

4. BASELINE CONDITIONS

4.1 INTRODUCTION

The PMP EIA (WRC, 2011a; WRC, 2011c) contains a comprehensive record of the baseline environmental conditions of the project area. In the present study, these baseline conditions related to PHD were verified, updated and further elaborated, with particular focus on data and information needed for preparation of the DEMP. The results of these activities are presented in the ensuing sections.

4.2 PHYSICAL ENVIRONMENT

4.2.1 *Physiographic Regions and Topography*

The project area spans across three out of the five physiographic regions of Nepal, viz. the Middle Mountain Region (<2,200 m), the High Mountain Region (2,200 – 4,000 m) and the High Himalayan Region (>4,000 m). About half of the project area lies within the Middle Mountain Region, while the remaining half is almost equally spread across the other two.

The topography of the project area is typical of those observed in the river valleys of Nepal. Irregular slopes rise successively from the banks of the Mahakali River and its tributaries to the rims of the river valleys. Terraces of cultivated fields dot the lower slopes of mountains and hills. At higher elevations, however, the slopes are comparatively barren with few trees and shrubs.

The topography around the PHD site is gentle to steep, while moderate to steep slopes characterize its reservoir area. In general, the topography along the riverbeds in this area is nearly flat to gentle, but the outer reservoir rim is steep. Two to three levels of river terraces are present along the Mahakali and Chameliya Rivers.

4.2.2 *Watershed Conditions*

The Mahakali watershed at the PHD site spreads over 12,100 sq. km in India and Nepal, with the watershed within Nepal accounting for 3,108 sq. km. The Nepali watershed, surrounded by the Karnali Basin on the east and north, comprises seven sub-watersheds, one each formed by the major Nepali tributaries of the Mahakali River, viz. Rithi Gad, Lasku Gad, Thali Gad, Bhartola Gad, Chameliya River, Lali Gad and Garma Gad.

A study conducted three decades ago (Shrestha, van Ginnekan, & Sthapit, 1983) ranked the general watershed conditions in the project districts, i.e. Darchula and Baitadi, as “fairly good”. This ranking, which categorized the average condition of district watersheds as very

poor, poor, marginal, fairly good and good, considered factors such as slope stability, soil type, hydrological conditions and vegetation cover. This study recognized that districts with good or fairly good average watershed conditions could have land units with poor or very poor watershed conditions.

Since the 1983 study, watershed conditions in the project districts have deteriorated due to human and natural processes. Although the project districts have good forest and vegetation cover in the watershed area (74,000 ha in Darchula and 20,000 ha in Baitadi), increasing forest degradation in mid-mountain areas near settlements, upland cultivation on slopes and uncontrolled grazing have accelerated soil erosion. Soil erosion rates are particularly high in degraded forests, heavily grazed grasslands and forests, gullied lands and terraced farming areas. Most of the sub-watersheds are in poor condition and contain highly eroded areas.

Gully erosion is common along the PHD reservoir rim, although its extent varies with local geological formations. It is very nominal between Jolibi and Uku village, but some erodible slopes exist near the latter. Although some erosion is present along the upper reaches of the Laligad Khola, the reservoir rim between Uku to Laligad villages is stable. Riverbank erosion along the Mahakali River is present in the thick alluvial deposits between Laligad to Kutia Sera (Jhulaghat). Gully erosion is very common along the tributaries of the Chameliya River between Panju Naya and Gokuleshwar. It is also developed in some areas between Belhar-Binayak and Pancheshwar, especially downstream of Aptiyad village, and in the tributaries around the proposed sites for permanent camps and other facilities.

Several small, medium and large-scale land instabilities exist along the reservoir rim. These are discussed in Section 4.2.7.

4.2.3 Land Use and Land Cover

4.2.3.1 Project Area

The major land uses and land covers in the project area are forestry, agriculture, bush lands, grasslands, flood plains and water bodies (Table 4-1, Figure 4-1). Of the total project area of 55,397.5 ha in Baitadi and Darchula districts, 18,758.6 ha (33.9%) is under forest cover, 17,993.5 ha (32.5%) under cultivation, 13,099.1 ha (23.6%) under bush lands and 4,211 ha (7.6%) under grasslands.

Table 4-1: Land use/cover in project area

Land use/cover	Area (ha)		
	Baitadi	Darchula	Total
Natural vegetation			
Forest	9,850.8	8,907.8	18,758.6
Grass	1,768.6	2,442.4	4,211.0
Bush	9,696.3	3,402.75	13,099.1
<i>Sub-total</i>	<i>21,315.7</i>	<i>14,753.0</i>	<i>36,068.7</i>
Cultivation	<i>11,105.8</i>	<i>6,977.7</i>	<i>17,993.5</i>
Others			
Flood plains	352.6	316.6	669.2
Cliffs	108.5	22.0	130.5
Barren lands	0	6.8	6.8
Water bodies	297.8	231.5	529.3
<i>Sub-total</i>	<i>758.9</i>	<i>576.9</i>	<i>1,335.8</i>
Total	33,090.4	22,307.1	55,397.5

