BOGATAN LAGAM KARNALI WATERSHED HEALTH REPORT

Vision statement – "Prosperous, inclusive watershed with rich biodiversity supported by sustainable agriculture, tourism and good governance."

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What is a watershed?

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

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

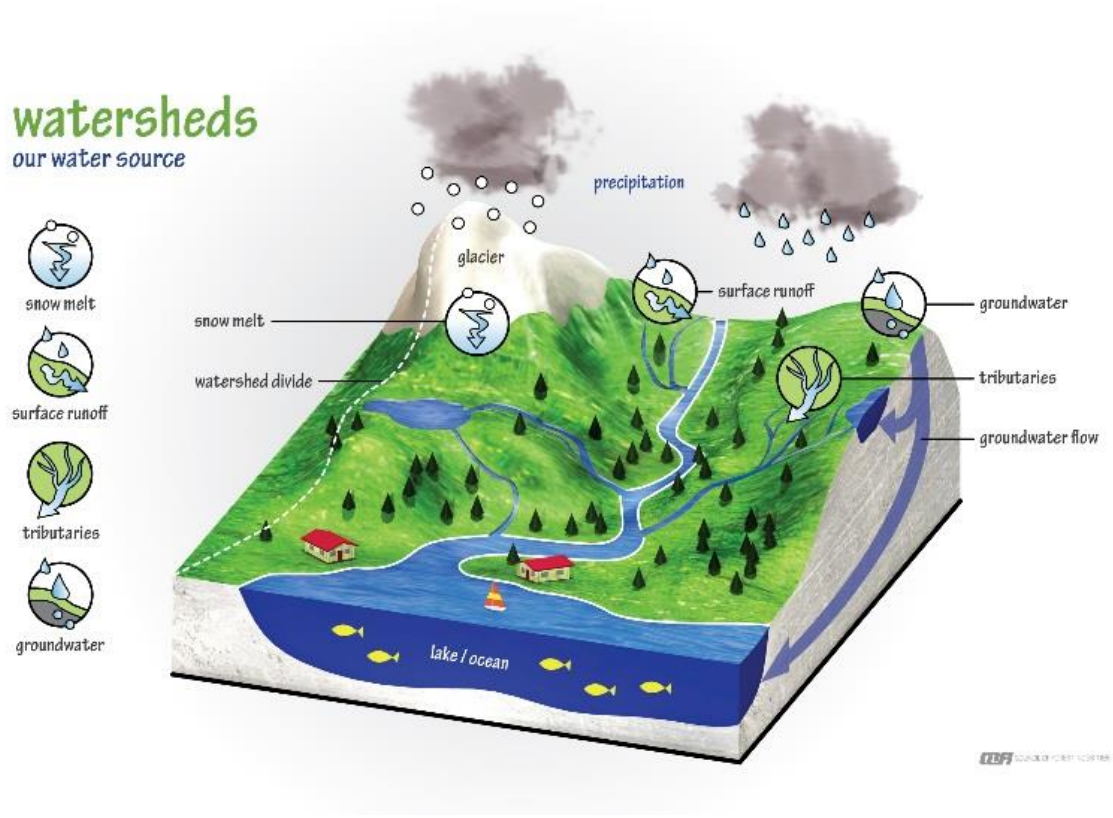

Figure 1: Diagram of a typical watershed

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

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

The health indicators in this report are grouped under larger categories of 1) nature 2) wealth and 3) power, each of which explores related aspects of the watershed from that particular viewpoint. A full profile of the Bogatan Lagam Karnali watershed has also been prepared and is available here.

River basin	Karnali
Watershed	Bogatan Lagam Karnali
Province	Numbers 6 (Doti) and 7 (Surkhet)
Total drainage area:	205.63 km^2
Number of streams	36
Major rivers	Serrigaad, Bandgaad, Guinada Khola, Pogade Khola, Baral Khola, Buda Khola, Bhatmare Khola, Kunadagaad, Kedarsain Khola, Dhameli Khola,
Lakes and wetlands	Sunpaal Taal, Libukhola Taal and Debalkhola Taal
Land cover	Forest, 80%; agriculture 18%; rivers and streams, 2%; grazing land, <1%
Rural municipalities	Badikedar and Bogatan (in Doti) and Chaukune (in Surkhet)
Population	10,764 (49% Male, 51% Female) (CBS, 2011)
Ethnic groups	Brahmin/Chhetri/Thakuri, 68%; Janajati, 4%; Dalit, 27%; Others, 1%

The Bogatan Lagam Karnali watershed stretches across the Doti and Surkhet districts in western Nepal, extending into parts of the Badikedar and Bogatan municipalities (in Doti) and Chakune (in Surkhet). From north to south, the watershed descends from high hills to mid-hills (Figure 2).

