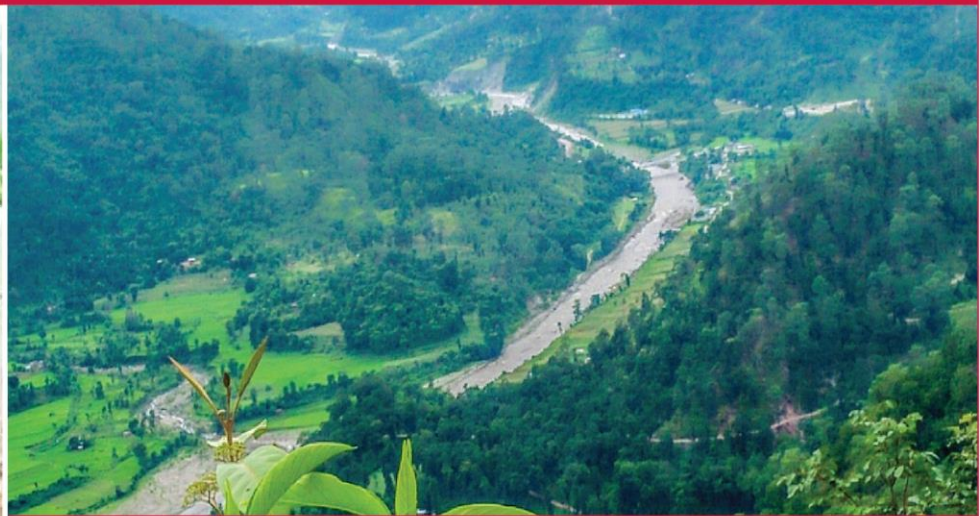


# THULIGAAD WATERSHED HEALTH REPORT



Community Vision - "Improved water sources and biodiversity conservation with inclusive and equitable watershed"

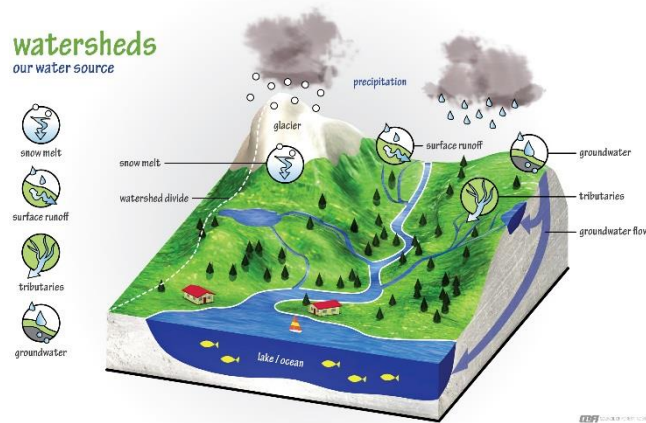


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## What is a watershed?

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**

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 Thuligaad 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.

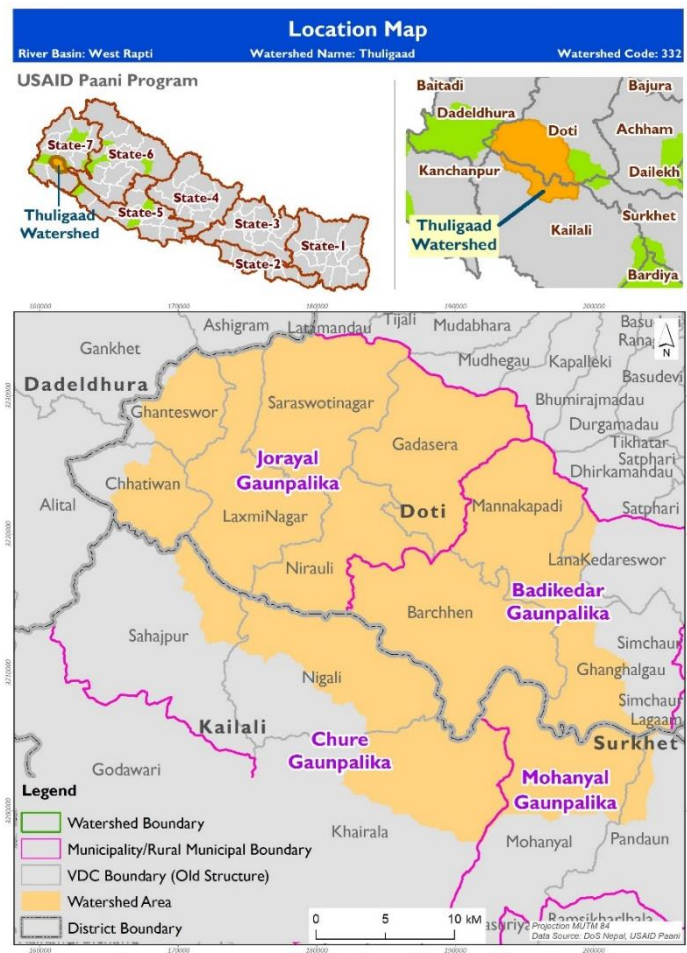
The health indicators in this report are grouped under larger categories of 1) nature, 2) wealth, and 3) power, each of which explores related aspects of the watershed from that particular viewpoint. A full profile of the Thuligaad watershed has also been prepared.

