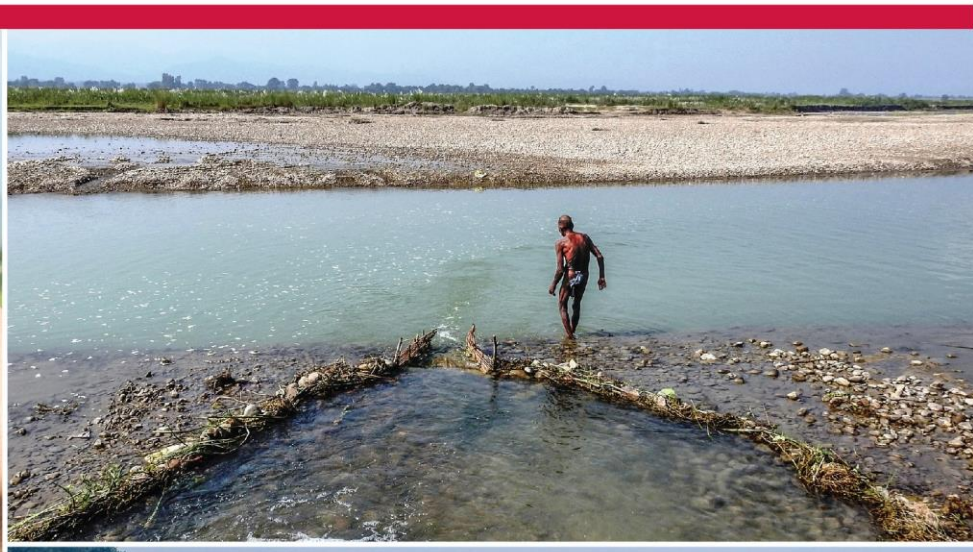
MIDDLE RAPTI WATERSHED HEALTH REPORT



Vision statement – "Economic development ensuring social justice and prosperity for the people through sustainable use of biodiversity and natural resources."

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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). But, 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

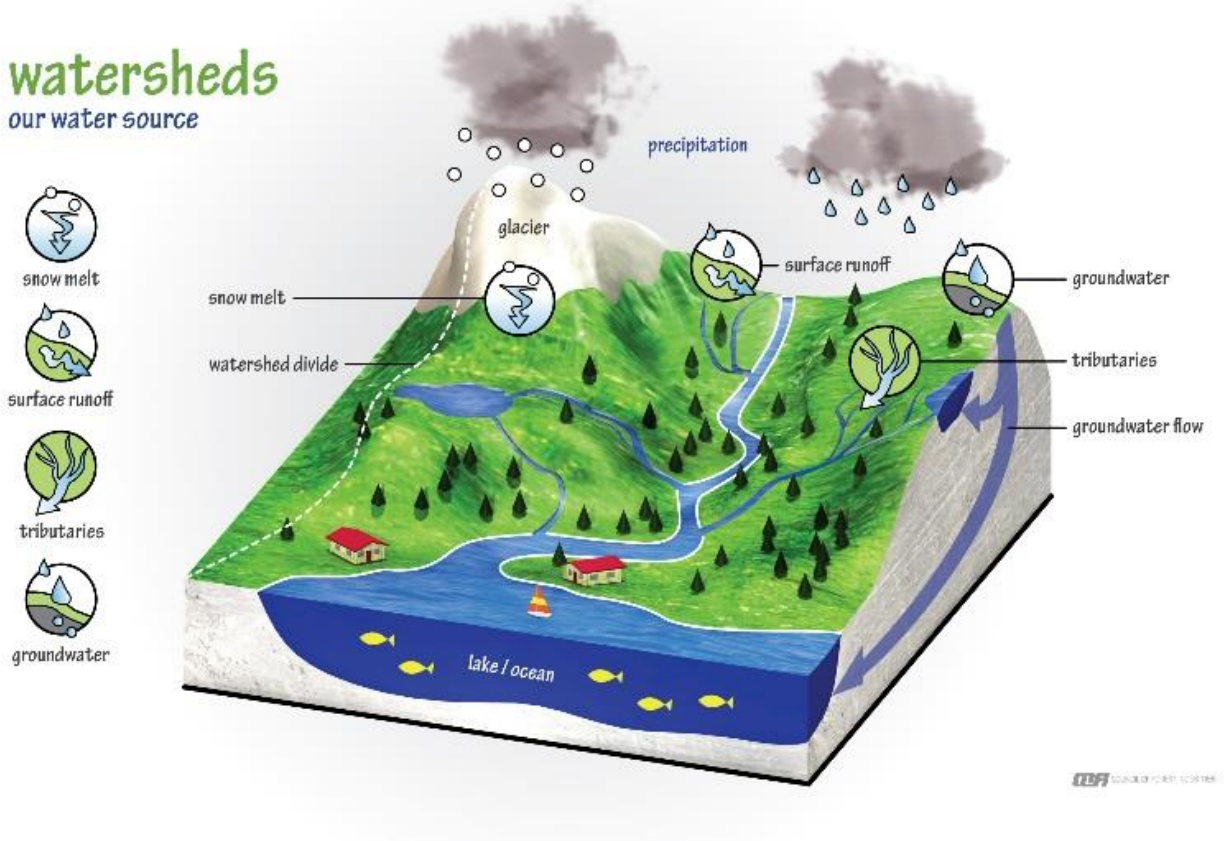


Figure 1: Diagram of a typical watershed

The goal of this watershed health assessment is to help people living in the Middle Rapti 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 Middle Rapti watershed has also been prepared and is available here: [LINK TO BE PROVIDED].

River Basin	Middle Rapti
Province	Number 5
Total Watershed area	456.4 km^2
Number of streams	47
Major rivers	Rapti, Arjun, Khabhari, Gurung, Supaila, Dolai, Kakrahawa, Sikrahawa, Narti, Kaudiya, Arnahawa
Lakes and wetlands	Jakhera
Landcover	Forest, 61%; agricultural land, 30%; rivers, 8%; grazing land, <1%
Municipalities	Lamahi
Rural Municipalitites	Rapti, Gadhawa and Rajpur
Population	94,241 (48% male; 52% female)(CBS 2015)
Ethnic groups	Brahmin/Chhetri/Thakuri, 20%; Janajati, 66% (55% Tharu); Dalit, 6%; Others, 7%

The Middle Rapti watershed (Figure 2) stretches from Dang district in Nepal southward to India, across the border. The landform is fragile, comprised of Churiya hills. The Rapti River is a braided stream that runs east to west, which cuts through the middle of the watershed parallel to the national East-West Highway. As frequently occurs in the Tarai, the river configuration changes its patterns frequently, as does the extent to which it reaches through the floodplains, delivering sediment for agricultural development but also increasing the risk of flooding. In total, the Rapti River descends more than 2,000 meters from the midhills to the plains.

