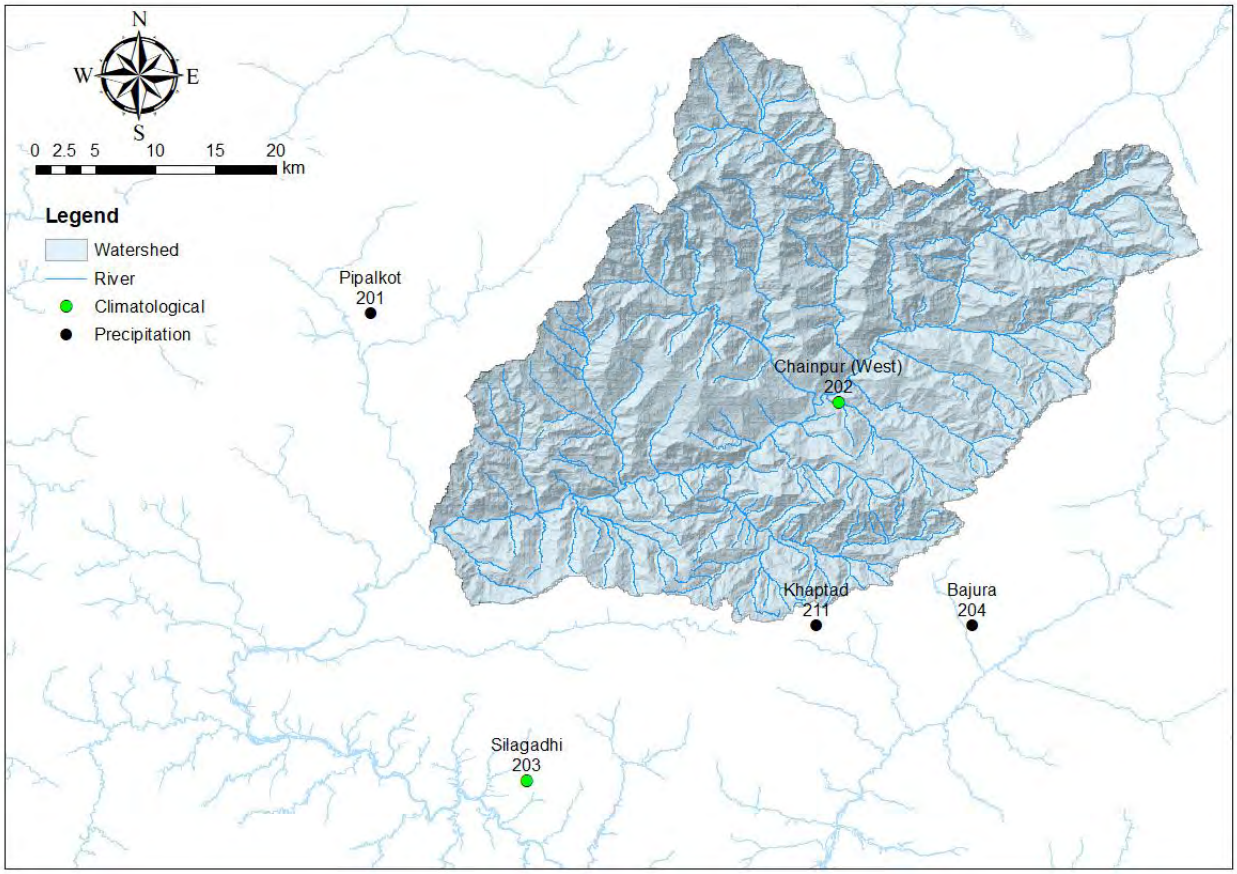


Figure 19: Meteorological stations in the vicinity of West Seti watershed used for temperature and precipitation analysis