Most of the residents of the area depend on agriculture and wage labor for income and livelihood. The area is largely inhabited by Brahmin/Chhetri/Thakuri (68%), followed by Dalits (27%), and a sparse Janajati population (4%). Agricultural land in Bogatan Lagam Karnali comprises nearly 18% of the total area in the watershed. Major crops cultivated in the watershed include wheat, millet, rice, potato, and maize.

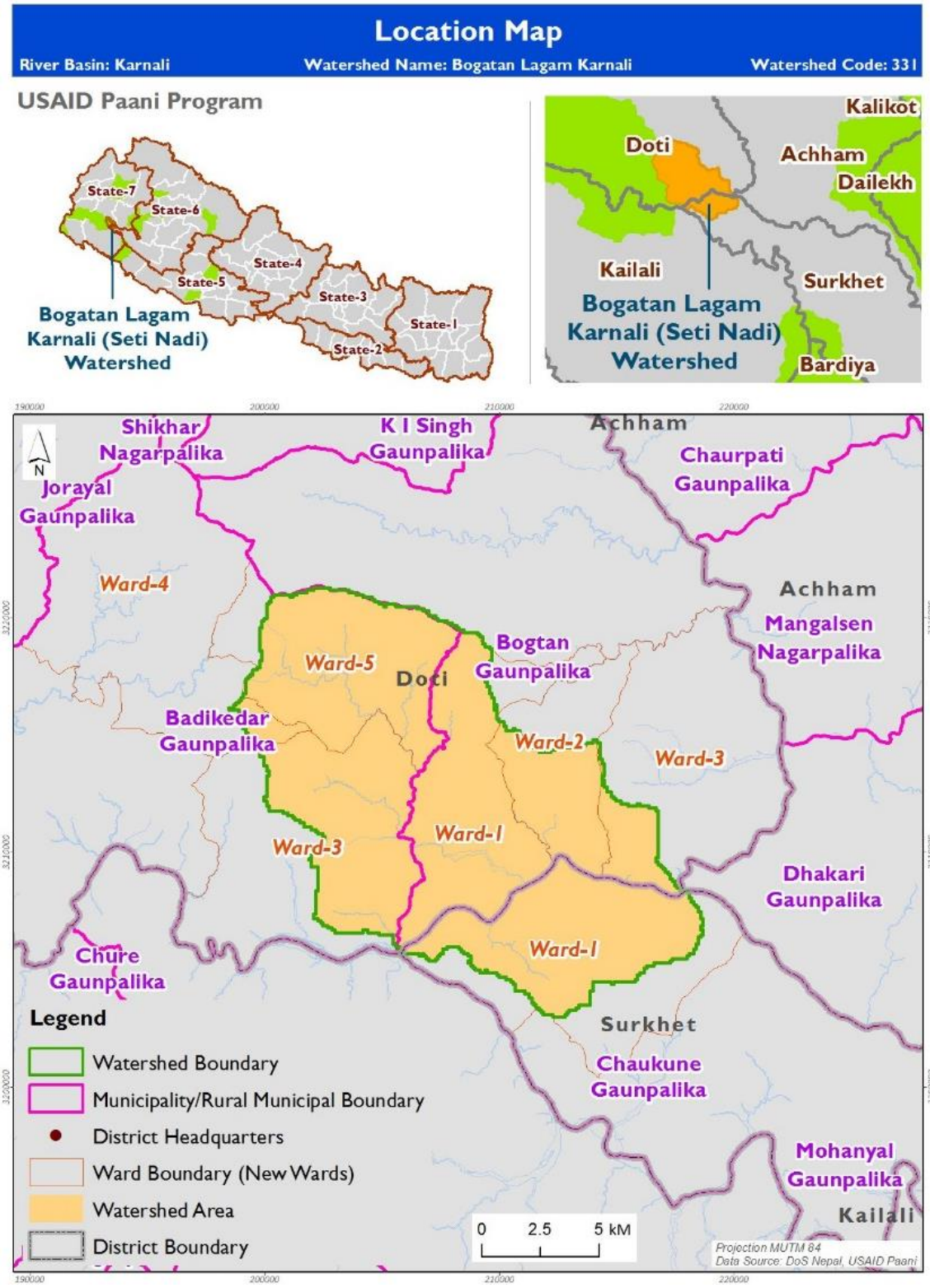

Figure 2: Map of the Bogatan Lagam Karnali watershed

Nature

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

Water

The condition of water resources within a watershed depends on many factors that affect the water cycle. In the Middle Karnali watershed, these include rainfall, minimal snowmelt, infiltration, and withdrawals for irrigation, among other factors.