<b>River basin</b>	Thuligaad
<b>Province</b>	Number 7
<b>Total drainage area</b>	879 km <sup>2</sup>
<b>Number of streams</b>	17
<b>Major rivers</b>	Karnaso, Kapadi, Kamaladi
<b>Lakes and wetlands</b>	Brahm Lake, Jwalaban Lake, Rakxes Lake and Chhatiwani Lake
<b>Land use</b>	Forest, 85.6%; Agricultural and pasture, 14.7; Shrub-forest mix, 0.7%
<b>Rural municipalities</b>	Joroyal and Baddi Kedar (in Doti) and Chure and Mohanyal (in Kailali)
<b>Population</b>	42,277 (50% male; 50% female)

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

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

The total drainage density in the Thuligaad watershed is 935 m/km<sup>3</sup> and the total area of the watershed is 879 km<sup>2</sup>. Conservation issues in the watershed include a wide range of concerns, including over-grazing, over-fishing, landslides due to unmanaged road construction, forest degradation due to forest fire, and unsustainable resin collection.



**Figure 2: Map of the Thuligaad watershed**



**Figure 3: View of the Thuligaad watershed**

The Thuligaad watershed is sub-tropical, rich in forest crops and agriculture biodiversity. At the higher elevations, Chir pine (*Pinus roxburgii*) predominate with other broad leaf trees. In lower areas, Sal forest (*Shorea robusta*) are common. Rice, maize, wheat and millet are the main cereal crops.

Major groups in the area include Brahmin, Chhetri, Dalit, and a wide range of Janajatis, including Magar, Badi, Majhi, Lama, Bhote, Gurung and Newar (CBS, 2015).

## 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. These include rainfall, glacier melt, infiltration, and withdrawals for irrigation among other factors.

### Rainfall

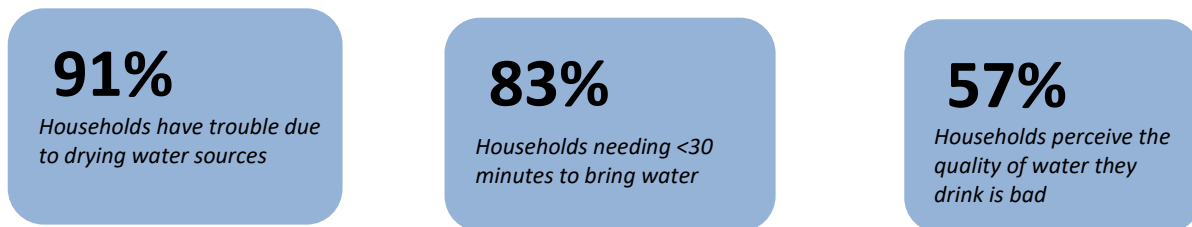
In the mountainous regions of Nepal, topographic variation has a profound effect on the spatial distribution of rainfall. Rainfall data were assembled by combining long-term records available in Kolagaon combined with data from six hydro-met stations located in areas that border the watershed (Dadeldhura, Dipayal, Banga Camp, Sandepani and Godavari) and that exhibited similar rainfall patterns to those measured in Kolagaon. Using this approach, the average dry season rainfall (November to April) is 314mm compared to the monsoon season rainfall (June to September) of 1,558 mm. The average annual rainfall for the watershed is 1,873 mm.