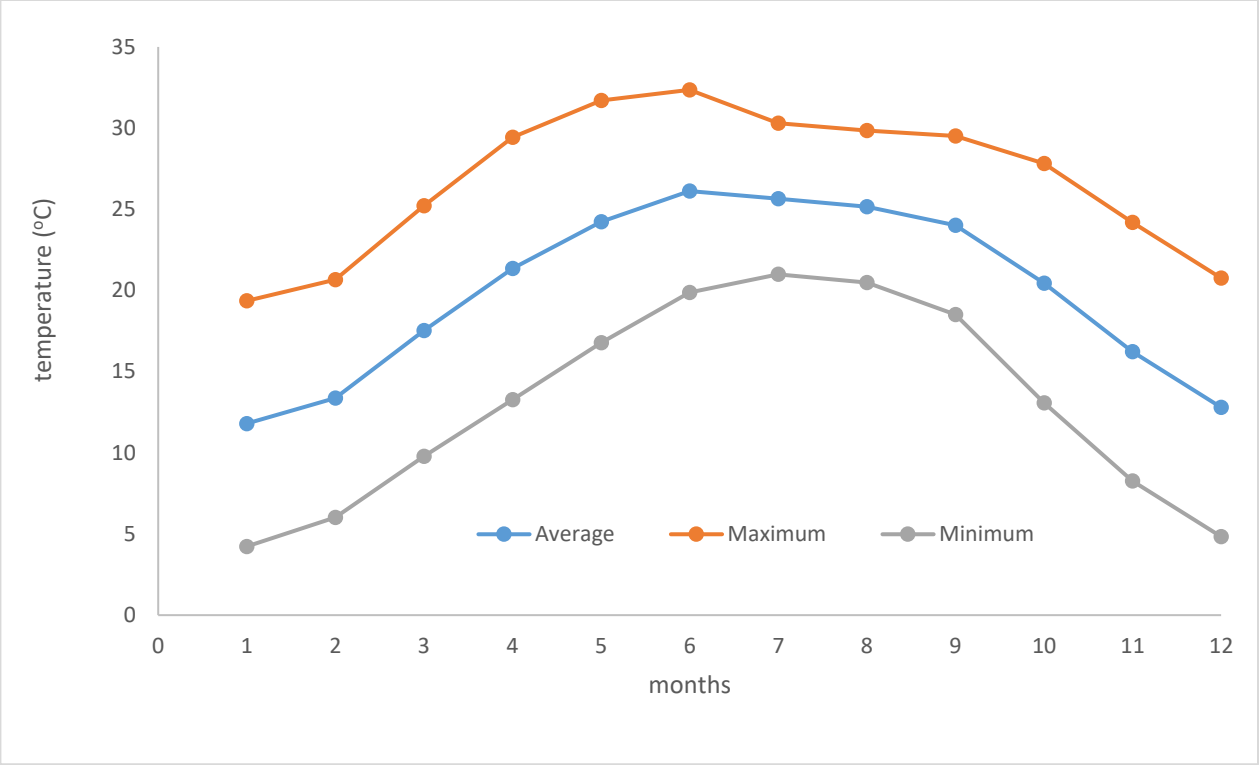


Figure 20: Maximum, minimum, and mean long-term monthly temperatures (°C) in the West Seti watershed