Rainfall

No rain gauging stations are situated within the Bogatan Lagam Karnali watershed itself, so data was collected from three stations closest to the area (Katai, Dipayal and Banga Camp) to account for existing spatial variations in rainfall. Using this approach, the average dry season rainfall (November - April) is 332 mm compared to the average wet season (June - September) rainfall of 1,328 mm. The average annual rainfall for the watershed is 1,659 mm.

The Bogatan Lagam Karnali watershed and its tributaries are the main source of water for domestic and agricultural uses, although local springs play an important role as well (Figure 4). Sixty-two percent of households draw water from piped systems, which indicates good community coverage for drinking water. The remaining households draw water from a variety of sources, including wells, rivers, lakes, rain water harvesting, and groundwater extraction. Still, availability is a nagging issue, as 79% of households reported difficulty in obtaining sufficient drinking water due to drying water sources.

Water accessibility, on the other hand, indicates the degree of ease for users to obtain water for domestic and agricultural needs. Seventy-nine percent of households said they needed less than 15 minutes per day to collect drinking water. Nine percent spend between 30-60 minutes per day, and less than 5% reported having no access to available water resources. Of those families needing more than 30 minutes per day to fetch water, 75% cited long distances to water sources as the major impediment (Figure 3).

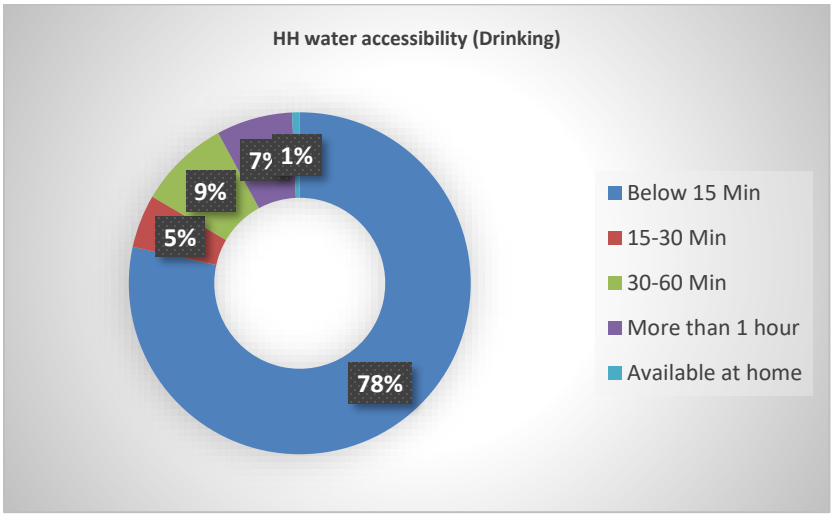

Figure 3: Water availability and accessibility in the Bogatan Lagam Karnali watershed