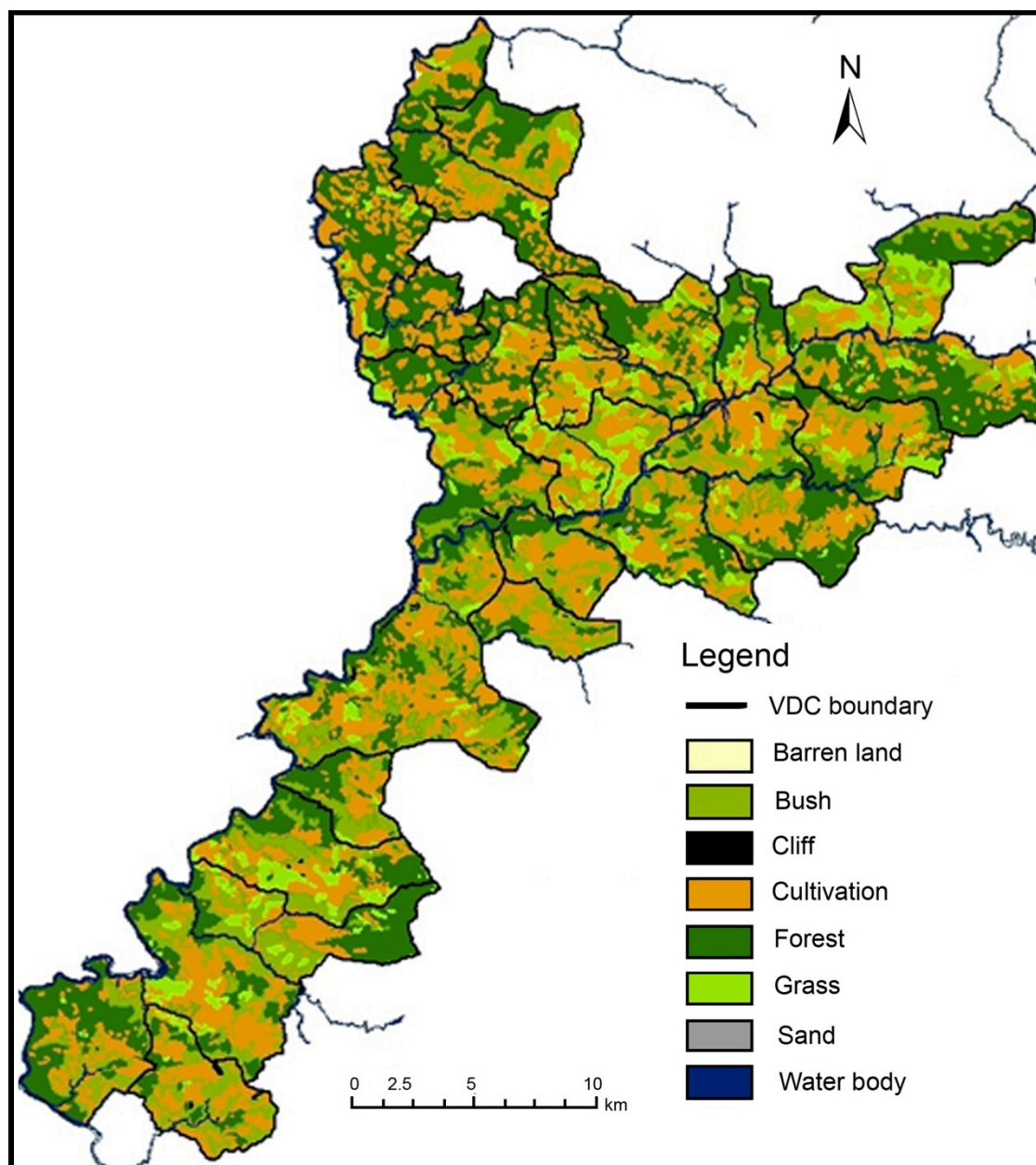


Figure 4-1: Land use and land cover in project area

4.2.3.2 Reservoir Area

The primary land uses/covers in the reservoir area are forestry, agriculture, flood plains and water bodies. Of the 3,968.2 ha of land that will be submerged under the reservoir (i.e. up to El. 680 m amsl), 2,148.3 ha (54%) are under natural vegetation, 1,013.5 ha (26%) under cultivation and 806.4 ha (20%) under other landforms (Table 4-2).

Natural vegetation cover in the reservoir area includes forests (64%), grasslands (15%) and bushes (21%). Bush lands consist of degraded forests with a few standing trees and are mainly covered with shrubs and weeds. Grasslands exist in small, scattered patches and mostly have anti-climax vegetation other than in riverbeds and on cliffs.

About 21% of the cultivated lands in the reservoir area is *khet* (partially or fully irrigated land for paddy cultivation), while the remaining 79% is *bari* (rain-fed lands used for cultivation of maize, millets, etc.). Important agricultural areas within the reservoir rim include Killali, Lali, Radam, Baku, Pithi, Uku, etc., along the Mahakali River and Gokuleshwar, Chuche Bagar, Baskot, Chamtadi, Panjyunaya, Goth, Banga Bagar, Chausera, Betalthala, Deojhadi, Sera, etc., along the Chameliya River.

Table 4-2: Land use/cover under reservoir, project structure/facilities and borrow and quarry sites

Land use/cover	Area (ha) under/at															
	Reservoir (up to El. 680 m asl)*	PHD associated structures	Owner's offices and camps					Contractor's office & camps				Borrow / quarry sites			Haul roads	Total
			GM's office, camps	Owner's colony	Owner's site office	Stores and sheds	Sub-total	Office facilities	Housing facilities	Labor camps	Sub-total	Borrow sites	Tiger quarry	Sub-total		
Natural vegetation																
Forest	1,372.2	39.4	-	40.7	18.4	18.6	77.7	9.94	37.44	55.49	102.87	0.1	122.6	122.7	118.7	1,833.57
Grass	320.94	-	-	2.9	-	-	2.9	-	0.16	0.16	0.32	0.1	-	0.1	-	324.26
Bush	455.19	-	21.5	1.9	2.2	-	25.6	7.14	0.17	-	7.31	-	4	4	-	492.10
Sub-total	2,148.33	39.4	21.5	45.5	20.6	18.6	106.2	17.08	37.8	55.65	110.5	0.2	126.6	126.8	118.7	2,649.9
Cultivated land	1,013.52	8.1	21.5	6.6	7.8	10.9	46.8	22.24	4.34	6.04	32.62	20.4	6.5	26.9	28.71	143.13
Other lands																
Sand	328.68	-	-	-	-	-	-	-	-	-	-	8.5	-	8.5	-	337.18
Cliffs	23.64	-	-	-	-	-	-	-	-	-	-	-	-	0	-	23.64
Barren lands	6.1	-	-	-	-	-	-	-	-	-	-	-	1.4	1.4	-	7.50
Water bodies	447.97	-	-	-	-	-	-	-	-	-	-	-	-	0	-	447.97
Sub-total	806.39	-	-	-	-	-	-	-	-	-	-	8.5	1.4	9.9	0	816.29
Total	3,968.24	47.5	43	52.1	28.4	29.5	153	39.32	42.11	61.69	143.12	29.1	134.5	163.6	147.41	4,622.87

* Includes Binayak borrow area and Parkoti spoil disposal site that will ultimately be submerged under the reservoir

4.2.3.3 Project Structures and Facilities

The present land uses/cover at the proposed locations of the various project structures and facilities are listed in Table 4-2 and shown on Figure 4-2. Of the total 346.6 ha that will be occupied by these structures, 220 ha (64%) are under forest cover, 87.5 ha (25.5%) under cultivation and 32.9 ha (9.6%) under bush lands.