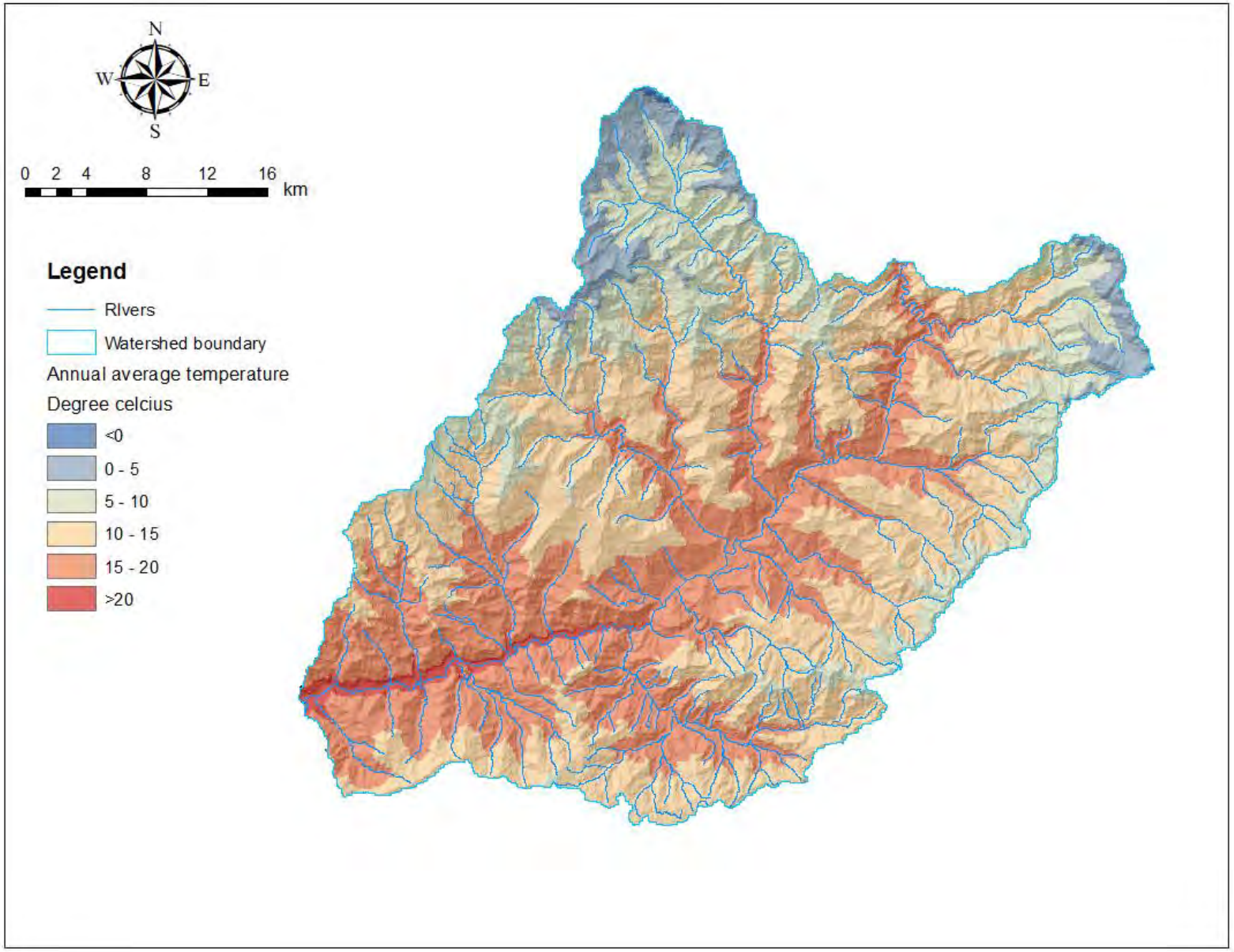


Figure 21: Mean annual temperature distribution (ºC) in the West Seti watershed

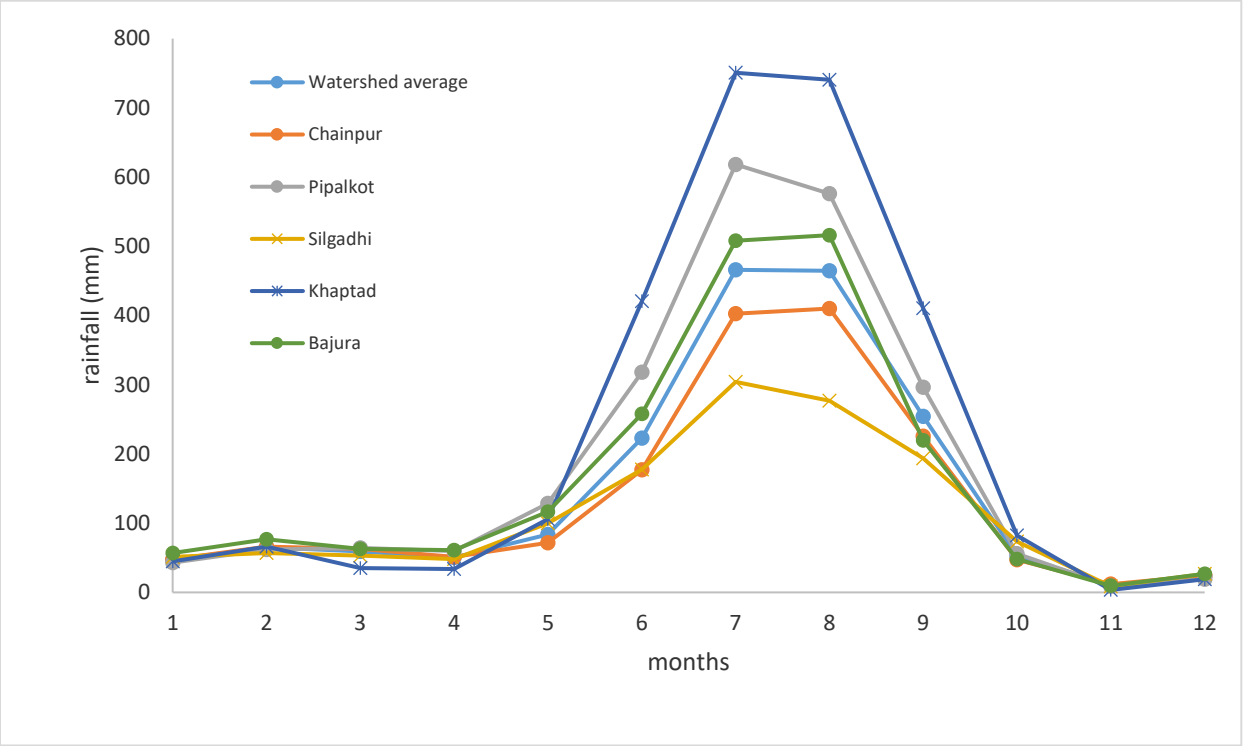


Figure 22: Long-term mean monthly rainfall (in mm) for the West Seti watershed

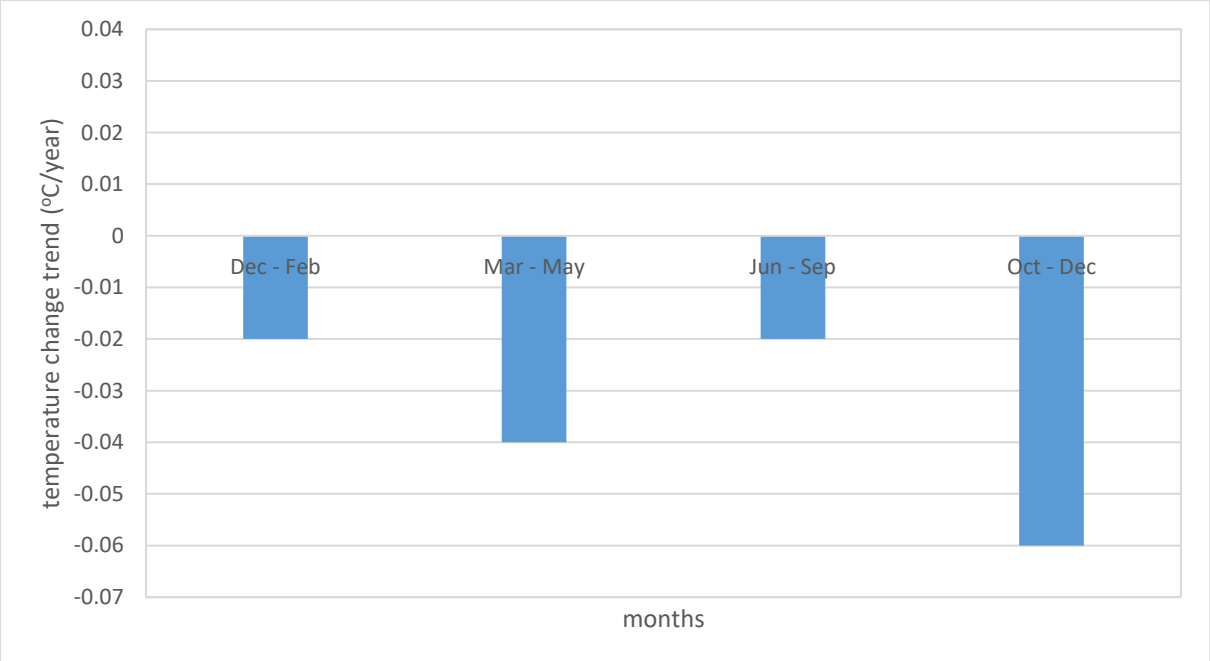


Figure 23: Seasonal temperature change trends (°C/year) observed in West Seti watershed