Overfishing is a current concern in Middle Rapti, as traditional fisher communities (typically comprised of marginalized people) have been replaced by commercial fishing ventures. With this change, more destructive fishing techniques have become common, such as poison, explosives and electric current.

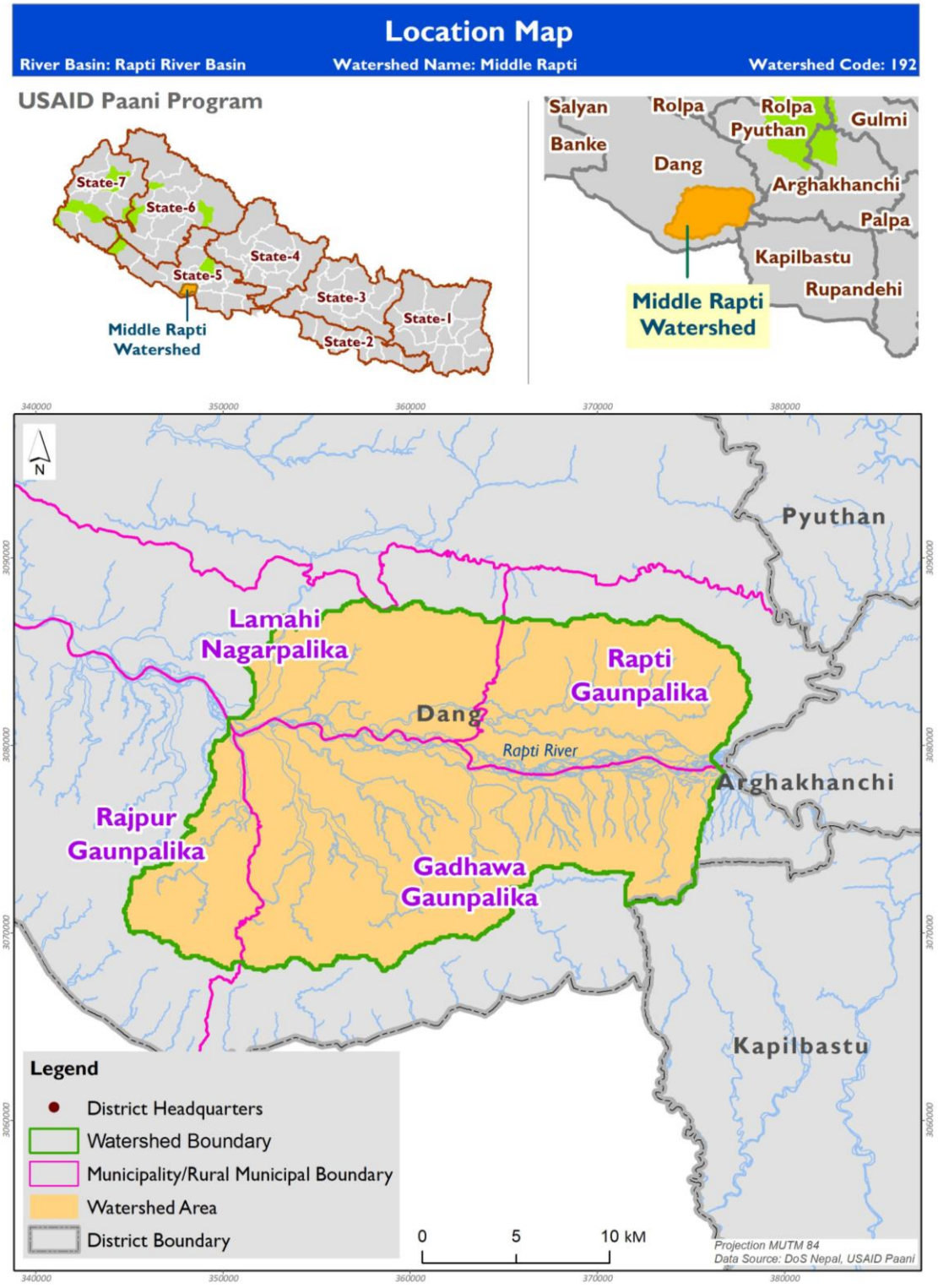


Figure 2: Map of the Middle Rapti Watershed

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 a large number of factors that affect the water cycle. In the Middle Rapti watershed, these include rainfall, minimal snowmelt, infiltration, and withdrawals for irrigation, among other factors.

Rainfall

Long-term rainfall data records are not available for the Middle Rapti watershed; thus, rainfall stations at Ghorahi (515), Koilabas (510) and Bhagwanpur (723) that lie near the watershed were used to estimate the amounts (Figure 3). The highest and lowest rainfall amounts are recorded in July and November, respectively. Average annual dry season rainfall is 167 mm, while average annual wet season rainfall comes to 1,474 mm. The average annual rainfall recorded is 1,641 mm.

Water availability and accessibility

The Rapti River and several kholas (streams) are the major sources of water in the area. For drinking water, residents rely on a range of technologies, including bore wells and tube wells. However, despite the many tributaries, many places are water scarce for significant portions of the year (e.g. Sitalapur, Bauraha, and Karange, among others).

Several findings point to the challenge of water availability in this watershed. Sixty-two percent of households have water in their homes, and the remaining 38% must rely on outside sources. Nine percent of households spend 30 minutes or more per day collecting water to meet daily needs. Seventy-one percent of families reported difficulty in obtaining enough water due to drying water sources (springs) in the region.

Water accessibility, on the other hand, 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. Ninety-five percent of households in the watershed said they have equal access to water for domestic and agricultural uses. Of the 5% who claimed unequal access to water, 35% cited time spent obtaining water, 24% complained about water scarcity and 12% cited caste discrimination as the causes for unequal access.