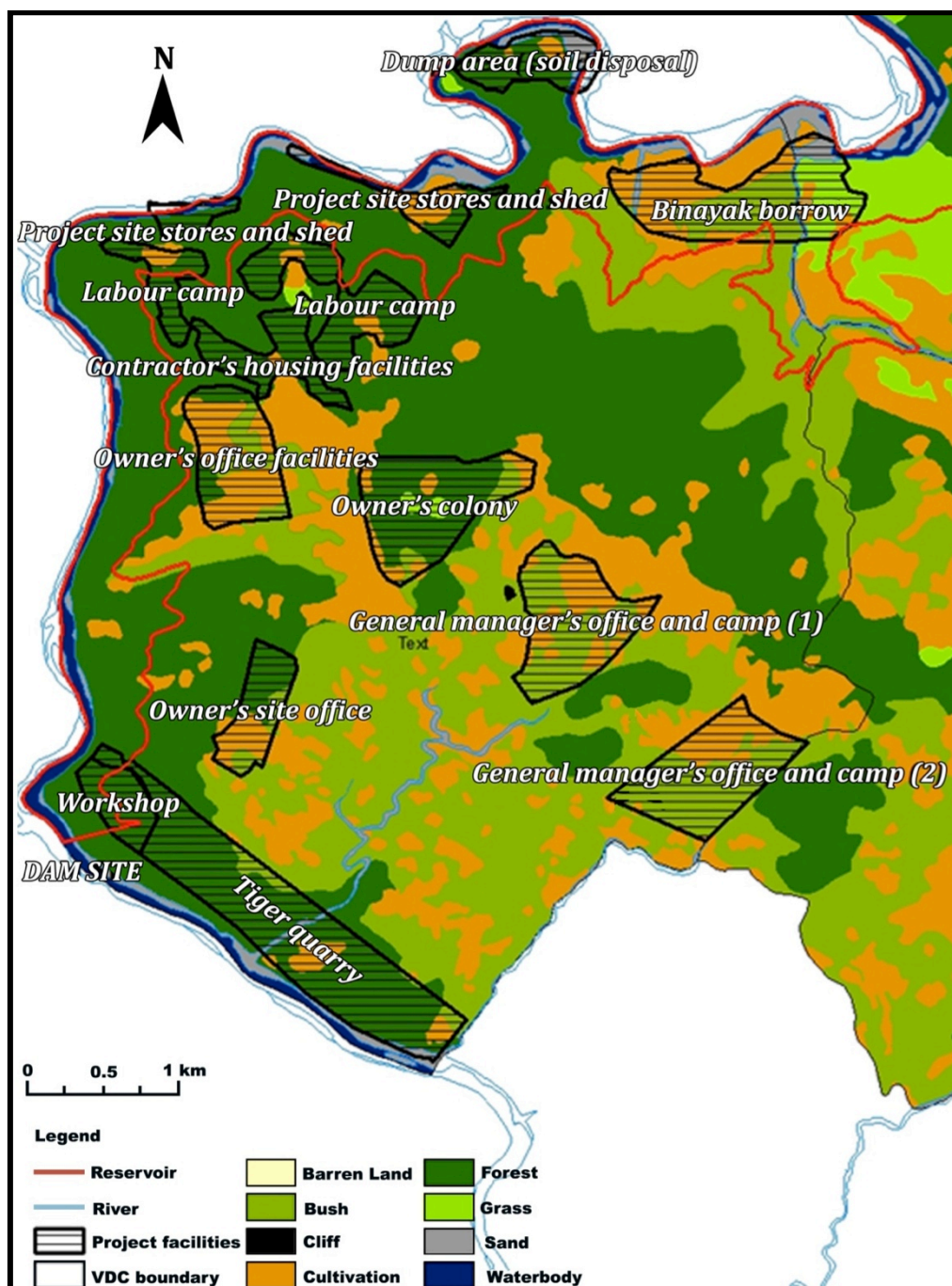


Figure 4-2: Land use/cover at project structures and facilities

4.2.3.4 Borrow / Quarry Sites and Haul Roads

As shown in Table 4-2, the current land uses/cover at the proposed borrow and quarry sites, excluding those that will be submerged under the reservoir, are forest (75%) and cultivation (16%). Likewise, about 80% of the 147.4 ha land required for haul roads is under forest cover, and the remaining 20% is under cultivation.

4.2.4 Climate

In general, the climate of the project area is sub-tropical. However, this area, like other parts of Nepal, experiences a variety of climates because of large topographical variations over a short north-south stretch (Nayava, 1981). Subtropical climate, with very hot summers and warm winters, exists in regions below elevations of 1,000 m amsl. Warm temperate climate, with hot summers and cold winters, extends up to nearly 2,000 m amsl. Regions up to 3,000 m amsl experience cool temperate climate characterized by mild summers and very cold winters. Tundra and alpine climates exist in the mountainous region.

In addition to altitudes, the slope and aspect of landforms also have a major influence on the weather and climate in the project area. At the same elevation, the southern aspect of the project area is much warmer and drier than the northern aspect. Similarly, the windward and leeward aspects are different at the same altitude.

4.2.4.1 Temperature

Altitude governs the spatial variation of temperature in the project area. In the Mahakali basin, the mean maximum temperature varies from 30 °C in the Terai to 26 to 30 °C over the Siwaliks, 22 to 26 °C in the middle mountains and below 22 °C in the high mountains and Himalayas. The mean temperature also shows a similar pattern, varying between 22 °C plus in the Terai and Siwaliks to less than 14 °C in the northwestern parts of the basin (Figure 4-3).