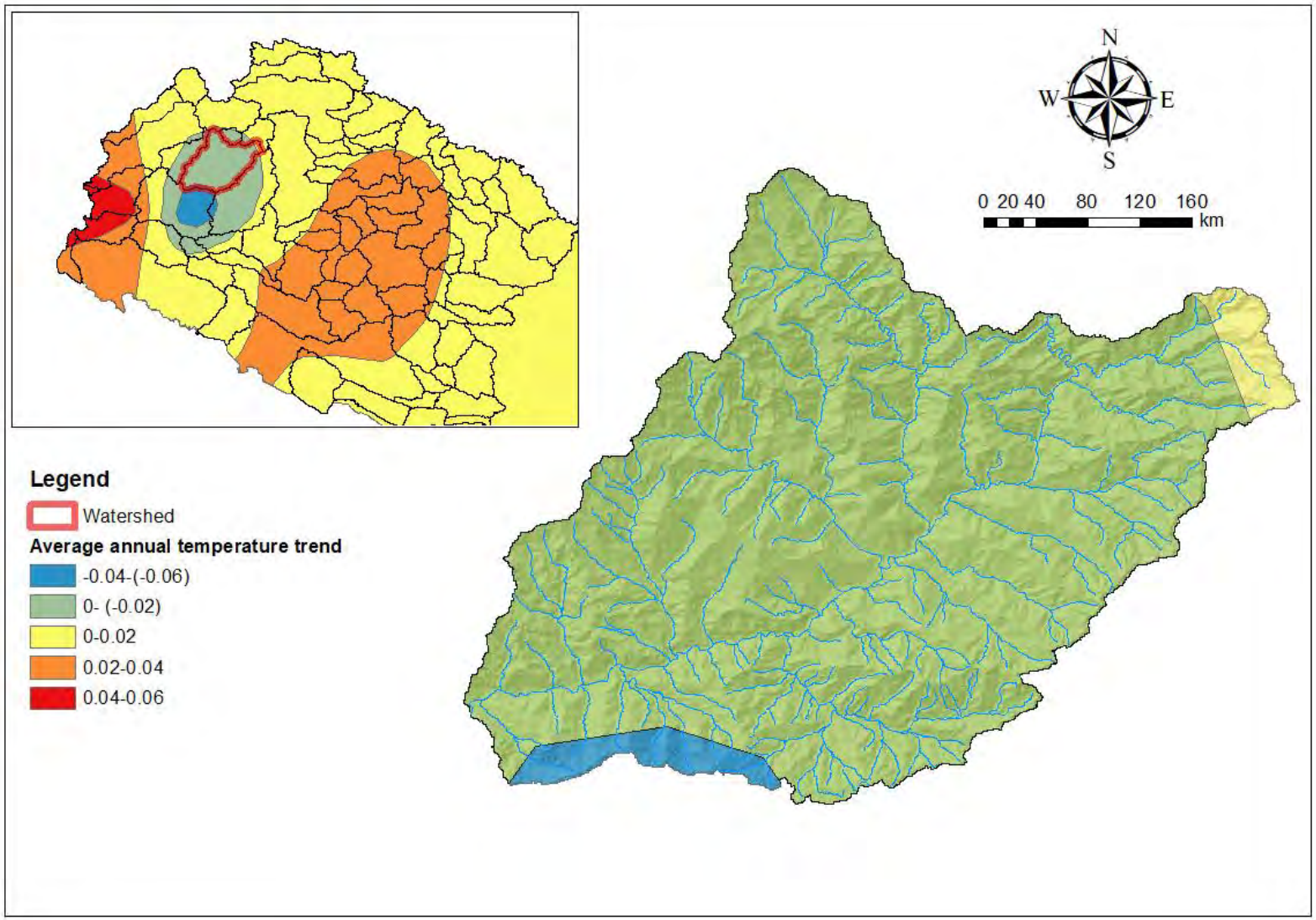


Figure 24: Annual mean temperature change trend in the West Seti watershed

Table 13: Seasonal rainfall trends observed in the West Seti watershed

Season	Months	Rainfall change rate mm/year	Remarks
Winter	Dec - Feb	0 to 0.8	*Northern part of watershed*
		0.8 to 1.6	*Southern part of watershed*
Pre-monsoon	Mar - May	-4 to -3	*Entire watershed*
Monsoon	Jun – Sep	0 to 10	*Entire watershed*
Post-monsoon	Oct – Nov	-2 to -1	*Western part of watershed*
		-1 to 0	*Eastern part of watershed*
Annul mean	-	0 – 10	*Entire watershed*