71%

Households facing challenges due to drying water sources

16%

Households that perceive the quality of water they drink is good

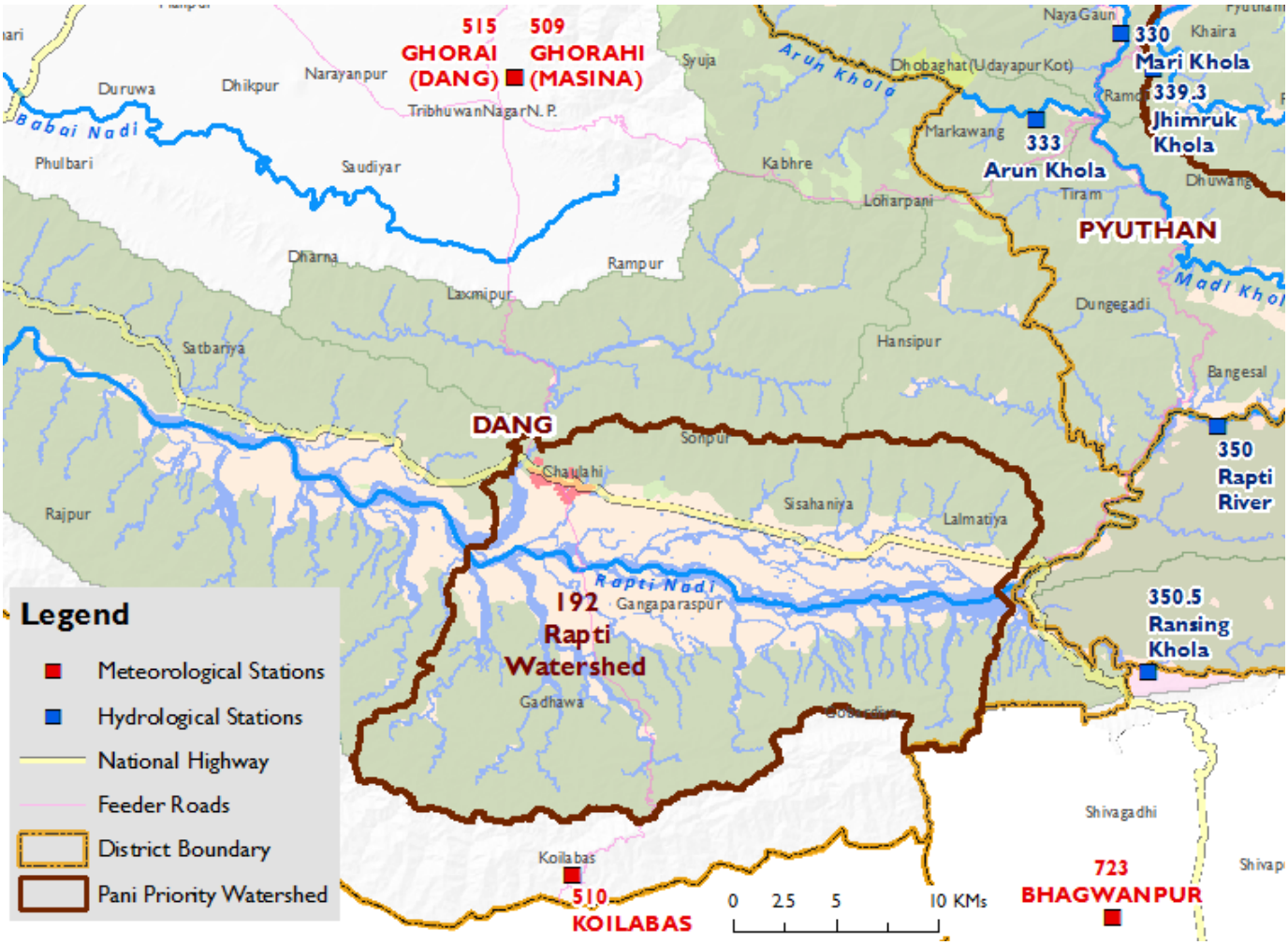


Figure 3: Locations of hydro-met stations near the Middle Rapti Watershed

River and lake water quality

Due to growing urbanization and improperly managed solid and other household waste, water pollution has been increasing in the watershed. Solid waste released from cluster settlements, such as Lamahi, Gadhawa and Patthargadhawa, has become the main source of pollution in the watershed. In Bhalubang, sewage from local hotels, and in Sisahaniya, waste from the marketplace, have become areas of concern. Other pollution sources include runoff agro-chemicals, draining sewage and plastics/rubbish. People reported that declining water quality may be contributing to a rise in allergies, livestock disease and declining populations of aquatic animals. If not addressed, this unmanaged waste threatens to complicate upstream and downstream relations between communities.