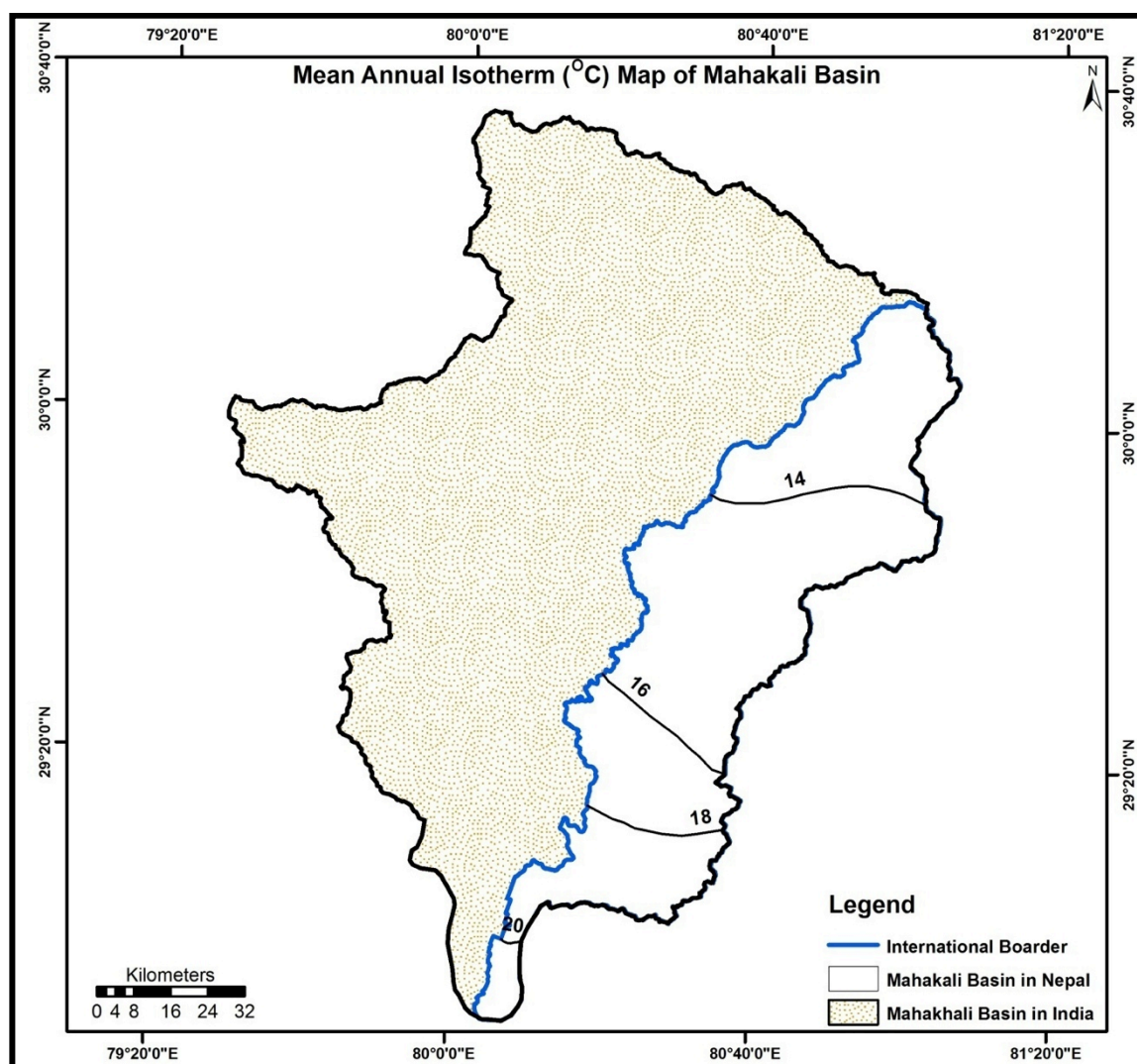


Figure 4-3: Isothermal map of Mahakali basin

4.2.4.2 Precipitation

The monsoon and the western disturbances are the major weather systems in the Mahakali basin. Monsoon generally starts in the area from the second week of June and lasts for four months up to September. Western disturbances affect the area in the winter season.

Based on the weather systems, the river basin witnesses four seasons: pre-monsoon (March to May), monsoon (June to September), post-monsoon (October to November) and winter (December to February). The area receives 12%, 77%, 3% and 8%, respectively, of its total annual rainfall during these four seasons. It receives its highest precipitation in July (25.6%) and its lowest in November (0.54%). The average annual rainfall in the project area is 1,532 mm.

In winter, more precipitation occurs in the northwestern parts of the project area, and much of this falls as snow in the high mountains and the Himalayas. This precipitation, which originates from disturbances in the Westerlies, decreases from the west to the east.

The interaction of the complex topography with the weather systems results in the spatial distribution of rainfall. Generally, the windward side of the topographical barriers receives the major portion of rainfall while the leeward side remains dry (Figure 4-4).