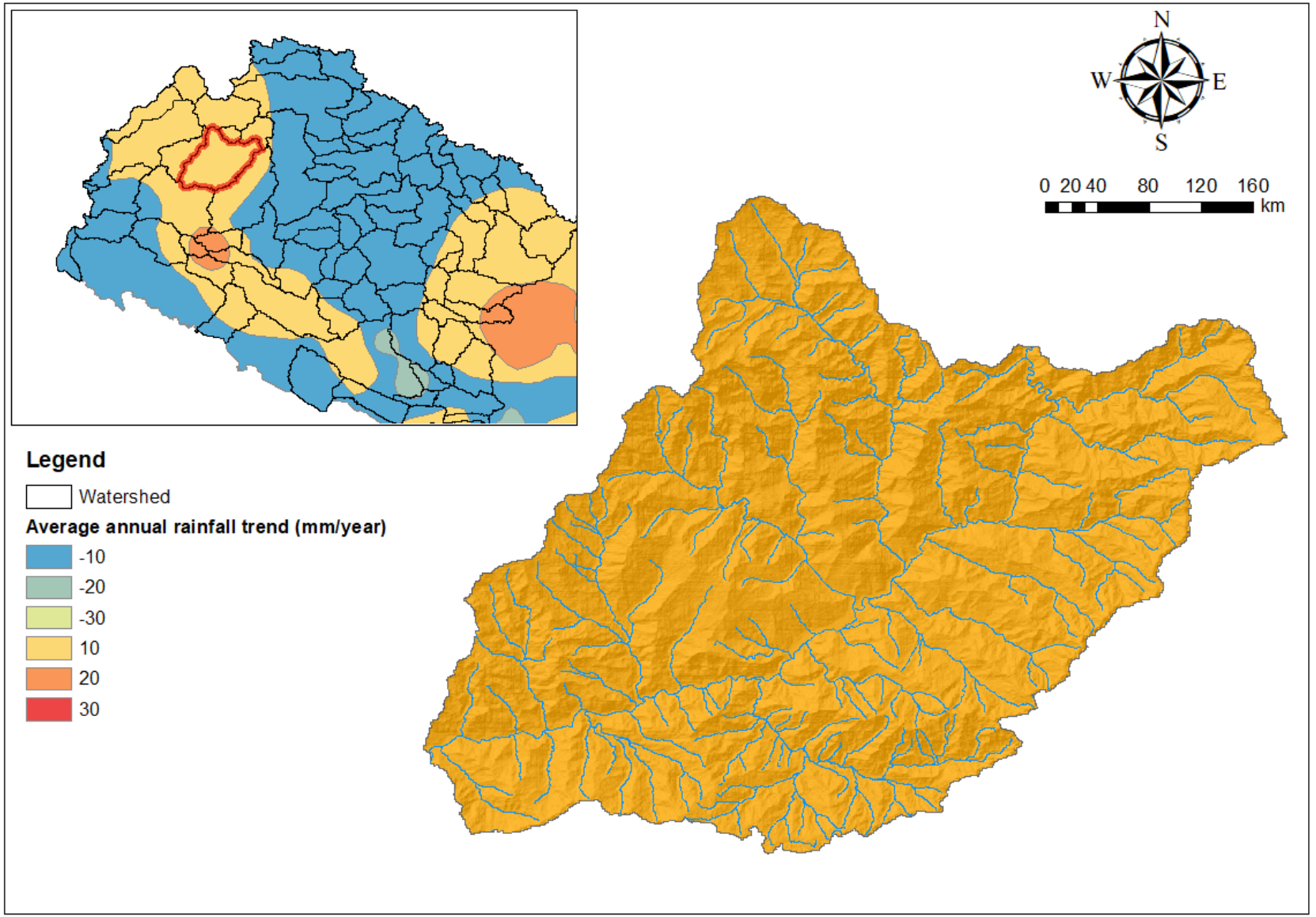


Figure 25: Long-term annual mean rainfall trends (mm/year) observed in the West Seti watershed

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

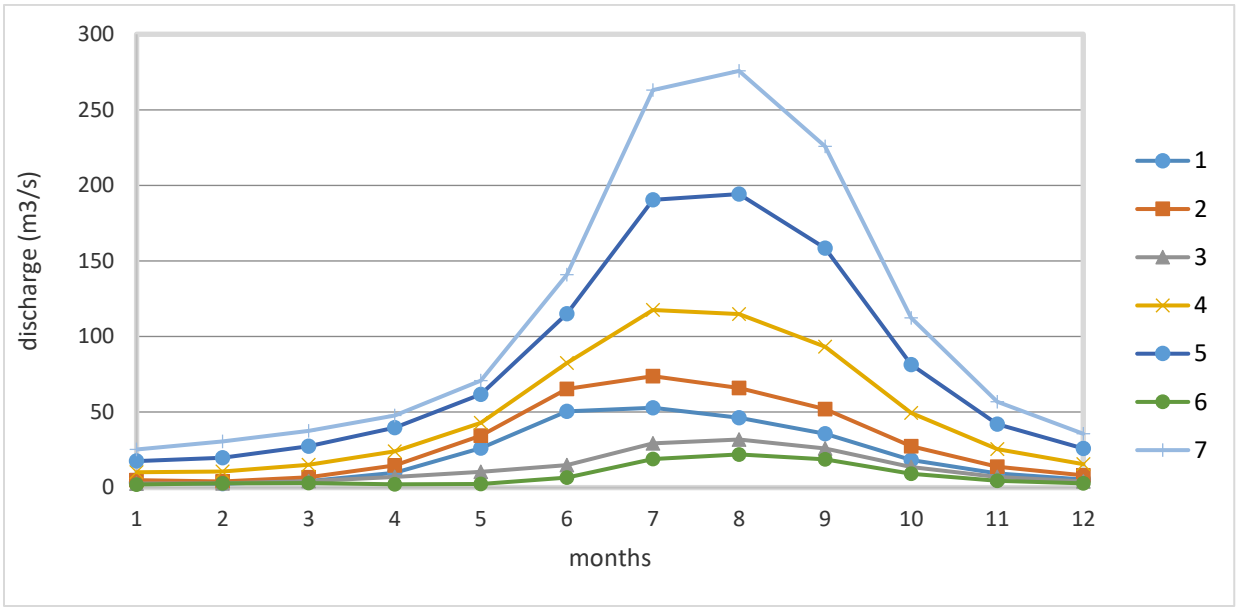


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Figure 26: Long-term mean monthly discharge rates on the Seti River taken from different locations