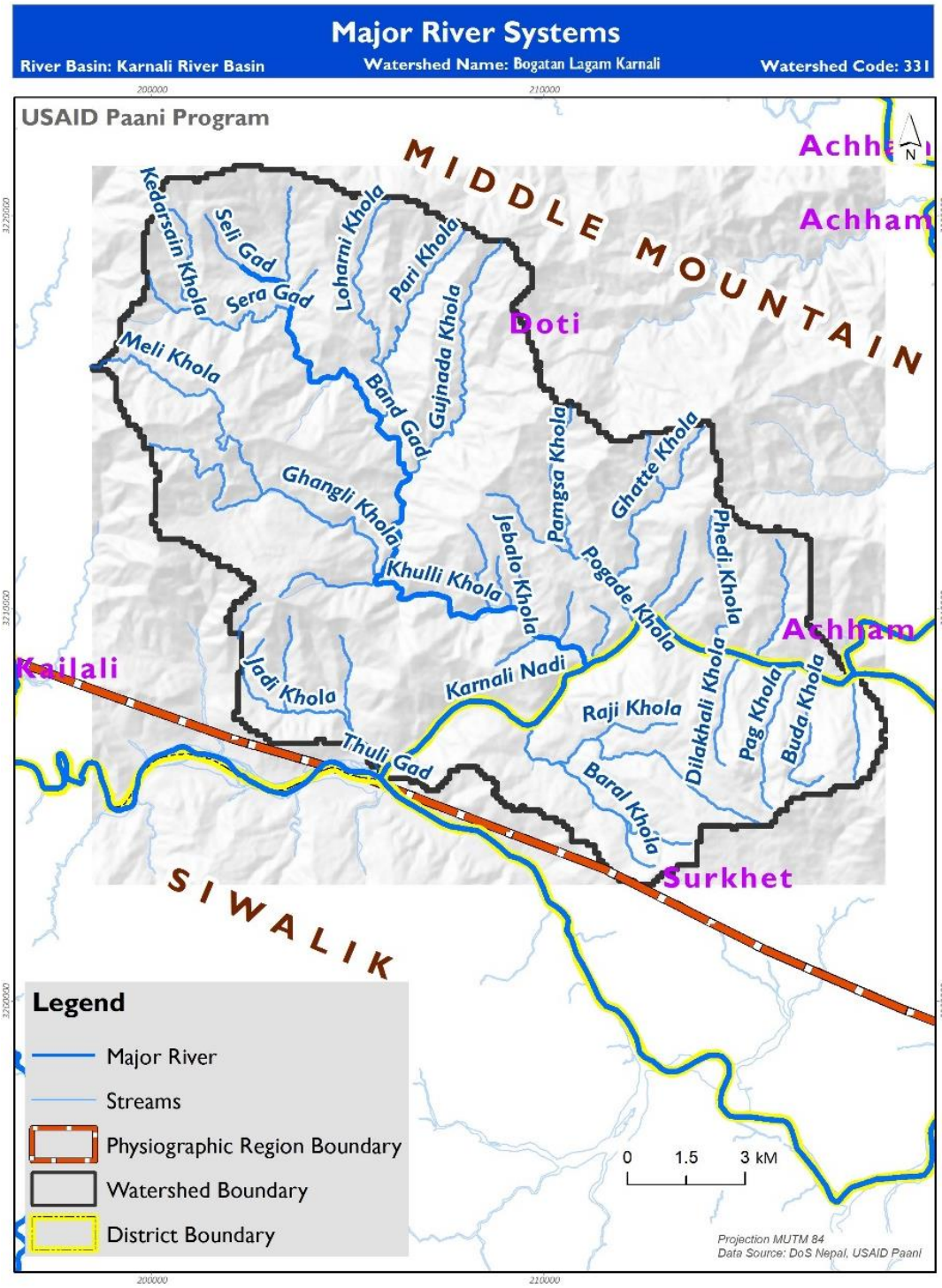

Figure 4: Rivers and streams in the Bogatan Lagam Karnali watershed

River and lake water quality

Water quality monitoring was conducted at ten sites in the Bogatan Lagam Karnali watershed (Figure 5). Water samples were collected and tested for pH, iron, nitrite-nitrogen, ammonium, phosphate, and temperature. The water quality was found to be within acceptable ranges in all categories except pH, which was slightly low at Dhameli, Silghatta, Guenada, Guena Dovan and Kedarsain. Ammonium levels were slightly elevated at Dhameli.

On the issue of wastewater, 38% of households said they disposed wastewater into the local sewage system, but 26% discard waste directly into the river and lowlands. Untreated waste can diminish water quality and impact the aquatic ecosystem. Ten percent of households do not have a toilet. Regarding solid waste, 82% of households said they burn their trash, while 15% dump trash into the river.