### Water availability and accessibility

The Thuligaad watershed and its tributaries are the main source of water for domestic and agricultural uses, although local springs play an important role as well. Though the exact reasons are unknown, community surveys carried out by NFIWUAN reveal that some of spring sources are drying out. Some areas reported water scarcity, including Mannakapadi, Ghagal, Kahirala, Mohanyal; Nirauli and Nigali.

Analysis of survey data shows that only 15% of households have sufficient water year-round for irrigation, and 91% of households reported difficulty in obtaining 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. 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. Based on survey data analysis, 83% of households have access to water within 30 minutes of home, with 9% Brahmin Chhetri reporting that it took them more than 30 minutes to obtain water compared to 6% Dalit. The most prominent barriers to access to water resources were reported as water shortage and long distance travel, by 59% and 33% of respondents respectively.



### River and lake water quality

Biophysical data collected from streams and tributaries in the Thuligaad watershed provide important information about the sources of pollution and the basis for improving the water quality and watershed health. Tests showed water quality as having normal levels of pH, ammonium, phosphate, and nitrate nitrogen. Poor infrastructure and low concentration on solid waste management, however, threaten this water quality in the long-term.

### 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 cover and land use

Eighty-five percent of land in the Thuligaad watershed is forest, followed by agriculture and pasture, (14%) and shrubs and bushes (0.7%). The remaining areas consist of grazing land covered by grass, shrubs and bushes. Rivers, streams and lakes cover very little area in the watershed. In terms of population, density is low and highly rural.

The Thuligaad watershed contains diverse habitats for both aquatic and terrestrial species due to its variety of forests, rangelands, and wetlands from the lower mid hills to higher elevations. The forests are dominated by Chir pine (*Pinus roxburgii*) and mixed broad-leaf trees including Sal (*Shorea robusta*) at lower altitudes and *Quercus* forest at higher elevations.

Four freshwater lakes provide important habitat for fish and migratory birds; however, more precise information on biodiversity is lacking. Surveys revealed that 17 wild animal species of national and global importance live in the watershed, as well as nine reptile species, 20 types of birds, 27 species of fish, and 16 species of aquatic vegetation.

### Fish diversity

Over-fishing and poisoning have significantly reduced the food supply of fish-eating birds. As a result, nearly all these bird species have declined in numbers from Nepal's wetlands and many of them are now included on the national threatened species list. Some other wetland species have also shown precipitous declines over recent years.

In terms of fisheries, there is a strong relationship between fish stocks and fish-dependent livelihoods. In the lakes, rivers, and streams of the watershed, 27 species of fish and 16 species of aquatic vegetation were reported. Of those species, *Sahar*, *Zebra machha*, *Buche asala*, *Asala soal*, *Chuche asala*, and *Rajabam* are commercially valuable native fish species. Surveys reveal that 69% of households perceive that native fish species are declining.

### Wealth

Indicators in this category refer to the current economic conditions within the watershed and future prospects. In this section, we focus on the most prominent forms of industry and livelihood in the Thuligaad area.

#### Infrastructure and extractives

The design and construction of infrastructure, such as roads and hydropower plants, has 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 within the watershed. Sustainable infrastructure should provide equitable distribution of benefits with minimal long-term, environmental impacts.

#### Large Hydropower

There is no large hydropower in the Thuligaad watershed; however seven microhydro plants are operational (Salmuni Devi, Masta, Chankatte I, Chankatte II, Gadserigaad, and Thulikhali), and one more is planned (Cheda Gaad) for meeting rural energy needs.

#### Capture Fishery Practices

Fishing in the watershed is characterized by traditional and non-traditional practices. Commonly-used traditional methods include net casting, gill nets, fishing hooks, draining water, and trapping fish in rice paddies. In recent years, however, harmful non-traditional methods (e.g., poison, explosives, and electric current) are becoming more popular and causing fish populations to decline.

#### Agriculture

Agricultural land in Thuligaad is irrigated and rain-fed. Thirty-seven percent of the land has access to irrigation, while the remainder relies on rain for cultivation. Of those with access to irrigation, only 15% have year-round irrigation while 85% irrigate for only part of the dry season.

Thuligaad is renowned for its fruits, vegetables, and cereal crops due to a favorable monsoon climate and fertile soils. However, this productivity is threatened by changing climate patterns, limited irrigation facilities, and the rising cost of seeds, tools and other relevant technologies. In NFIWUAN's community surveys 85% of respondents reported that agriculture has declined in recent years due to climate change, and 93% reported that soil fertility has decreased over the past decade.