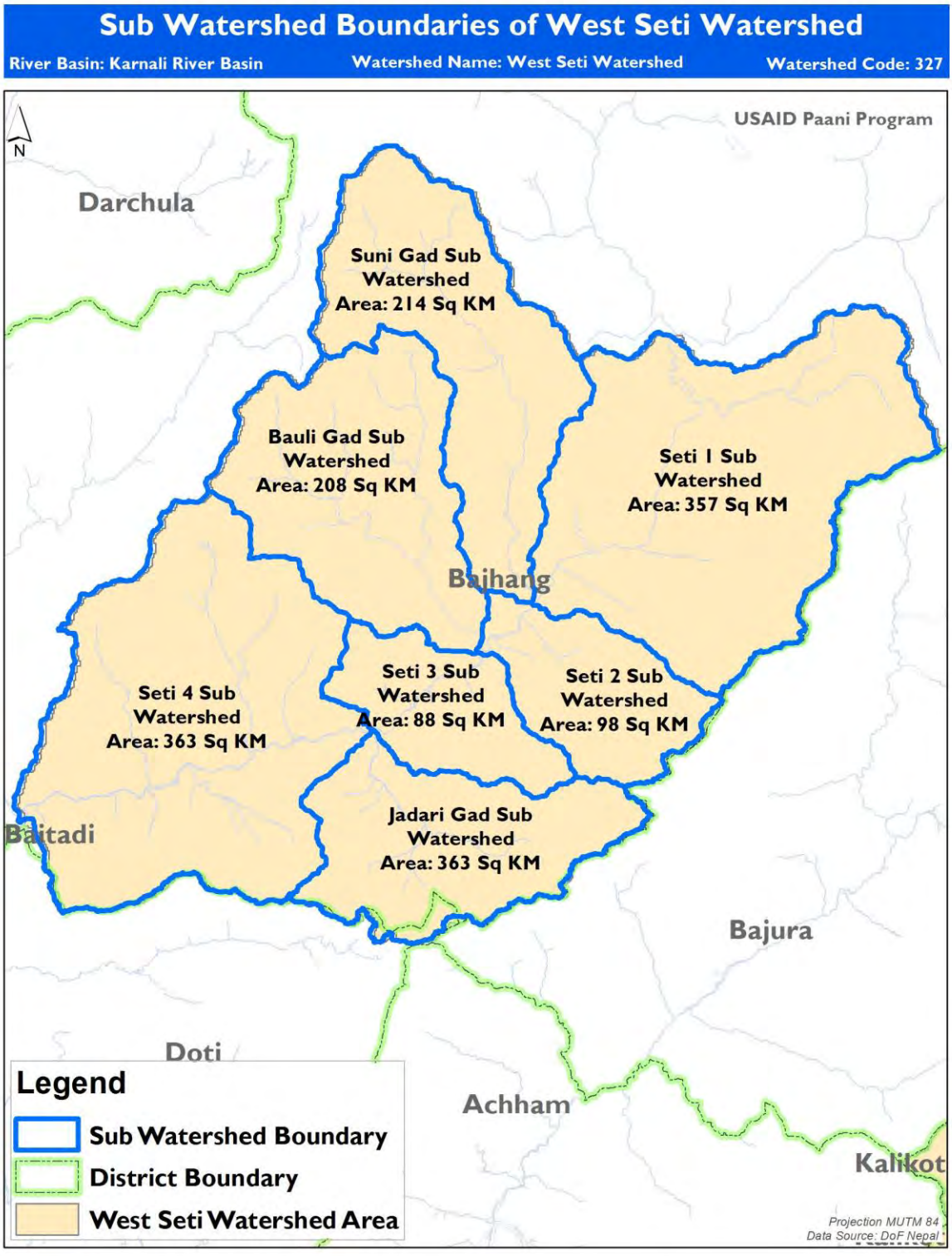

Figure 27: Map of sub-watersheds contained within the West Seti watershed

Annex 6: Forests

Table 14: Forest types by area and percentage

Type	Area (km^2)	Percentage of total forest cover
Mixed hardwood	404	53
Sal	7	1
Pine	133	18
Sisau (sisam)	6	1
Banjh Oak (Quercus)	152	20
Himalayan fir (Abies)	31	4
Deodar cedar	26	3
Total	**758.2**	**100**

Annex 7: Fish and aquatic life

Table 15: Species of fish commonly found in the West Seti watershed

SN	Nepali name	Common name	Scientific name	Status	Location
1	Buchhe Asala (P1)	Snow trout	Schizothorax richardsonii	Decreasing	Seti Nadi
2	Githi, Katle (P2)	Copper Mahseer	Neoliossocheilus hehexagonolepis	Decreasing	Seti Nadi
3	Sahar (P3)	Golden Mahseer	Tor putitora	Decreasing	Seti Nadi
4	Baghe	Not available	Botia iohachata	Decreasing	Seti Nadi
5	Kyathel Dhami	Sulcatus catfish	Pseudecheneis sulcatus	Decreasing	Seti Nadi

Annex 8: Mammals

Table 16: Types of mammals, location, and population trend

SN	Nepali name	Common name	Scientific name
1.	Chituwa	Leopard	Panther pardus
2.	Shyal	Golden jackal	Canis aureus
3.	Rato bandar	Rhsus macaque	Maccaca mulatta
4.	Dhedu	Common langur	Semnopithecus entellus
5.	Ghoral	Himalayan ghoral	Naemorhedus goral
6.	Naurimuso	Mongoose	Hepestes edwardsi
7.	Kasturi mriga	Musk dear	Muschus chryosogaster
8.	Bandel	Wild boar	Sus scrofa
9.	Kalo bhalu	Black bear	Ursus thibetamus
10.	Dumsi	Porcupine	Hystrix hytrix
11.	Sambaar	Sambar deer	Cervus unicolor
12.	Ott	Common otter	Lutra Lutra
13.	Nir biralo	Civet	Paguma Larvata
14.	Bwaso	Gray wolf	Canis lupus
15.	Ban biralo	Jungle cat	Felis chaus
16.	Ratuwa	Wild boar	Sus scrofa

Source: DoF, Bajhang annual report 2016/17, Khaptad National Park annual report 2017/18

Annex 9: Reptiles

Table 17 : Reptile species, location and population trend

SN	Nepali Name	Common name	Scientific name
1.	Sun gohoro	Yellow monitor or golden monitor	Varanus flavescens
2.	Dhaman	Indian rat snake	Ptyas mucosus
3.	Vaguta	Indus valley bullfrog	Rana tigrina

Source: DoF, Bajhang annual report 2073/074

Annex 10: Birds

Table 18: Bird species commonly found in the West Seti watershed

SN	Nepali Name	Common name	Scientific name
1.	Pani hash	Ferruginous duck	Aythya nyroca
2.	Kalo gidda	Cinerous vulture	Aegypius monachus
3.	Seto gidda	Egyptian vulture	Neophron percnopterus
4.	Danphe	Himalayan monal	Lophophorus impejanus
5.	Munal	Crimson-horned pheasant	Satyr tragopan
6.	Huchil	Eurasian eagle owl	Bubo bubo
7.	Chukar	Chukar patridge	Allectoris chukar
8.	Kalo titra	Black francolin	Francolinus francolinus
9.	Piura	Rufous-throated partridge	Arborophila rufogularis
10	Fokaras	Koklass pheasant	Pucrasia macrolopha
11.	Ban kukhura	Red junglefowl	Gallus gallus
12.	Kalij	Kalij pheasant	Lophura leucomelanos
13.	Chir	Cheer pheasant	Catreus wallichii

Source: DoF, Bajhang annual report 2073/074, and Khaptad National Park annual report 2016-2017