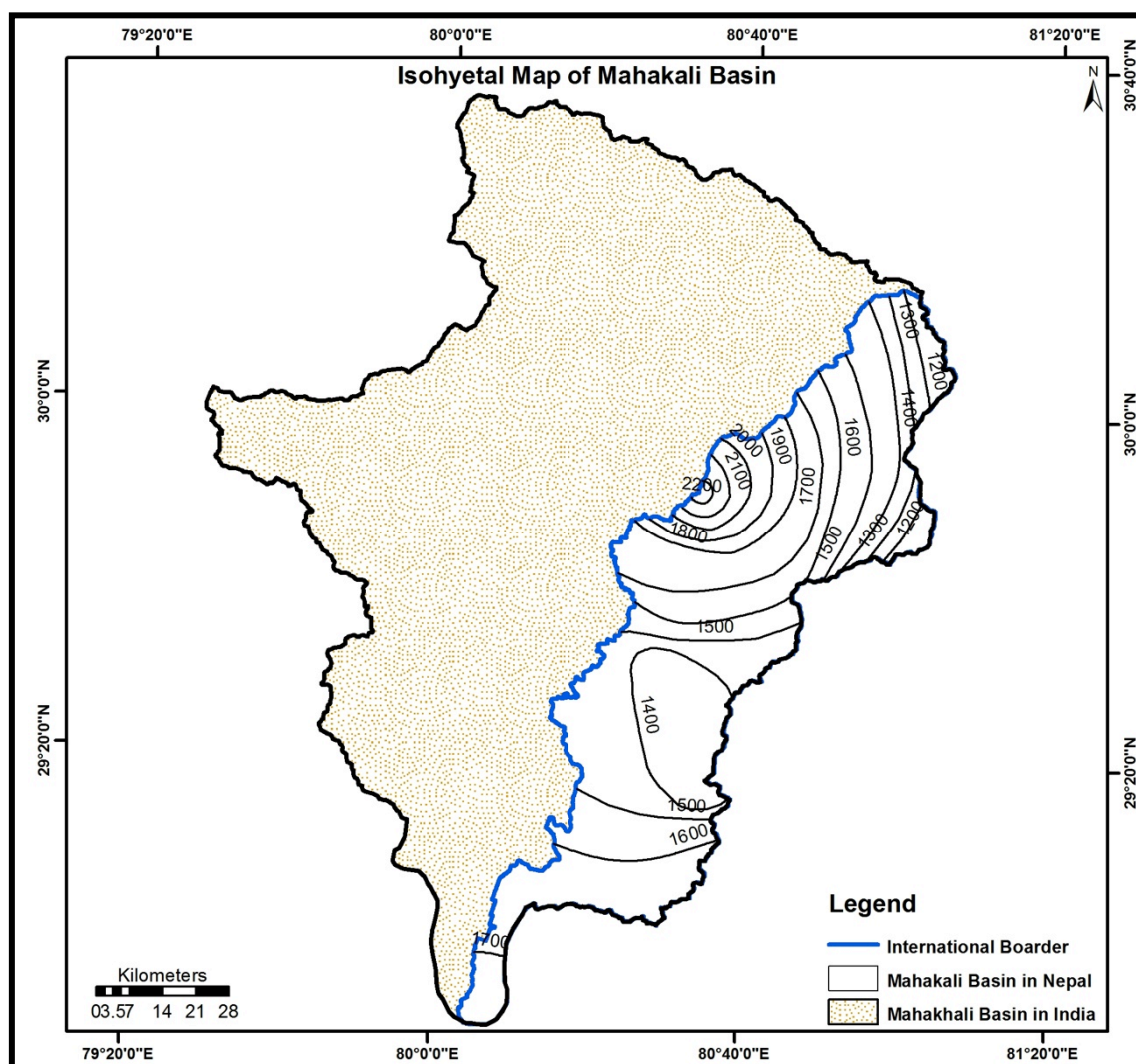


Figure 4-4: Isohyetal map of Mahakali basin

The highest annual precipitation recorded in and near the Mahakali Basin is 2,256.3 mm at Pipalkot, Bajhang (El. 1,456 m amsl). Likewise, the lowest annual precipitation observed in this area is 1,390.6 mm at Patan, Baitadi (El. 1,266 m amsl).

4.2.4.3 Evapotranspiration

The mean monthly evapotranspiration in the Mahakali basin varies between 50 and 75 mm in the coldest month (January) and between 120 and 190 mm in the hottest month (May). Similarly, the mean annual evapotranspiration ranges between an estimated 1,100 and 1,200 mm in the Terai, hills and mountains and between 900 and 1,100 mm in the rain shadow (Figure 4-5). Evapotranspiration values between 1,200 to 1,300 mm are estimated at higher elevations due to high winds in these regions.

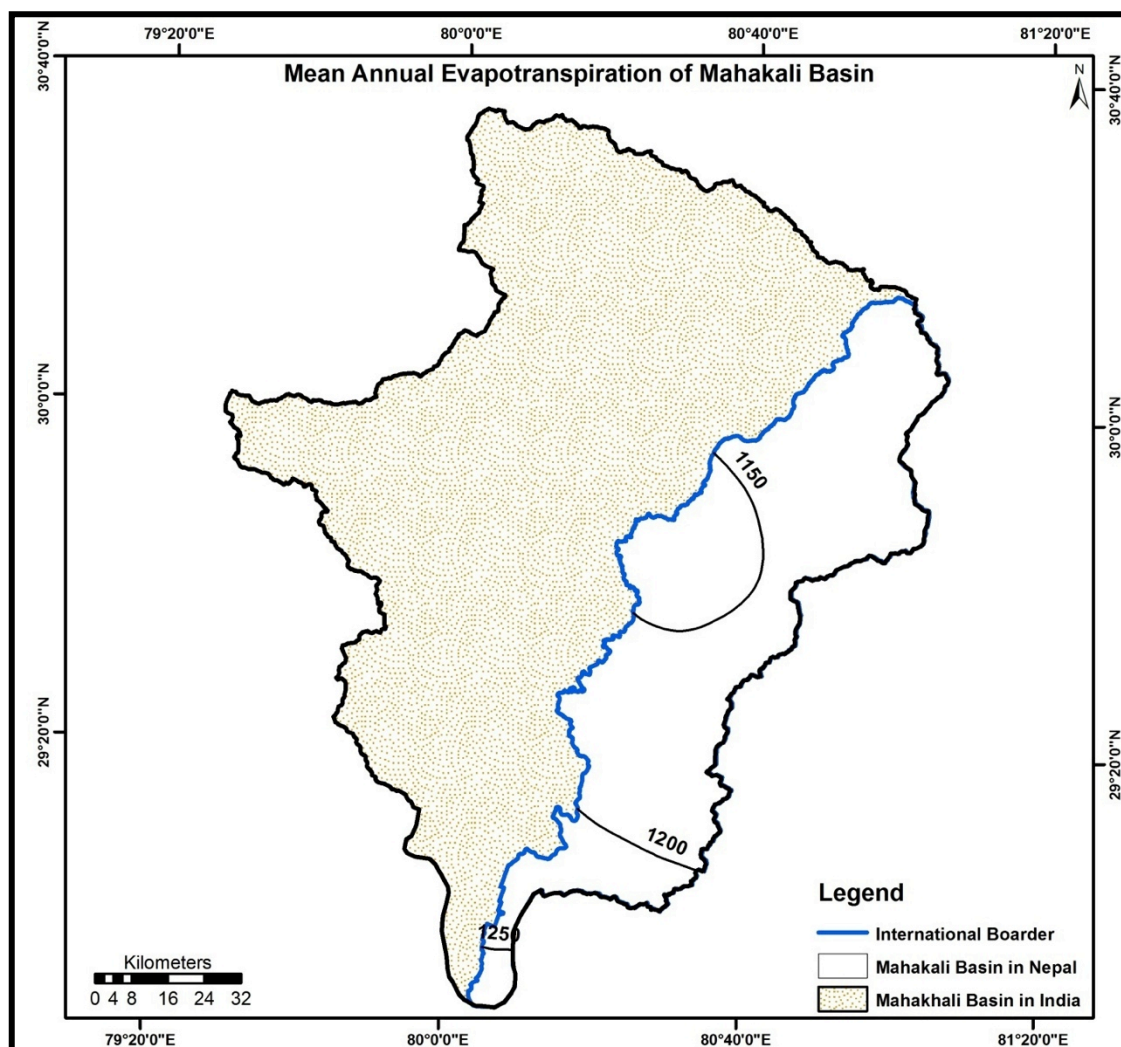


Figure 4-5: Mean annual evapotranspiration map of Mahakali basin

4.2.4.4 Relative Humidity

Data on relative humidity are available at DHM's Dhangadhi station (St. No. 209) for the year 2012 (Table 4-3). As shown, the observed mean monthly relative humidity at this station varies from 34.1% in May to 93.3% in August.