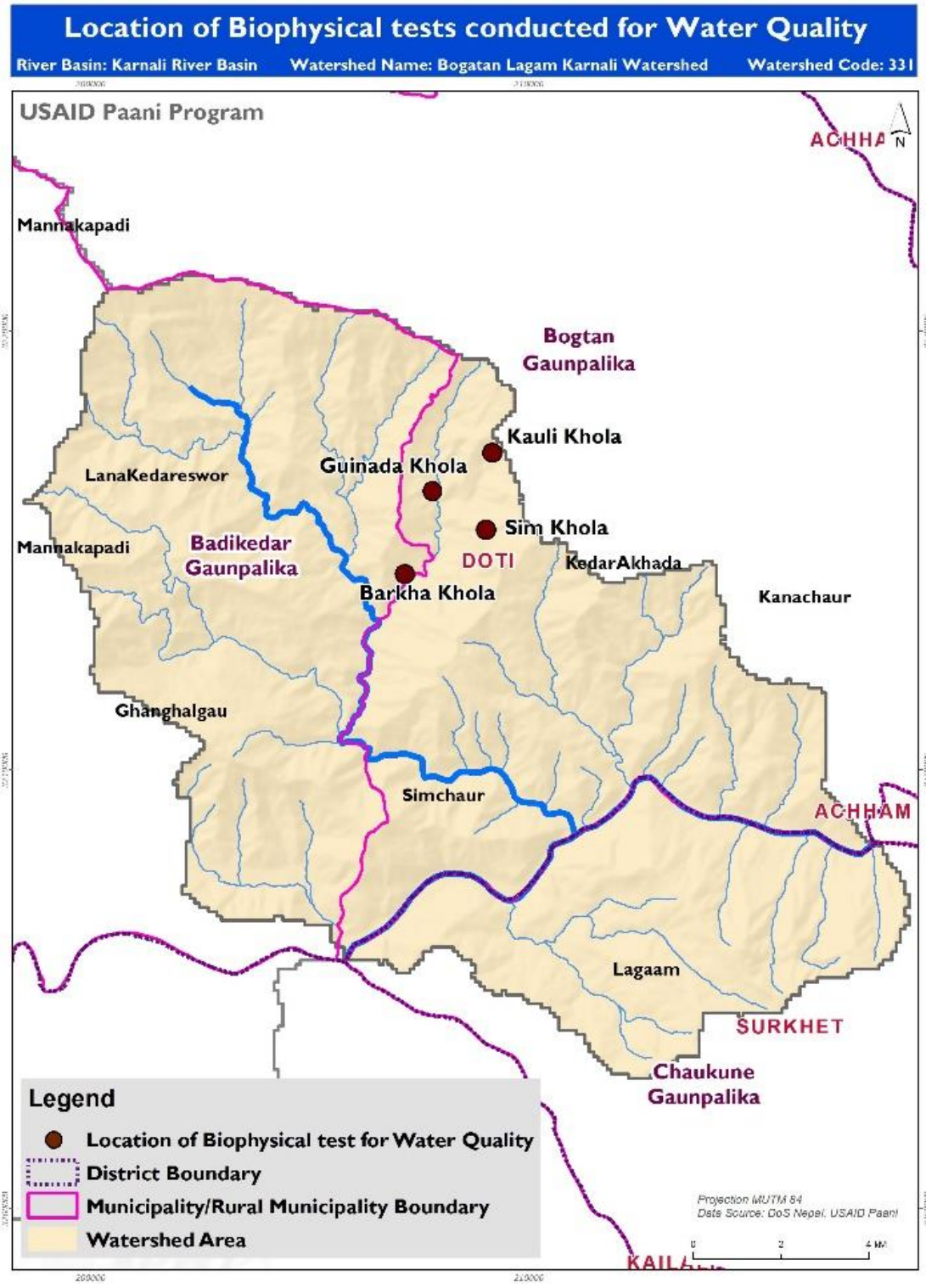

Figure 5: Water quality testing points in the Bogatan Lagam Karnali watershed

Biodiversity and habitat

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

Land cover and land use

Nearly 80% of the land cover in the Bogatan Lagam Karnali watershed is forestland, while 18% of the land area is committed to agriculture. Rivers, streams and lakes cover very little area in the watershed. In terms of population, density is low and highly rural. Due to the large percentage of forest cover, soil erosion issues are minimal at present.

The Bogatan Lagam Karnali watershed contains diverse habitats for both aquatic and terrestrial species due to its variety of forests, rangelands and wetlands from the lower midhills to higher elevations (297 masl to 2,744). The forests are dominated by Chir pine (*Pinus roxburgii*), rhododendron, and mixed broad-leaf tree species, including Sal (*Shorea robusta*) at lower altitudes and Quercus at higher elevations.

While the significant forestation in the watershed does provide ample control over soil erosion, land satellite data from Global Forest Watch between 2000-2016 shows the watershed has lost 135 hectares of forest over that time, while gaining only 32 hectares in other parts (Figure 6).