Annex 11: Roads

Table 19: Key roads in the West Seti watershed

SN	Locations linked	Distance of road
1	Rithapata - Subeda - Kadel - Byasi - Lekhgaun - Sainpasela - Bhamchour - Khirtadi – Pipalkot – Kafalseri - Darchula	5.10
2	Chainpur - Luyata – Puwagadi - Korilakot – Kotbvhairab – Paraktne – Dangaji - Dipayal	59.66
3	Maurebagar – Chaudhari – Maulali – Sainpasela – Lekhgaun – Pathivera - Surma	8.72
4	Jadar – Kuch - Dangaji	1.00
5	Bhadebagar (Matela) – Jhuteda (Byashi) - Jay Prithivinagar	9.00
6	Rithapatta (Shelakhet) – Daulichour – Surma - Pathivera	0.37
7	Luyanata – Hemantabada – Kailash – Kotdewal – Masta – Rilu – Datola - Melbisuna	0.49
8	Chainpur - Saipal - Taklakot	18.97
9	Puiyatola - Timurathi	2.10
10	Chainpur – Saipal - Taklakot	1.19

Annex 12: Hydropower

Table 20: Hydropower projects in development in the West Seti watershed

Project	Capacity (MW)	River	Location	Promoter	Status
Dhauligad Sunakhani Bagar	1	Dhauligaad	Majhigau (Bajhang)	Khecheswor Jalvidyut Co P Ltd Bajhang	Survey license issued
Sunigaad	11	Sunigaad	Sunikot (Bajahng)	Omega Energy Developer Pvt. Ltd	Survey license issued
Jeuligaad Cascade	2	Jeuligaad	Chainpur, Rithapata (Bajhang)	Shurma Bhagwati Developers Pvt. Ltd.	Survey license issued
Uppder Sunigaad	8	Jeuligaad	Dilichaur (Bajhang)	Omega Enegy Developer Pvt. Ltd	Survey license issued
Chainpur Seti	210	Seti Khola	Dhamena, Melbisauni, Kanda (Bajhang)	Nepal Electricity Authority	Survey license issued
Seti Nadi 3	165	Seti Khola	Sunikot, Luyanta (Bajhang)	Chilime Hydropower Company Ltd	Survey license issued
Kalanga	15	Kalangagaad	Sunkunda, Khiratadi (Banjh)	Kalanga Hydropower Pvt. Ltd	Generation license issued
Upper Kalangaad	38	Kalangagaad	Dahabagar, Khiratadi, (Bajhang)	Sni Gad Hydro Pvt. Ltd	Generation license issued
Sanigaad	11	Sanigaad	Bajhang	Sanigad Hydro Pvt Ltd	Generation license issued
Lower Kalangaad	8	Kalangaad	Khiratadi, Raya, Sunkuda (Bajhang)	Bagthala Hydro Pvt. Ltd	Generation license issued

Annex 13: Irrigation

Table 21: List of irrigation projects by name, location, and area in West Seti watershed

SN	Name	Area covered (ha)	NP/GP
1	Nangabagar	5	Chhabish Pathivera GP
2	Chaingur	2	Jaya Prithivi NP
3	Dewal	3	Jaya Prithivi NP
4	Dumri	6	Jaya Prithivi NP
5	Mateli	6	Chhabish Pathivera GP
6	Buntadi	4	Chhabish Pathivera GP
7	Pimijiula	3	Jaya Prithivi NP
8	Bhandarigaujiulo	11	Chhabish Pathivera GP
9	Golailiulo	14	Jaya Prithivi NP
10	Padeshijiulo	10	Jaya Prithivi NP
11	Jujigiulo	20	Durgathali GP
12	Oikhetjiulo	14	Thalara RM
13	Birijiulo	21	Khaptad Chhanna GP
14	Odgau	50	Khaptad Chhanna GP
15	Bhandarjiulo	5	Jaya Prithivi NP
16	Thalijiulo	30	Durgathali GP
17	Dankotjiulo	40	Khaptad Chhanna GP

Annex 14: Water quality

Table 22: Water quality in various locations throughout the West Seti watershed

SN	River or stream	Electric Conductivity	Temperature	DO (mg/L)	Turbidity (NTU)	Iron (mg/L)	pH	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Ammonium (mg/L)	Phosphate (mg/L)
1.	Sunigaad	66.66	15.3	8.83	13.5	0.00	5.1	0.00	0.00	0.0	0.6
2.	Dumrigaad	176.7	19.5	8.1	11.5	0.2	6.2	0.00	0.00	0.0	10
3.	Ratapani	156.6	16.6	8.31	35	0.0	5.7	0.00	0.00	0.00	6.5
4.	Bauligaad	63.5	18.4	8.11	89.3	0.00	5.3	0.00	0.00	0.00	5.8
5.	Luyatakhola	48.5	24.8	7.24	60.2	0.00	5.3	0.00	0.00	0.00	7.2
6.	Tamel	117	16.8	8.82	137.6	0.00	5.6	0.00	0.00	0.00	7.9
7.	Mauribagar	68.6	19.4	8.35	32.8	0.00	5.3	0.00	0.00	0.0	7.2
8.	Deuda	124.3	19.3	8.87	147.3	0.00	5.9	0.00	0.00	2.0	9.0
9.	Thalaragaad	146.9	25.7	7.43	44.7	0.00	6.3	0.00	0.00	0.0	5.1
10.	Ayera Khola	258.4	20.3	8.15	68	0.00	6.1	0.00	0.00	0.0	3.7
11.	Khpatad Tal	35.5	17.8	6.65	30	0.0	5.2	0.00	0.00	2.0	0.3
12.	Tribeni	11.8	13.1	7.22	25	0.0	5	0.00	0.00	0.0	4.4
13.	Dau Tal	41.1	24.1	9.75	20	0.0	5.9	0.00	0.00	-	0.30
14.	Panduragoth	103.9	23.8	3.5	27	0.0	6.6	0.00	0.00	-	-