Agricultural land in Thuligaad supports a multiple-cropping regime. Farmers rely on community-managed seed banks and cold storage for selling seeds of higher quality. Livestock are also an important source of income, particularly pigs, sheep, buffalo and cattle, among others. A dairy in Budar collects milk and generates numerous milk-based products (e.g., yogurt, ghee) for the market.

Beyond agriculture, wage labor, seasonal labor migration, and gravel mining work are other important sources of livelihoods for local households.

### Gravel mining

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

Mining operations extract boulders, gravel, and sand for road development, local construction, and sale in the market.

### Roads

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

### Irrigation

Streams and rivulets are the main sources of water used for drinking, irrigation, sanitation, energy and domestic purposes. Surveys reveal that water sources are drying out, and some areas (Mannakapadi, Ghagal, Kahirala, Mohanyal, Nirauli and Nigali) are facing acute water stress. Across households, accessing drinking water is most common through piped systems (70%) followed surface water harvesting (22%), waterfalls (4%), dug wells (2%), and tube well boring (1%). Rainwater harvesting was reported as the most prominent source for irrigation (51%), followed by river canal irrigation (42%). As noted above, only 15% of households surveyed have year-round irrigation.

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

### Climate resilience and disaster risk reduction

Increased human activity combined with climate change impacts is intensifying environmental degradation in many parts of the Thuligaad watershed, an area that, according to residents, has a long historical record of natural disasters such as floods, forest fires, and landslides. For this reason, a focus on building climate resilience and disaster risk reduction in the area are warranted.

At present, only 20% of households report that they are undertaking climate resilience activities, a low figure compared to the level of climate-related incidence among the population. Rising water temperatures increase the likelihood of water-borne disease, and 63% of households reported at least one member falling sick in the past three months. According to the Nepal Health Research Council, 30 people died in the Doti portion of the watershed in 2016. Over the past two years, floods and other disasters have been recorded in Sarsotinagar, Laxminagar, Nirauli, Nigali, Mannakapadi, Khairala and Barchhen.

### Early warning systems

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

Despite these efforts, most residents expressed concern that deadly disasters were likely in the future. Surveys reveal that only 6% households say they have an early warning system in their community and of this group, 87% of households said they had access to it.

### 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

In the watershed, there are a diverse range of community-based organizations, federations and line agencies that are responsible for various aspects of watershed management, such as the District Drinking Water Supply (DDWS), Division of Irrigation Office (DIO), and District Coordination Committee (DCC). The DCC, District Forest Office (DFO), District Agricultural Development Office (DADO), and District Soil Conservation Office (DSCO) are the principal institutions related to aquatic biodiversity management in watershed.

Rural municipalities in Thuligaad are empowered to prepare and implement programs for conservation of the environment and natural resources in the watershed. These local bodies have considerable power to manage public resources to generate revenue. The DCCs in Doti and Kailali are responsible for undertaking different responsibilities for agriculture, drinking water, hydropower, infrastructure, social welfare, and the environment.

The DFO is responsible for conservation of natural resources in the watershed and for supporting local communities and community forest user groups (CFUG). More than 100 CFUGs in the watershed are in the process of developing and implementing community forest operation plans.



Overall, CFUGs have been largely successful. Community forestry has contributed to restoring forest resources, increasing water resource conservation, enhancing water quality in the region. It is revealed from FGD and household Survey by Paani 2017 that the advantage of community forestry includes employment and income generation. Besides this, the CFUGs are potential for ecosystem services and supported community resilience by increasing water infiltration, decrease in landslides, and increased water availability for longer duration in water sources.

Seventeen percent of respondents reported being aware of local level planning processes. Thirty-two percent of respondents are affiliated with various community groups. Disaggregation of affiliation based on caste and ethnicity shows that 44% Brahmin/Chhetri, 27% Dalit and 17% of Adibasi Janajati are affiliated with formal groups. Despite their levels of membership, only 7% of women and marginalized community members are serving in leadership roles. Residents reported that participation of women and minority groups has increased in the last two decades. While cultural biases and discrimination persist, women comprise 33% of representative community bodies. Dalit groups reported that in some instances they are still barred access to water resources for drinking water and conducting social rituals.