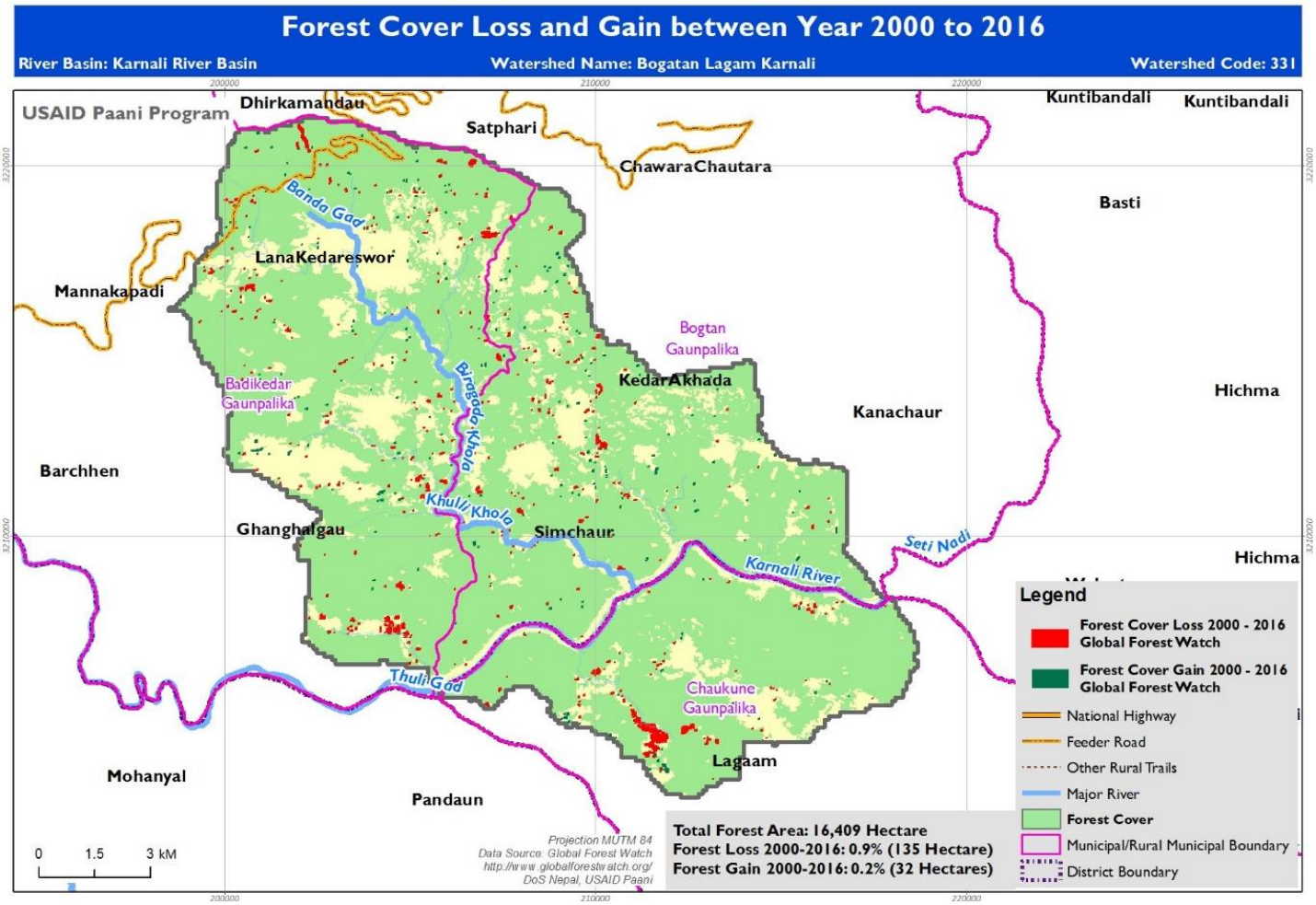

Figure 6: Forest cover loss and gain in the Bogatan Lagam Karnali watershed, 2000-2016

Fish diversity

The Bogatan Lagam Karnali watershed contains 36 rivers that provide important habitat for aquatic biodiversity, especially fish species. While there is a lack of precise information on fresh water biodiversity in the watershed, communities and other stakeholders were consulted, and secondary literature reviewed to determine the diversity of fish present. Based on this data collection, 17 different locally named fish species were reported, including Kuera, Satto, Gerara, Oyara, Asla, Kaloch, Pangar, Sueni, Githi, Geraj.

Wealth

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

Agriculture is the primary source of income (76%), and farmers earn most of their take home pay through staple crops, such as rice, wheat and millet. Livestock rearing (6%) and seasonal migration (14%) are also significant sources of livelihood in the watershed followed by wage employment (3.5%), off farm activities

and traditional occupations. When looking at gender and work, surveys revealed that men predominate in agricultural and migratory activities, while most women undertake off-farm activities for income.

Infrastructure and Extractives

The design and construction of infrastructure, such as roads and hydropower plants, have an impact on the health of the watershed. For example, poorly designed rural roads on steep slopes can greatly increase soil erosion and landslides. Similarly, hydropower plants that divert or impound water will restrict the amount of water available for aquatic life that people depend on for their livelihoods. Irrigation canals, while bringing benefits to one group of farmers, can also reduce the amount of water available to other farmer populations. As demonstrated by these examples, it is important that the design, construction, and operation of infrastructure projects account for the full range of social, economic and environmental factors within the watershed. Sustainable infrastructure should provide equitable distribution of benefits with minimal long-term, environmental impacts.

Capture fishery practices

Most fishing in the watershed takes place in the perennial tributaries, where both modern and traditional fishing practices are used. A rise in destructive fishing practices such as using poison, gill nets, and explosives are threatening long-term sustainability.

Sustainable agriculture

As most households in the Bogatan Lagam Karnali watershed rely on agriculture for livelihoods, soil fertility is a serious concern for all residents. Seventy-two percent of respondents said soil quality had declined in recent years, and 88% reported declines in productivity. Soil erosion due to climate change impacts is making productivity concerns more acute. The practice of terrace farming is common in the area. Major crops include wheat, rice, maize, millet and potato.