Annex 15: Pollution

Table 23: Major pollution points in the West Seti watershed

Place	Source of Water Pollution	Causes
Deuda, Bajhang	Point source	Urbanization
Tamail, Chainpur	Marketplace	Urbanization and increasing population at the junction between Khaptad GP and Khaptad National Park
Chainpur, Bajhang	Unmanaged household waste and sewage	District headquarters and urbanization

Annex 16: Forest management

Table 24: Forest management by modality in the West Seti watershed

SN	NP/GP	Total area of forest (ha)	Community forest (ha)	Leasehold (ha)	Religious (ha)	Government-managed (ha)	National park (ha)
1	Chhabish Pathivera GP	11,609	1,944	158.9	0	9,500	
2	Durgathali	6,167	2,003	189.1	0	3,974.9	
3	Jayaprithivi NP	16,638	7,131	104.5	0	9,402.2	
4	Saipal GP	146,398	459	289.7	0	145,650	
5	Khaptad Channa GP	11,345	3,337	417.3	0	3,525.9	4,065
6	Kedarsieu GP	11,359	1,616	91.38	2.94	9,649.18	
7	Masta GP	10,899	6,599	118.9	0	4,181	
8	Surma GP	27,013	1,959	0	0	25,053.8	
9	Talkot GP	33,450	2,820	537.7	0	30,102.8	
10	Thalaral GP	10,522	1,846	137.9	0	5,563.7	2,974

Source: Dept. of Forests, Bajhang

Annex 17: Current policy provisions and relevant observations

Table 25: Current policy provisions and relevant observations

Policy Provision (for aquatic natural resources)	Local reality
LGOA provides municipalities and rural municipalities different concurrent powers, functions, and duties such as development of local policy, legislation, standards, plans related to forest, wildlife, birds, water use, environment, ecology and bio-diversity, implementation and regulation; survey, production, collection, promotion, processing and market management of herbs and other non-timber forest products at the local level; protection of wildlife and birds, commercial breeding, use and monitoring; documentation of biodiversity; and protection and promotion native species [section (11)(4) (E)]. These are some of the rights and duties which are yet to be exercised and discharged by the local governments.	The municipalities in the watershed area focus only on collecting and disposing solid waste.
CFUG: Forest Act 2049 and Forest Regulation 2051 prohibits a number of activities in CF, unless specific permission has been granted by the DFO. Such activities include harvesting trees, carrying out cultivation and any other destructive practices inside forests; mining, quarrying stone, soil or sand, or removing any substances in a way that is likely to have significant adverse impact on the environment; using hazardous pesticides or explosives in a river, stream or source of water flowing inside a CF.	Community forest user groups are independent, autonomous and guided by their constitutions and operational plans as approved by district forest officers and chairperson of respective CFUG. FECOFUN is an umbrella organization of CFUGs and advocates for community rights and sustainable management of forest resources with active participation and equitable benefits sharing over resources.

Annex 18: Key stakeholders in the West Seti watershed

Table 26: Key organizations and offices relevant to watershed health

SN	Name	Address
Government Organizations		
1	District Coordination Committee	Chainpur, Bajhang
2	District Soil Conservation Office/watershed office	Chainpur, Bajhang
3	Division Forest Office	Chainpur, Bajhang
4	District Agriculture Knowledge office	Chainpur, Bajhang
5	District Livestock Hospital office	Chainpur, Bajhang
6	Division Irrigation	Chainpur, Bajhang
7	Women and Child Dev. Office	Chainpur, Bajhang
8	District Technical Office	Chainpur, Bajhang
9	Jayaprithivi Municipality	Chainpur, Bajhang
10	Water Induced DC Division	Chainpur, Bajhang
11	Distrct Health Office	Chainpur, Bajhang
12	District Administration Office	Chainpur, Bajhang
13	Centre Beaure of Statistics	Chainpur, Bajhang
14	Road Division	Chainpur, Bajhang
15	Hydrology and Meteriology Office	Chainpur, Bajhang
16	District Education Office	Chainpur, Bajhang
17	Chainpur Water Users Commiittee	Chainpur, Bajhang
Nov-Governmental Organization		
1	Promoting Agriculture, Health and Alternative Livelihoods (PAHAL)	Chainpur, Bajhang
2	Rural Village Water Resources Management Project (RVWRMP)	Chainpur, Bajhang
3	Khapatad Tourism Board	Chainpur, Bajhang
4	SUAAHARA - Good Nutrition	Chainpur, Bajhang
5	NGO federations Bajhang	
6	FECOFUN Bajhang	
7	Saipal Bajhang	
8	Sahara Nepal	

9	Nepal Red Cross	Chainpur, Bajhang
10	Social Development Center (SDC)	Chainpur, Bajhang
13	Community Development Fund (CDF)	Chainpur, Bajhang
14	World Vision	Chainpur, Bajhang
15	United Missions to Nepal (UMN)	Chainpur, Bajhang
16	Dalit Help Society	
17	Himawanti Nepal	
18	Feminist Dalit Organization (FEDO)	Chainpur, Bajhang
19	Nepal Federation of Irrigation Water Users' Association, Nepal (NFIWUAN)	Chainpur, Bajhang
20	Nepal Federation of Indigenous Nationalities (NEFIN)	Chainpur, Bajhang
21	Federation of Drinking Water and Sanitation Users, Nepal (FEDWASUN)	Chainpur, Bajhang
22	Nepal Federation of Environmental Journalists (NEFEJ)	Chainpur, Bajhang
23	Federation of Nepalese Chambers of Commerce and Industry (FNCCI)	Chainpur, Bajhang
24	Nepal Electricity, Dipayal	Chainpur, Bajhang
25	World Food Organization (WFP)	Chainpur, Bajhang
26	Food First Information Network (FIAN)	Chainpur, Bajhang

Annex 19: Vision building framework for the West Seti watershed

Figure 28: Vision building framework illustrated