Table 4-3: Mean monthly relative humidity at Dhangadhi

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
RH (%)	93.3	77.5	59.8	43.4	34.1	48.2	80.4	84.8	83.0	78.5	84.1	87.7

4.2.4.5 Wind Speed

The mean monthly wind speed at Dadeldhura (DHM St. No. 104), recorded between 1978 and 1998, varies between 5.8 to 8.7 km/hour (Table 4-4). Wind speeds recorded at other nearby stations over a similar are period comparatively lower, varying between 0.8 and 2.8

km/hour at Mahendranagar (DHM St. No. 105), 0.7 and 2.4 km/hour at Dipayal (DHM St. No. 218) and 1.5 and 4.6 km/hour at Dhangadhi (DHM St. No. 209).

Table 4-4: Mean monthly wind velocities (km/hour) at nearby meteorological stations

Station	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Dadeldhura	7.0	7.7	8.4	8.7	8.3	7.3	6.2	5.8	6.0	6.8	6.5	6.3
Mahendranagar	1.2	1.5	2.0	2.6	2.8	2.5	1.6	1.3	1.1	0.9	0.8	0.8
Dipayal	0.7	1.1	1.6	2.3	2.4	2.4	1.9	1.2	1.4	1.5	1.1	0.7
Dhangadhi	2.0	2.4	3.3	4.1	4.6	4.4	3.8	2.8	2.3	1.5	1.7	1.7

4.2.4.6 Sunshine Duration

The mean monthly sunshine durations recorded at nearby DHM stations between 1978 and 1998 are listed in Table 4-5. As shown, the sunshine duration at Dadeldhura varied between 8.9 hours in April to 3.9 hours in July and August, 8.8 hours in April to 4.9 hours in July and August at Mahendranagar and 7.8 hours in May to 4.6 hours in July at Dipayal.

Table 4-5: Mean monthly sunshine duration (hours) at nearby meteorological stations

Station	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Dadeldhura	7.1	7.2	7.6	8.9	8.5	7.2	3.9	3.9	5.5	8.6	8.4	7.3
Mahendranagar	5.9	7.0	7.7	8.8	8.7	7.1	4.9	4.9	6.1	7.3	8.0	6.0
Dipayal	6.2	6.4	7.3	7.7	7.8	6.7	4.6	5.2	6.0	7.7	7.7	6.0

4.2.5 Hydrology

The traditional source of the Mahakali River is the pond of the *Kali* temple at Kalapaani in Pithoragarh District, Uttarakhand, India (El. 3,600 m amsl); however, its geographic sources are in the Himalayas, some five kilometers further north and a few thousand meters higher.

4.2.5.1 Drainage Pattern and River Morphology

In its initial reaches, the Mahakali River flows towards the southeast. Below Kalapaani, it flows towards the southwest and forms Nepal's western border with India.

The Mahakali River drains water down from both Indian and Nepali territories. The catchment area of the Mahakali River at the PHD site is 12,100 sq. km. Of this, about 19.7% lies in Nepal and the remaining 80.3% in India.

The prominent Indian tributaries of the Mahakali River upstream of the PHD site are the Dhauliganga, Gori Ganga and Sarju. These rivers join the Mahakali at Tawaghat, Joljibi and about two km upstream of the PHD site, respectively. Likewise, the major Nepali tributary is the Chameliya River that merges with the Mahakali River at Kutiyasera of Dasarathchand Municipality. Among the different tributaries, the Sarju River is the largest, with a total drainage area of 4,019 sq. km (Table 4-6).

Table 4-6: Characteristics of Mahakali basin first and second order sub-basins (EDC, 1995)

Tributary basin	Drainage area (km ²)	Highest elevation (m)	Stream bed elevation(m)	Length (km)	Average gradient
Mahakali main stream	2,338	7,820	410	120	0.0217
Khunti Yankti	514	6,320	3,008	40	0.0468
Dhauli Ganga	1,357	6,640	1,130	78	0.0481
Gori Ganga	2,300	7,820	600	100	0.0489
Chameliya	1,572	7,090	530	75	0.0499
Sarju	4,019	6,310	418	115	0.0229

4.2.5.2 Long-term Flows

The minimum and maximum flows in the Mahakali River occur in February/March and July/August, respectively. Stream flow data for the period 1962 to 1992 show the minimum and maximum mean monthly flows in the river at 107 and 2,427 m³/s, respectively (EDC, 1995).

The long-term mean monthly hydrograph for the Mahakali River, based on flow data from 1962 to 1992, is shown in Figure 4-6. The long-term average monthly flow at the dam site is estimated at 582 m³/s.