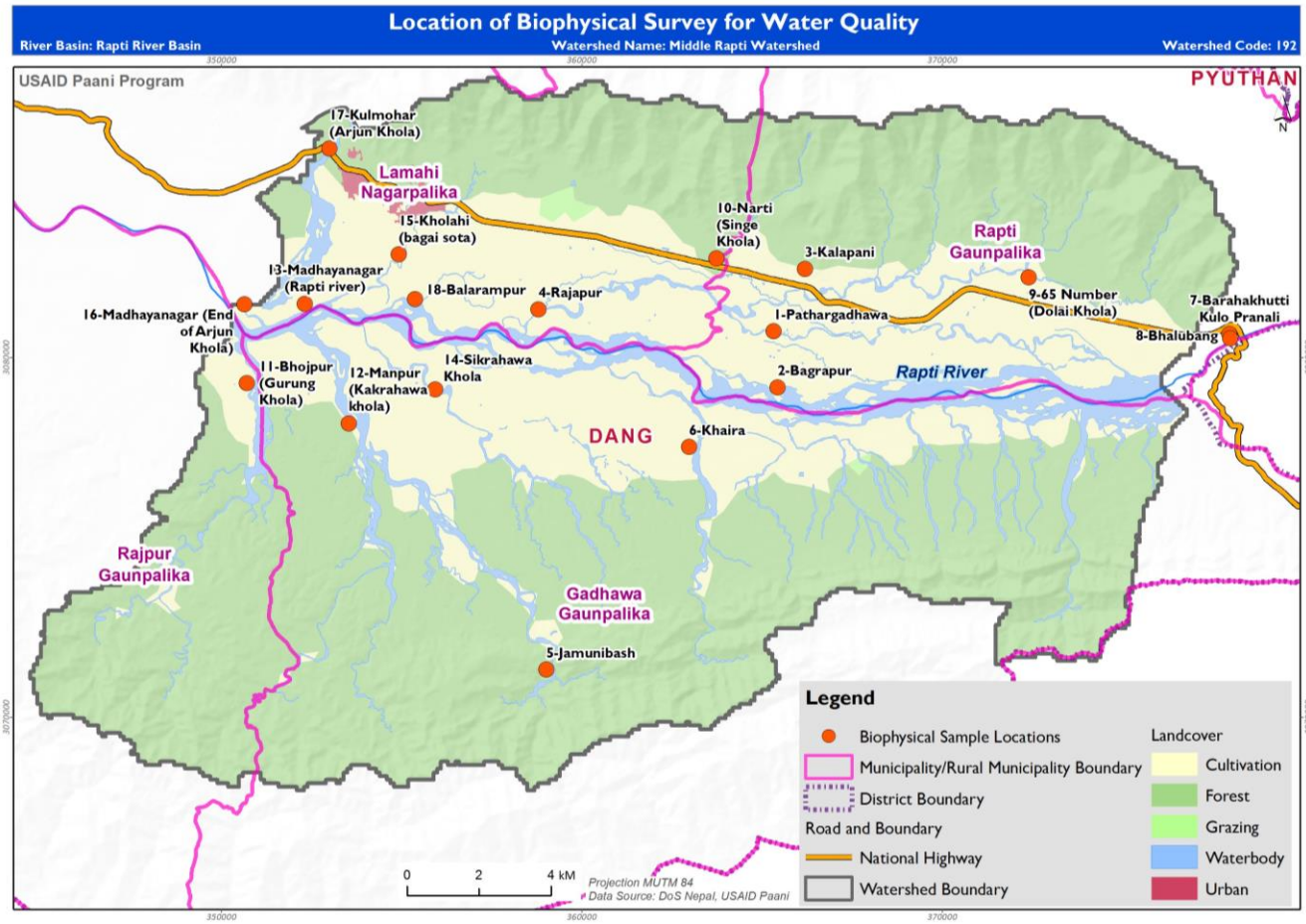


Figure 4: Water sampling sites in the Middle Rapti Watershed

Eighteen locations in the watershed were selected and measurements taken during dry and wet seasons from seasonal and perennial streams (Figure 4). Water samples were collected and tested for pH, iron, nitrite-nitrogen, ammonium, phosphate, and temperature. Generally, water quality in the Middle Rapti watershed falls within accepted ranges for drinking, agriculture, irrigation, and aquatic life. Levels of iron and ammonium were slightly elevated in some tributaries.

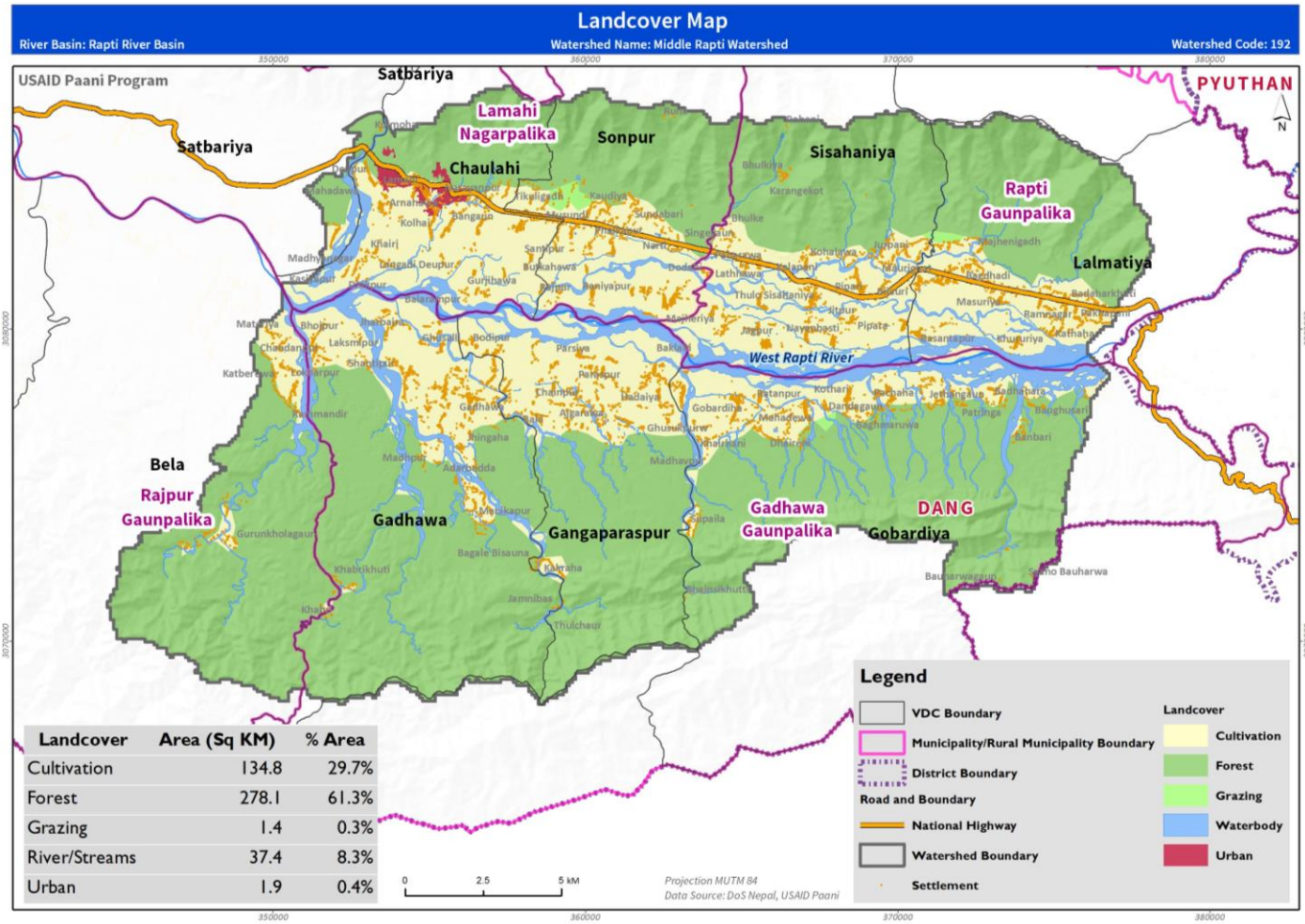
Looking at local perceptions of water quality, 14% reported the water quality as good, 50% as average, and 25% said water quality was poor.