Hydropower

The watershed has not developed much in terms of infrastructure development. Only one micro hydro plant (Tunaghat) is operative.

Roads

The Bogatan Lagam Karnali watershed contains 80 kms of road and plans that have been developed to extend the many sub-networks in the region. Road coverage is sparse in the watershed, and vehicular traffic is minimal. During the rainy season, vehicular movement nearly ceases altogether due to landslides and dangerous road conditions. According to respondents, various bioengineering measures to minimize the environmental impacts of road building (e.g., erosion and landslides) on the watershed have been ineffective.

Irrigation

Major sources for irrigation include rivers and ponds, but primarily rainwater harvesting, which provides 50% of irrigation in the watershed. Thirteen percent obtain irrigation water from nearby rivers, while 15% use seasonal (or impermanent) rivers. Most households, we note, employ a combination of sources to meet their irrigation needs.

In terms of gender, we find that 89% of men take authority on management of irrigation systems. However, 91% of women make decisions regarding domestic water use at the household level.

Climate resilience and disaster risk reduction

Increased human activity combined with climate change impacts are intensifying environmental degradation in many parts of the Bogatan Lagam Karnali watershed, and, in some cases, intensifying the likelihood and effects of natural hazards such as floods and landslides. For this reason, a focus on building climate resilience and disaster risk reduction in the area is evident.

Regarding natural disasters, Kedaraakhada, Lanakedareswar and Simchaur have been marked as "low vulnerable" while Ghagal is marked as "medium vulnerable." Surveys indicate that few households have the appropriate knowledge to devise measures for coping with climate change impacts and potential natural disasters.

Local NGOs and government line agencies are actively working to improve climate resilience in the watershed. The District Soil Conservation Office (DSCO) is supporting several programs to enhance water source protection, riverbank protection and pond conservation, among other initiatives. The Agriculture Extension Service has developed activities related to seed distribution, farmer education, small irrigation projects and model nutrition gardens. The Rural Village Water Resource Management Program (supported in part by the government of Finland) has been developing Water Use Master Plans (WUMP) to improve the efficiency and distribution of water and crops for local communities. Some of its activities include tunnel farming, recharge ponds, irrigation ponds and establishing local cooperatives.

To date, five WUMPs have been developed in the watershed. However, no Local Adaptation Plans of Action (LAPA) nor Community Adaptation Plans of Action (CAPA) have been developed.

Early warning systems

There are no early warning systems present in the Bogatan Lagam Karnali watershed.

Power

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

Local institutions and inclusiveness

There are numerous organizations, federations and line agencies in the watershed that are responsible for managing the watershed to provide public services. Thirty-one community Forest User Groups (CFUGs) support watershed management and forest regeneration efforts in the area. However, while the CFUG Guidelines 2071 call for 50% representation by women, currently only 18.2% of membership is female. The District Forest Office (DFO) for the watershed says the guidelines are being reviewed and will ensure the proper levels of representation.

In addition to the CFUGs, there are 10 irrigation user groups, 15 water user groups and one indigenous committee to assist with natural resources issues. A women's cooperative advocates for empowering

women in policymaking at the local level. In Bogatan municipality, a recently formed agriculture, forest and environment committee features three women on a seven-member board.

Looking at participation in different organizations and community groups, 52% of the respondents are involved in a community organization whereas the remaining 48% are not involved in any community organizations. This shows a lack of equal access to information and representation in community organizations. The majority of respondents from the watershed are involved in CFUGs, which comprise 17.4%. Within natural resource management (NRM) groups specifically, women and persons from marginalized groups hold 13% of the positions, and less than 1% of leadership positions.

While the work of local organizations has been impressive in many regards, general participation in community groups is low: only 22% of residents claim membership in a community group. Looking at ethnicity, participation from Janajatis and Dalits (19%) lags far behind participation among Brahmin/Chhetri/Thakuri (62%).

Awareness about government planning in the watershed is low: only 20% claimed knowledge of local level planning processes, such as LAPAs and CAPAs.

Policies, frameworks and regulations

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

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

More recently, Article 57 (4), Schedule (8) of 2015 Constitution of Nepal stipulates that under the new federal system, the local government holds the executive and legislative power on drinking water, roads and irrigation management, small hydropower projects, and environmental conservation and biodiversity. Schedule 9 of the same article states that the federation, province, and local level governments hold concurrent authority to make decisions about wildlife, ecology, and disaster management.

Although the local government has this authority, these policies have yet been effectively implemented in NRM in the watershed, mainly due to lack of capacity and awareness on the part of the local the government.