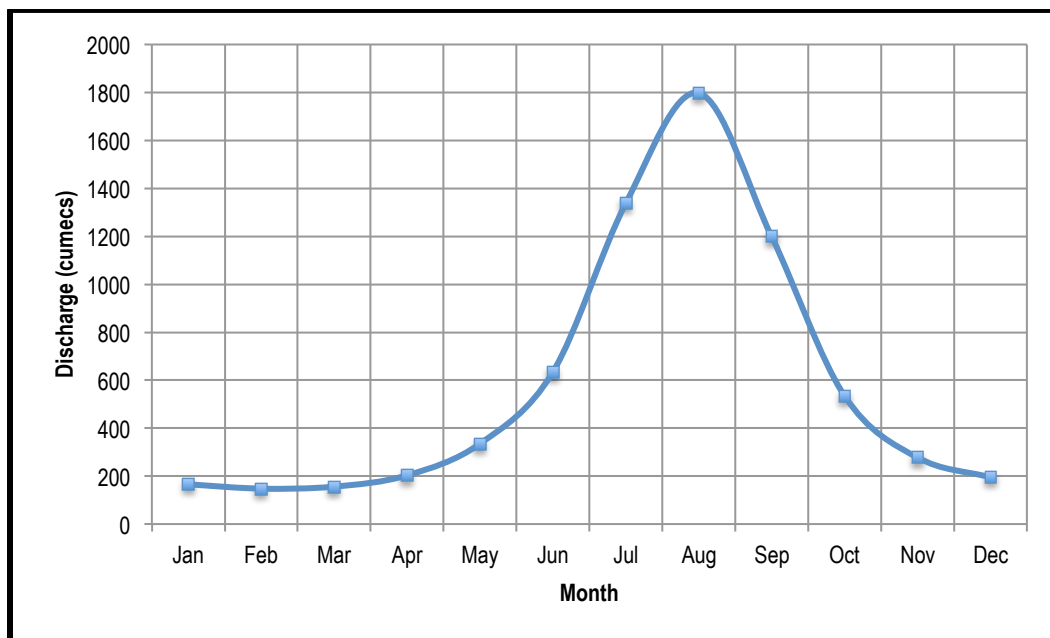


Figure 4-6: Long-term mean monthly hydrograph for the Mahakali River

4.2.5.3 Floods

The basic characteristics of different return period floods for the Mahakali River derived in the PMP DPR (EDC, 1995) are listed in Table 4-7. As shown, the probable maximum flood (PMF) for the river is estimated at 23,500 m³/s.

Table 4-7: Basic characteristics of floods of different return periods (EDC, 1995)

Return period (years)	Av. daily flow (m ³ /s)	Peak flow (m ³ /s)	Volume ² (million m ³)
2	3,950	5,140	164.7
5	4,880	6,340	274.9
10	5,440	7,070	356.2
20	5,950	7,740	440.6
50	6,570	8,540	552.5
100	7,010	9,110	639.6
500	7,990	10,400	859.4
1000	8,400	10,920	956.9
10000	9,730	12,650	1,318.2
PMF		23,500	4,740.1

² Above 1,000 m³/s base flow

4.2.5.4 Glaciers and Glacial Lake Outburst Floods

The Mahakali basin within Nepal is home to 167 glaciers that cover a total area of 112 sq. km (ICIMOD, 2011). These glaciers are located between elevations of 3,695 m and 6,850 m amsl.

Within the Nepali territory, nine glacial lakes with a total area of 0.137 sq. km are reported (ICIMOD, 2011). The areas of these lakes vary between 0.003 and 0.049 sq. km. These lakes are of four types: end moraine dammed, lateral moraine dammed (with ice), other moraine dammed and supra-glacial. No potentially dangerous lakes are identified in this basin.

4.2.6 General Geology

Geologically, the project area lies within the Lesser Himalaya of the far-western region of Nepal (Figure 4-7). The area consists of sedimentary to meta-sedimentary and metamorphic crystalline rocks of the Lesser Himalaya.

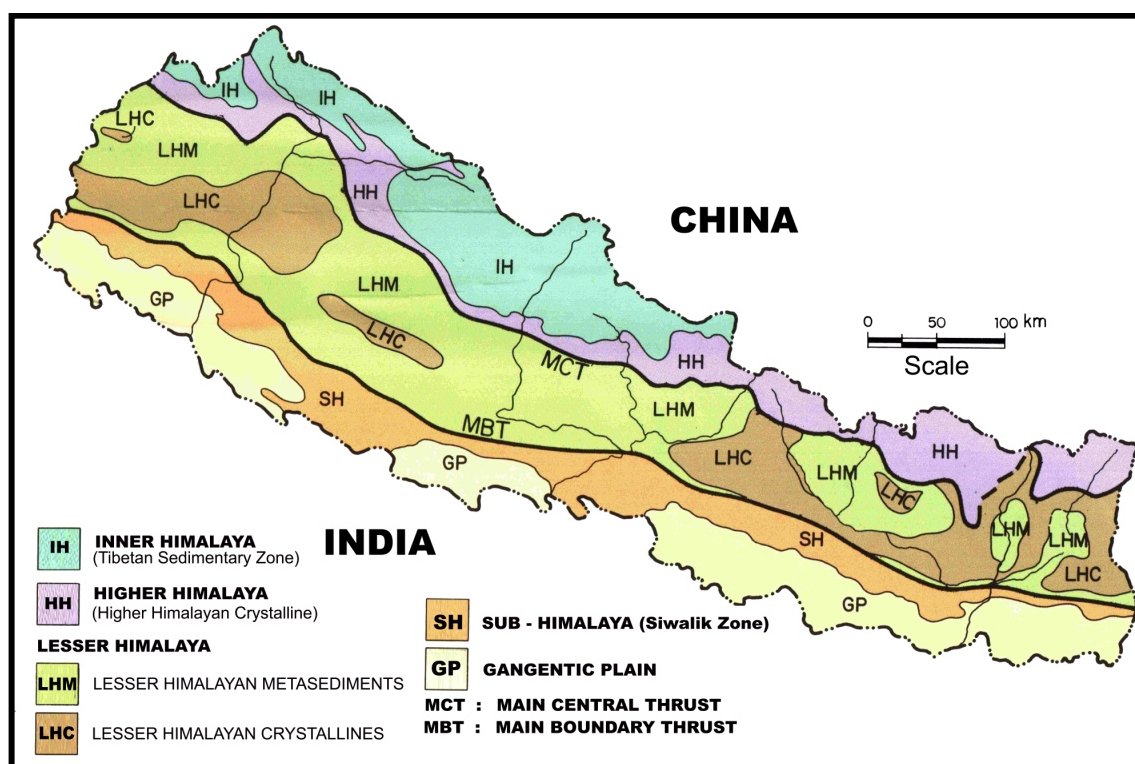


Figure 4-7: Geological map of Nepal (UN, 1993)

The Lesser Himalaya is bounded by two major thrusts: the Main Central Thrust (MCT) on the north and the Main Boundary Thrust (MBT) on the south. The MCT is located over 80 km north of the PHD site, while the MBT is located about 25 km to its south. The MCT dips less than 45° towards north, separating high-grade metamorphic rocks of the Higher Himalaya from the less metamorphic rocks of the Lesser Himalaya developed to the south. The MBT separates the meta-sedimentary succession of the Lesser Himalaya from the sedimentary Siwalik succession of the Sub-Himalaya in the south. The trend of the MBT is northwest, and it dips north.