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 and human uses, such as fishing or agriculture.

Land use and land cover

Nearly 61% of the Middle Rapti watershed is forest, 30% is cultivated for agriculture, and just over 8% is covered by rivers. Grazing land comprises less than 1% of land cover.



Landcover	Area (Sq KM)	% Area
Cultivation	134.8	29.7%
Forest	278.1	61.3%
Grazing	1.4	0.3%
River/Streams	37.4	8.3%
Urban	1.9	0.4%

Figure 5: Land cover map for the Middle Rapti Watershed

The forests of Middle Rapti are predominantly mixed hardwood (74%) followed by Sal forest (20%) and other (6%) (DFRS 2015). Data from Global Forest Watch indicates that 2% of the forest area (~560 hectares) was lost between 2000 and 2016, while in other parts of the watershed, 0.7% (~184 hectares) was gained. Figure 6 illustrates this dynamic.

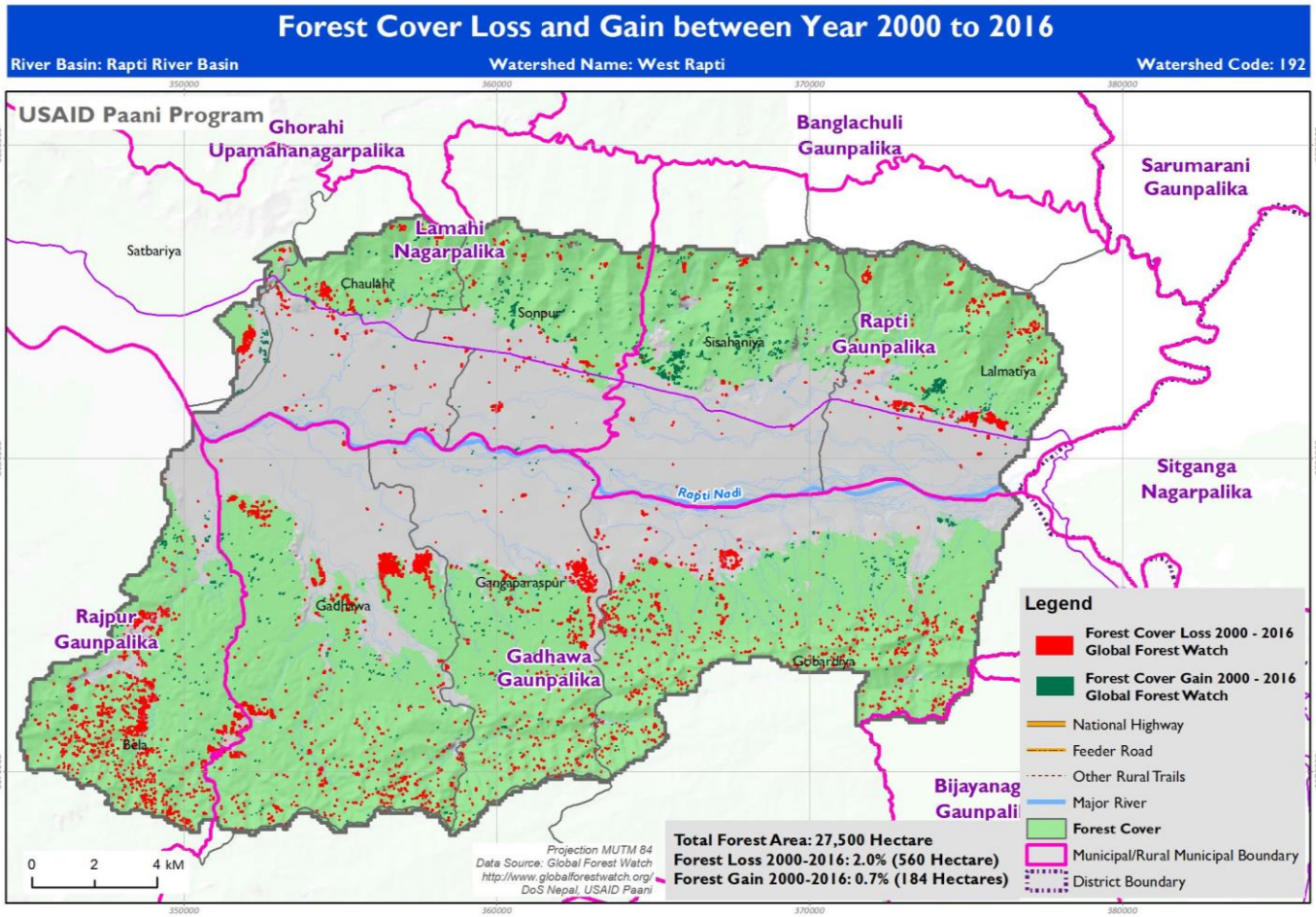


Figure 6: Forest cover loss and gain in the Middle Rapti Watershed, 2000-2016

Fish diversity

Respondents reported 39 species of fish in the Middle Rapti watershed, though that number may be slightly lower, as certain fish species may be named differently based on location or lingual group. In particular, the Rapti River and the Praganna, Dolai, Arjun and Gurung kholas were cited as having rich diversity of fish. Several rare species of fish were found in these areas, including the Chipi, Saura and Kathlaggi. Fifty-nine percent of respondents reported that native fish populations had declined.

59%

Respondents reporting that the native fish population has decreased

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 Middle Rapti watershed.

Agriculture is the primary source of livelihood (52.94%), and farmers earn most of their take home through staple crops. Wage employment (2.4%) and remittance (5%) are also significant sources of livelihood in the watershed followed by other sources (25%), which include off-farm activities, livestock service, poultry and dairy.

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 and/or timing 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 fish and 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 factors within the watershed. Sustainable infrastructure should enable equitable distribution of benefits with minimal long-term, environmental impacts.

Capture fishery practices

Traditional fishing communities practice capture fishing using traditional methods such as *helka* (hand nets), *tapi* (wicker hand traps), and *jaal (*drag nets*)*. However, more and more, commercial fishing ventures are becoming active in the watershed and employing more destructive methods such as poison, electric current and explosives. The use of electric current is especially problematic in the Rapti River. The increasing use of nets for fishing is also cause for concern. Despite these threats, 91% of respondents say they have not faced any problems in capture fishery.