Watershed health assessment – Summary

The list of health indicators presented in this section takes into account factors related to biophysical health, infrastructure, socio-economic and governance within the watershed. Each of these indicators was

assessed through consultation with stakeholders in the Bogatan Lagam Karnali watershed and assigned a score between 0-5 points.

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

Color Symbol	Description	Treatment measures
[4-5 points] 	Good health condition, no additional treatment required	Intervention required to keep condition intact
[2-4 points]	Fair condition, functioning at risk, be alert to maintain and improve condition of the watershed	Promotion of good practices needed to improve health condition; special attention if not additional treatment may be necessary.
[<2 points] 	Poor condition, impaired functioning, decreased quality and quantity of ecosystem services in the watershed	Special measures must be adopted to restore watershed health conditions and ecosystem services

Based on the designated indicators for assessment, we rate the health status of the Bogatan Lagam Karnali watershed as ***fair*** (Table 1)**.** Destructive fishing practices, aggressive gravel mining and unsustainable rural roads pose major challenges to watershed health. Low participation rates of local residents in community groups is also a concern. The watershed rates well for lack of invasive species and equitable benefit sharing.

Table 1: Summary of health indicators for the Bogatan Lagam Karnali watershed

Thematic area	Watershed health indicator	Rating	Rationale
WATER 	Water availability		– 79% of households report difficult obtaining sufficient water
	Water accessibility		- 79% of households spend less than 15 minutes per day collecting water

BIODIVERSITY & HABITAT 	Water quality		- 4% of respondents say drinking water quality is good - Water quality affected by rising use of fertilizers and pesticides - Higher than normal levels of phosphates and pH detected
	Household sanitation		- 10% of households do not have toilet - 26% of households dispose household waste water directly into rivers and low lands
	Solid waste disposal		- 82% of households burn solid waste instead of proper disposal
	Quantity of fish		- Fish stocks have decreased, possibly due to climate change impacts and lower water levels - 91% of households said native fish species are decreasing
	Fishing practices		- Rise in destructive fishing practices such as poison and gill nets
	Invasive species		- No invasive aquatic species reported
	Species diversity		- 17 species of fish reported in the watershed
	Land use and land cover		- High forest cover (80%) but agricultural land use is rising (currently at 18%) - Invasion of Banmara weed is degrading forests and raising the likelihood of forest fires
SUSTAINABLE INFRASTRUCTURE	Sustainability of hydropower		- Powerhouse at Bogatan is damaged and will be relocated - Tunaghat micro hydro plant is operative

	Sustainability of gravel mining		- Over extraction of sand and gravel contributing to floods at Lagam
	Sustainability of rural roads		- Roads do not employ bioengineering methods for reducing erosion
	Sustainability of irrigation		- Most irrigation sourced through canals, though ponds are becoming more common - 78% of households use irrigation in the watershed
CLIMATE RESILIENCE AND DISASTER RISK REDUCTION 	Areas vulnerable to landslides, floods and landslides		- Haphazard rural road construction, open grazing, and more intensive farming have accelerated landslides in the watershed
	Use of climate resilience adaptation practices		- Few adaptation practices observed in the watershed
	Households with access to early warning systems		- No early warning system present in the watershed
GOVERNANCE AND EQUALITY 	Household members engagement/participation in local planning processes		- Low participation and information about local participation processes - Fewer than 6% of respondents were aware of local level planning processes, such as LAPA and CAPA
	Community members are active in NRM groups [Biodiversity, disaster, climate change, water, agriculture, forest, irrigation, farmers]		- Only 32% of respondents are aware of local organizations active in NRM - Only 22% of residents claim membership in an NRM community group

	Women, marginalized castes, and ethnic groups hold key positions in NRM groups		- Women and marginalized groups do not hold any key positions in NRM groups at present
	People comply with laws and policy provisions and local norms and standards		- Lack of information about policy and laws and low implementation of the provisions
	Government enforces laws and regulations		- Low enforcement of laws and regulations
	Conflicts over NRM [Water/benefit sharing, watershed issues, sand mining, irrigation, hydropower] issues are resolved		- Conflicts over NRM are solved by local level government - Respondents have complained about the lack of transparency and accountability for drinking water use
	Good coordination between the, municipalities/rural municipalities, and provinces including government line agencies in the watershed		- Low coordination among local government and local stakeholders
	Equitable access and benefit sharing arising from use of natural resources (ecosystems services and products)		- Respondents say they are satisfied with benefit sharing related to local resources and ecosystem services

References

Central Bureau of Statistics, Nepal (CBS). *2015 Statistical Year Book Nepal*. Kathmandu: Government of Nepal. Accessed January 11, 2018. (http://cbs.gov.np/image/data/2017/Statistical%20Year%20Book%202015.pdf).