### 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.

### Watershed health assessment - Summary

The list health indicators presented in this section takes into account factors related to biophysical health, infrastructure, socio-economics and governance within the watershed. Each of these indicators was assessed through consultation with stakeholders in the Jhimruk 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
<b>[4-5 points]</b> 	Good health condition, no additional treatment required	Intervention required to keep condition intact
<b>[2-4 points]</b> 	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.












<p><b>[&lt;2 points]</b></p> 	<p>Poor condition, impaired functioning, decreased quality and quantity of ecosystem services in the watershed</p>	<p>Special measures must be adopted to restore watershed health conditions and ecosystem services</p>
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Based on the designated indicators for assessment, we rate the health status of the Thuligaad watershed as **good** (Table I). Our assessment indicates the water quality is good for drinking, irrigation, domestic use, and energy generation. Other positive indicators include moderate agricultural production and high utilization of indigenous seed, tools and technologies with limited available irrigation and soil management practices.



**Table I: Summary of health indicators for the Thuligaad watershed**

Theme	Watershed health indicators	Watershed indicator rating	Rationale for rating
<p><b>WATER</b></p> 	<p>Water availability</p>		<ul style="list-style-type: none"> <li>- Drying of water sources, excessive use, contaminated water, and deforestation affecting water availability</li> <li>- 83% of households have water sources within 30 minutes</li> </ul>
	<p>Water accessibility for community, agriculture</p>		<ul style="list-style-type: none"> <li>- Number of water sources are drying up and provide limited water in summer. 91% of respondents reported difficulty in water collection due to drying water sources</li> <li>- 15% of households do not have equal access to community water sources.</li> </ul>
	<p>Water quality for drinking, irrigation and energy generation</p>		<ul style="list-style-type: none"> <li>- Water samples tested in the normal range across a range of indicators</li> <li>- 57% of the households reported that the quality of the water they drink is bad. 14% of households are treating water through boiling, filtration, decantation, and Sodis method.</li> <li>- 63% of households reported illness in past 3 months</li> <li>- Non-point source pollution is a challenge</li> </ul>
<p><b>BIODIVERSITY &amp; HABITAT</b></p>	<p>Household sanitation</p>		<ul style="list-style-type: none"> <li>- Improper management of non-point source pollution, including household waste</li> </ul>

			<ul style="list-style-type: none"> <li>- 70% of HHs reuse waste water in kitchen gardens, while 30% dispose of waste water in river bodies, 20% in sewage system, and 3% use a septic tank.</li> <li>- 87% of households have a toilet</li> </ul>
	Solid waste disposal		<ul style="list-style-type: none"> <li>- Non-point source pollution and household waste disposal is worsening</li> <li>- 38% of households burn their HH waste, 28% convert it into compost, 11% use landfill sites while 15% throw waste directly into the river.</li> </ul>
	Land use and land cover		<ul style="list-style-type: none"> <li>- Forest (85%), non-forest area (14.9%), other wooded land (0.7%).</li> <li>- Forest and agricultural land have moderate quality and productivity</li> <li>- Forest cover is changing due to gravel mining and forest fires</li> </ul>
	Species diversity [Fresh water]		<ul style="list-style-type: none"> <li>- Watershed supports 17 wild animal species, 9 species of reptiles, 20 species of birds, 27 species of fishes, 16 species of aquatic vegetation.</li> <li>- Watershed supports several commercially valuable and endemic fish species like Sahar, Zebra machha, Buche asla, Asala soal, Chuche Asala, Raja bam</li> <li>- 31% of the respondents report the introduction of new species over the last decade</li> <li>-</li> </ul>
	Invasive species [Aquatic]		<ul style="list-style-type: none"> <li>- No serious observation of invasive aquatic species</li> </ul>
	Quantity of fish [Local]		<ul style="list-style-type: none"> <li>- Quantity of fish has been decreasing due to unsustainable harvesting</li> <li>- During household survey, 69% respondent answered that the native fish species have been decreasing</li> </ul>
	Fishing practices		<ul style="list-style-type: none"> <li>- Harmful fishing practices, such as poison and electric current, are contributing to fish population decline</li> </ul>