Irrigation

Farming in the Middle Rapti watershed is supported by robust irrigation facilities, but flooding, river cutting and drying water sources threaten the effectiveness of this system, particularly in downstream communities. Nearly 11,000 hectares are covered by irrigation, distributed by 19 separate systems, covering approximately 7% of the cultivated land.

The Badka Path irrigation system was built 30 years ago to serve the areas of Jethangaun, Patringa, Kothari, Mahadewa, Dhaireni, Ratanpur, Gobardiha and Gangaparaspur (in Gadhawa municipality). Today, however, river cutting has badly damaged the Badka Path system and is no longer functional. Respondents within the Badhara and Bhanpur Majhmeriya irrigation systems say that water discharge is low and they need to enhance their canals for better water quantity. In the hill areas, no irrigation system currently operates.

Thirty-seven percent of households harvest rainwater, while 28% use surface water for irrigation, and 23% are covered by river canal irrigation. The remaining households obtain water from nearby ponds and lakes, and 7% of households are landless.

Some respondents said that tail end users in irrigation systems encountered trouble in obtaining enough water, due primarily to poor management and maintenance. Increased sedimentation and mud deposition in the canals are chronic issues that hamper system performance.

Gravel mining

In the Middle Rapti watershed, some settlements (e.g., Lamahai, Ghadawa, Bhalubang, Sisahaniya) are developing into small cities, requiring more construction material for roads, bridges and public buildings. As such, gravel mining has been increasing in the area and become a main source of revenue for local governments.

Local residents reported that aggregate mining for infrastructure development had been disturbing fish habitats in the Rapti River and its tributaries.

The District Coordination Committee (DCC) in Dang issues licenses for gravel mining in the watershed. Most operations use labor and household equipment, while a few employ trippers and tractors. Extraction work goes on nine months a year, halting in the summer for the monsoon. Estimated amounts of gravel extraction run between 700 and 800 m^3 per day, equally nearly 205,000 m^3 per year.

Regulations currently prohibit mining within 50 meters of critical public sites like culverts, irrigation canals and drinking water sources, and within 500 meters of bridges. In addition to the needed public revenue it generates, gravel mining has also provided numerous employment opportunities for local residents. However, the impacts of mining practices on local biodiversity and aquatic life are not yet fully understood.

Residents reported that aggregate mining for infrastructure development has been disturbing fish habitats in the Rapti River and its tributaries.

Roads

The Middle Rapti watershed road network consists of 26 km of national highway, 23 km of feeder roads, 28 km of district roads, and 85 km of rural roads, many of which connect certain areas (e.g., Chailahi, Sisahaniya, and Lalmatiya) to the East-West Highway that extends across the watershed parallel to the Rapti River.

Improperly designed and constructed roads (particularly in Gadhawa municipality) have worsened the intensity and frequency of some climate-induced hazards, such as landslides, soil erosion, deforestation, and loss of water sources. These hazards in turn negatively affect watershed habitats and aquatic life.

Climate resilience and disaster risk reduction

Increased human activity combined with climate change impacts are intensifying environmental degradation in many parts of the Middle Rapti watershed, and in some cases, intensifying the likelihood and effects of natural hazards such as floods and landslides (Figure 3). Average annual and monsoon

discharge data from 1976-2012 shows an increasing trend in rainfall. For this reason, a focus on building climate resilience and disaster risk reduction in the area is warranted.

Located south in the Tarai, flooding is the primary concern for watershed health in Middle Rapti. All areas in the watershed are at risk for flooding, followed by landslides and forest fires. Rupakot and Bhulke villages (in Lamahi and Rapti municipalities) are particularly vulnerable to landslides as the hill geology (Churiya) is particularly fragile.

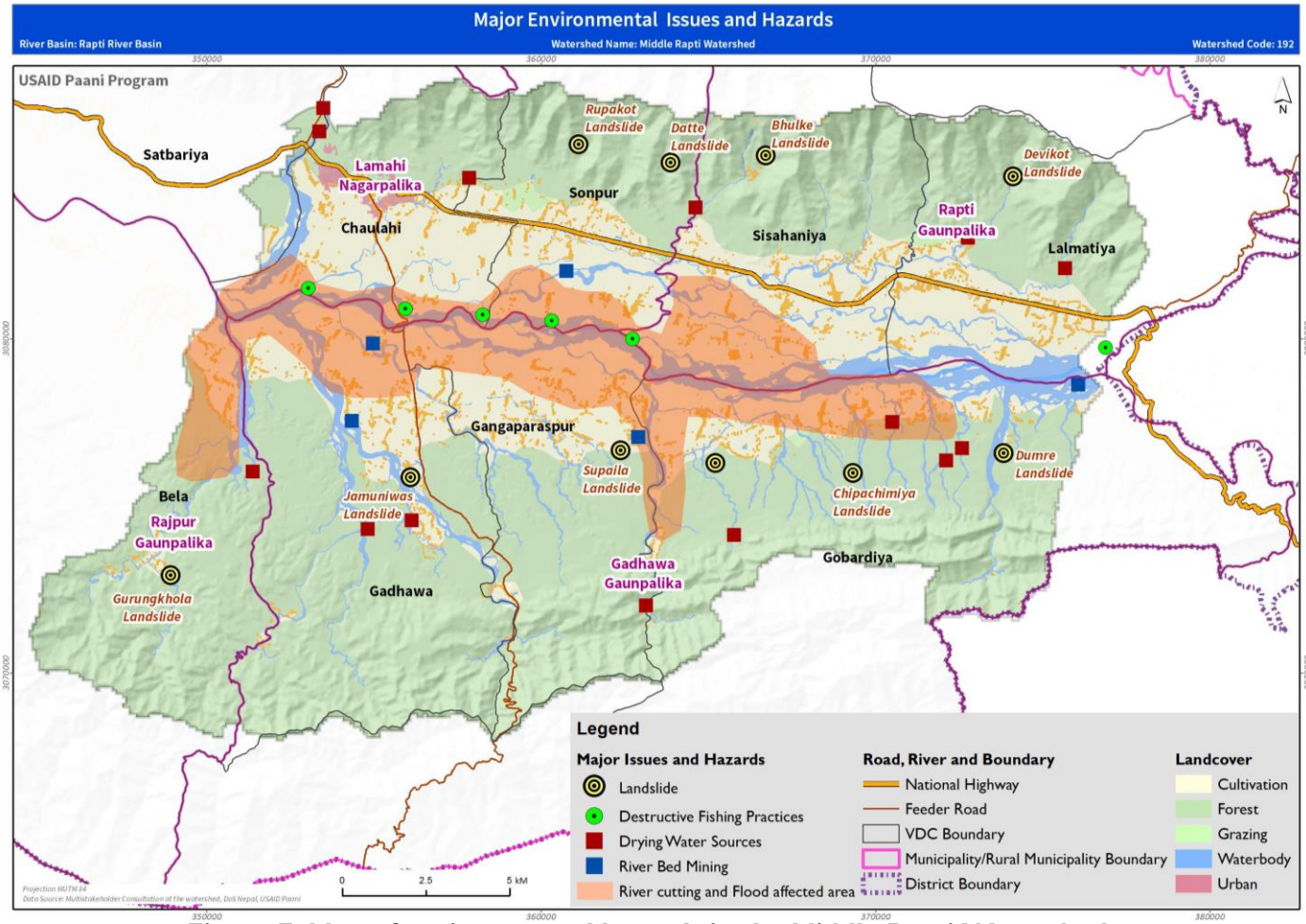


Figure 7: Map of environmental hazards in the Middle Rapti Watershed

Climate change impacts are influencing variability in temperature and rainfall in the watershed, and these two factors are of primary concern for their close relationship with agricultural productivity. In Middle Rapti, the mean temperature appears to be increasing 0.02ºC/year post-monsoon and 0.04ºC/year pre-monsoon. During winter months, the mean temperature is decreasing by 0.02ºC/ year. Rainfall, meanwhile, appears to be decreasing in the northern part of the watershed while increasing in the southern part at roughly 10 mm/year. If these trends continue unabated, it may become more difficult for farmers and fishers to generate reliable production to support their livelihoods and the economy.

Considering these changes, many households are adopting climate resilience practices to offset changes in climate. Figure 4 below shows a roster of adaptation practices taken up by local residents. These various

activities are intended to provide households with more livelihood options and durability against future hazards.

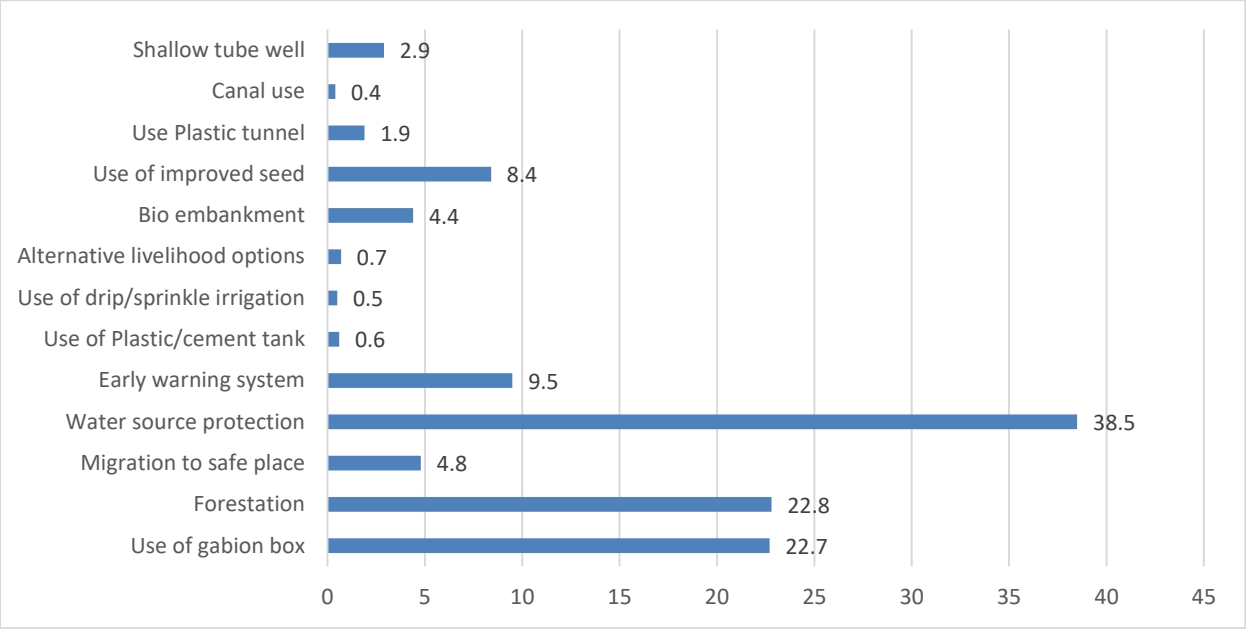


Figure 2: Climate resilience practices observed in the Middle Rapti Watershed (n = 1240 households)

Local bodies at the watershed level have developed Local Adaptation Plans of Action (LAPAs) and Community Adaptation Plans of Action (CAPAs), which seek to provide blueprints for anticipating, mitigating and responding to natural hazards and climate change impacts (Figure 9). Currently, there are seven LAPAs and 52 CAPAs in the watershed. LAPAs, in particular, advocate an integrated resource management approach that includes water, forests, energy, livelihoods, and infrastructure development.

Early warning systems

Early warning systems (EWS) in Middle Rapti operate through media such as SMS, radio, mobile phones and newspapers, but these systems are accessed by only 6% of the population. There are no siren systems currently operating in the area.

However, the need for improved EWS is well-established, and in the minds of residents, long overdue. Respondents across the watershed listed numerous flood events in the past decade that had exacted large tolls in human and property loss, such as the 2003 flood that altered the flow of the Rapti River and submerged four villages. Since then, smaller annual floods during monsoon have continued to abrade the hillsides, increasing soil erosion and sedimentation downstream.

Surveys found that 68% of residents have access to disaster risk related (DRR) information in Middle Rapti. Of the 32% who said they did not have access, 33% said they had not been aware of the service and had

never asked for such service, 20% said they had not been informed about DRR services and information, and 13% said DRR information had not been shared equally due to caste discrimination.