			<ul style="list-style-type: none"> <li>- The productivity of migratory fish species has been negatively affected due to rural road construction</li> </ul>
<b>SUSTAINABLE AGRICULTURE</b> 	Climate and physiography		<ul style="list-style-type: none"> <li>- People perceive that climate change is affecting the watershed and livelihoods</li> <li>- 19.6% of households are undertaking climate resilience activities</li> </ul>
	Soil management [conservation, fertility]		<ul style="list-style-type: none"> <li>- Limited soil management practices in use</li> </ul>
	Agriculture productivity [Data]		<ul style="list-style-type: none"> <li>- Outmigration, climate change, and rain-dependent systems are responsible for decreasing production</li> <li>- Production and productive capacity are moderate</li> </ul>
<b>SUSTAINABLE INFRASTRUCTURE &amp; MINING</b> [e-friendly framework] 	Sustainability of hydropower		<ul style="list-style-type: none"> <li>- No large hydropower in the watershed.</li> <li>- Seven microhydro plants to meet rural energy needs</li> <li>- Optimal microhydro production impeded by sedimentation and landslides</li> </ul>
	Sustainability of gravel mining and construction materials		<ul style="list-style-type: none"> <li>- Only four mining sites in the watershed</li> <li>- Limited monitoring of mining operations and no proper investigation of excavation and landslides/river cutting</li> </ul>
	Sustainability of rural roads		<ul style="list-style-type: none"> <li>- Construction of rural roads is rapid with little oversight and regulation</li> <li>- Watershed has no master plan for road construction</li> </ul>
<b>CLIMATE RESILIENCE AND DISASTER RISK REDUCTION</b> 	Sustainability of irrigation		<ul style="list-style-type: none"> <li>- Limited irrigation facilities available and water sources are drying up</li> <li>- Irrigation user groups and related federation function poorly</li> </ul>
	Climate induced threats – intensity & severity [landslides, floods and landslides]		<ul style="list-style-type: none"> <li>- Rapid rural road construction, increased mining operations, and river cutting are major threats</li> <li>- Landslides in Chure are increasing</li> </ul>

	Community response, measures to adapt to CC impacts		<ul style="list-style-type: none"> <li>- 20% of respondents say they are undertaking climate resilience activities</li> </ul>
	Community access to early warning systems		<ul style="list-style-type: none"> <li>- Only 6% of respondents said they have an early warning system (EWS) in their community. Among these respondents, 87% of households report having access to EWS.</li> </ul>
<p><b>GOVERNANCE AND EQUALITY</b></p> 	Inclusive participation in local planning; Women, marginalized castes and ethnic groups hold key positions in NRM groups		<ul style="list-style-type: none"> <li>- People's participation has increased but active participation is not assured</li> <li>- Poor, marginalized and rural people have limited access and influence in decision-making processes</li> <li>- Only 32% households reported that they are affiliated with local groups, with 44% of Brahmin/Chhetri, 27% of Dalit and 17% of Janajati affiliated in groups.</li> <li>- However, participation of women and marginalized groups in leadership positions is limited to 7%.</li> <li>-</li> </ul>
	Persistence of active NRM groups [Biodiversity, disaster, climate change, water, agriculture, forest, irrigation, farmers]		<ul style="list-style-type: none"> <li>- Forest user groups engaged in various conservation activities</li> <li>- CFUGs have health participation from local communities</li> <li>- Some community members express confusion about their roles in carrying out various responsibilities</li> </ul>
	People comply with laws and policy provisions, including local norms and standards		<ul style="list-style-type: none"> <li>- Moderate compliance with laws and policy provisions, including local norms and standards</li> <li>- Good awareness of laws and regulations</li> </ul>
	Equitable access and benefit sharing arising from use of Natural resources (ecosystems services and products)		<ul style="list-style-type: none"> <li>- Communities have success in resolving benefit sharing issues locally</li> <li>- Poor, marginalized and rural people have limited access and influence in decision-making processes</li> </ul>

	<p>Coordination between the, [rural] / municipalities, provinces and line agencies</p>		<ul style="list-style-type: none"> <li>- Only moderate coordination among agencies in federal structure</li> <li>- Limited awareness among community members regarding agency roles and responsibilities</li> </ul>
	<p>Adoption of climate-smart, environment and watershed management friendly practices [across all thematic areas]</p>		<ul style="list-style-type: none"> <li>- Community people adopting local adaptation measures based on experience</li> <li>- Concerns expressed about conservation of lakes and ponds, and maintenance of irrigation channels, bio-engineering structures, and ravine plantations</li> </ul>

## 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>).