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. Eighty-nine community forest user groups (CFUGs) support watershed management and forest regeneration efforts in the area. Four other federations focusing on forestry, irrigation, sanitation, and drinking water also work to improve the effectiveness and sustainability of these sectors. The Praganna Irrigation System is one of the oldest farmer managed irrigation systems (FMIS) in the country.

The Mahajum system still exists in parts of the watershed, which manages irrigations systems through cash or contributions of labor (*jharali*) for the repair and maintenance of irrigation canals each year.

Other important local offices in the watershed include the District Agriculture Development Office (DADO), the District Soil Conservation Office (DSCO), and District Forest Office (DFO). Within the watershed, municipalities are responsible for preparing and implementing specific programs addressing forests, vegetation, biodiversity, and environmental conservation.

Among the population, 55% claim affiliation with a community group. Of those claiming affiliation, 31% belong to a CFUG, 10% to a farmer's group, 7% to drinking water organizations, 6% to an irrigation user group, and 4% to a water user group. Interestingly, even though 55% of respondents claimed participation in community groups, only 33% of respondents were formally registered with a local organization or institution.

Women's membership in formally registered institutions is 33%, as required by law. But in terms of leadership positions, women and persons from marginalized groups occupy only 13% of these key decision-making roles. Affiliation by caste finds that 76% of Janajatis and only 10% of Dalits claim membership.

Regarding government planning and community awareness, only 22% of respondents said they were aware of when and how these plans were developed. This statistic brings into question the potential for developing effective LAPAs and CAPAs if community input is low.

Looking at awareness by caste reveals a wide differential: of the 22% of respondents who claimed awareness of local planning, 76% were Janajati compared to only 12% Brahmin/Chhetri/Thakuri.

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 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.

Despite this legislation, 90% of respondents said they rarely comply with local laws and policies. For example, the Solid Waste Management Act mandates proper disposal of domestic and commercial waste, but throughout the watershed are high levels of unmanaged waste in urban areas around hotels, markets and cluster settlements. Similarly, the Aquatic Animals Protection Act forbids destructive fishing practices such as poison and electric current. Both practices have become more commonly practiced in Middle Rapti.

The Pragranna Irrigation System (mentioned above) is expected to distribute the benefits from its services, but focus group discussions found that no formal structure exists for this system.

Several governance opportunities may be capitalized upon in the next few years, as the recently-elected parliament means fresh local representation for watershed concerns. A move toward a federalist structure could mean greater responsibility at local levels, which could improve meeting pressing environmental challenges in the watershed, both upstream and downstream.

Watershed health assessment – Summary

The list of health indicators presented in this section takes into account biophysical health, infrastructure, socio-economic and governance factors within the watershed. Each of these indicators was assessed through consultation with stakeholders in the Middle Rapti 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 Middle Rapti watershed as ***fair*** (Table 1)**.** Well-developed adaptation plans in all the wards, improved soil fertility in the northern part of the watershed, and active engagement of natural resource community groups are among the most positive factors impacting watershed health. Unmanaged solid waste and poor coordination between levels of government are causes for concern. Rapidly developing infrastructure – roads and irrigation – require more attention in the coming years.

Table 1: Summary of health indicators for the Middle Rapti Watershed

Thematic area	Watershed health indicator	Rating	Rationale
WATER 	Water availability		- 9% of households spend 30 minutes or more per day collecting water to meet daily needs. - 71% percent of families reported difficulty obtaining enough water due to drying water sources (springs) in the region.
	Water accessibility		- 5% of respondents say they do not have equal access to water - 3.5% require more than an hour daily to obtain sufficient water
	Water quality		- Only 16% of respondents rated drinking water quality as "good" - Use of chemical fertilizers and pesticides
BIODIVERSITY & HABITAT 	Household sanitation		- Unmanaged livestock waste - Some open defecation persists
	Solid waste disposal		- High levels of unmanaged waste disposal in cluster settlements, hotels and markets in urban areas - District has not been declared an open defecation-free zone
	Fish quantity		- 59% said native fish populations have declined
	Fishing practices		- Destructive fishing practices in use

	Invasive species		- Invasive fish species (Mangur) feed on small fish
	Species diversity		- Fish diversity decreasing - Overfishing occurring
	Land use and land cover		- Good vegetative cover (61% forest) - Well-managed forest resources - Increased river cutting
SUSTAINABLE INFRASTRUCTURE 	Sustainability of hydropower	**NA**	- No hydropower schemes in this watershed
	Sustainability of gravel mining		- Increased gravel mining is a concern as more licenses issued - Poor monitoring of existing mining operations
	Sustainability of rural roads		- Not all roads constructed with proper planning and initial environmental evaluation - Some water sources filled up with gravel and soil from road building
	Sustainability of irrigation		- Poor maintenance and management of systems threaten long-term use due to sedimentation and disrepair
CLIMATE RESILIENCE AND DISASTER RISK REDUCTION 	Areas vulnerable to landslides, floods and landslides		- Annual flooding occurs during monsoon
	Use of climate resilience adaptation practices		- Local adaptation plans developed and under implementation
	Households with access to early warning systems		- Only 6% of households have access to early warning systems
GOVERNANCE AND EQUALITY	Household members engagement/participation in local planning processes		- Only 22% of respondents are aware of local level planning processes

	Community members are active in NRM groups (Biodiversity, disaster, climate change, water, agriculture, forest, irrigation, farmers)		- 55% of respondents reported affiliation with a local organization - Local groups lack budgetary and technical knowledge, and lack access to information
	Women, marginalized castes and ethnic groups hold key positions in NRM groups		- 33% of membership of local organizations are women as required by law - Women and marginalized groups hold only 13% of leadership positions in local organizations
	People comply with laws and policy provisions and local norms and standards		- 90% of respondents say they rarely comply with local laws and policy
	Government enforces laws and regulations		- Low enforcement of policies such as the Solid Waste Management Act and the Aquatic Animals Protection Act
	Conflicts over NRM (Water/benefit sharing, watershed issues, sand mining, irrigation, hydropower) issues are resolved		- Low implementation of policy and rules in this regard
	Good coordination between the, municipalities/rural municipalities, and provinces including government line agencies in the watershed		- Low coordination between level of government agencies both at the policy and program levels
	Equitable access and benefit sharing arising from use of natural resources (ecosystems services and products)		- No formal benefit sharing in place but traditional distribution system in place

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