4.2.6.1 Stratigraphy

The project area is composed of rock successions of three groups: Dadeldhura, Midland and Surkhet. These stratigraphic subdivisions are detailed in Table 4-8 and Figure 4-8.

Table 4-8: Stratigraphic divisions of project area

Stratigraphic groups	Formation	Rock types
Dadeldhura	Kalikot	Garnetiferous biotite schists and micaceous quartzites with gneisses
Midland	Syanja	Shale inter-bedded with pink or purplish calcareous quartzite and dolomite with ripple marks, mud cracks and cross-bedding
	Lakharpata	Dolomite and dolomitic limestone with thin phyllite inter-beds, locally stromatolitic
	Galyang	Mainly shale and slate with grey to black carbonate inter-beds
	Malekhu	Milky white dolomite
	Banku	Massive quartzite with intercalation of chlorite schist and phyllite
Surkhet	Suntar	Alternating beds of shale, meta sandstone and ferrogenous quartzite

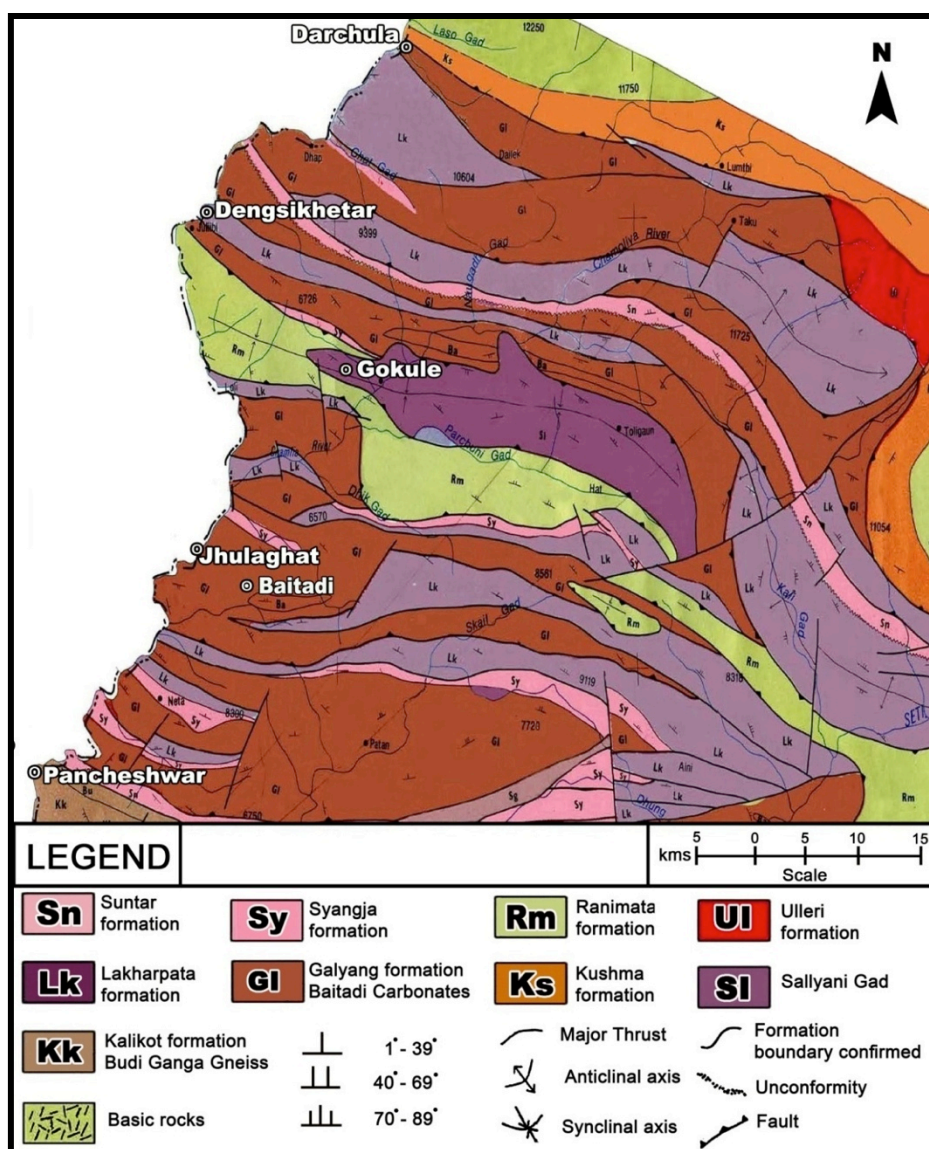


Figure 4-8: Geology of project area

4.2.6.2 Structures

The project area is characterized by the development of two thrust sheets: Dadeldhura and Bajhang. The Dadeldhura thrust sheet is developed at the dam site as a synclinal structure composed of medium to high-grade metamorphic rocks. The axis of the syncline passes about 5 km downstream of the dam site, trending nearly east – west.

The Bajhang thrust sheet is developed around the central part of the project area. It is well exposed in the Gokuleshwar area. It represents a major synclinal structure of the area.

Several synclinal and anticlinal structures of local significance exist in the project area. The general trend of beddings or foliation planes is east – west, and they dip south or north.

4.2.7 *Land Instabilities*

In the present study, 35 landslides were identified in the project area along the Mahakali and Chameliya Rivers. The principal features of the recorded large, medium and small-scale landslides are listed in Table 4-9, Table 4-10 and Table 4-11, respectively, and their details are presented in Appendix B. The locations of these landslides are marked on Figure 4-9.

The distribution of landslides in the study area is mostly controlled by rock mass strength. Twenty of the 35 landslides are located in very weak rock masses of shale and slate rocks representing the Galyang (G1) formation. Three very large and active landslides at Chamtari (Photo 4-1), Dethala (Photo 4-2) and Osap (Photo 4-3) are developed within this rock mass. These landslides require immediate treatment. Thus, areas within the Galyang formation are highly susceptible to landslide hazards.



Photo 4-1: Landslide at Panjunaya (LS 8)



Photo 4-2: Landslide at Devthala (LS 11)

Table 4-9: Large-scale landslides in project area

ID	Location	Size (m ²)	Geology	Geomorphology	Failure
LS 5	Chamtari River, LB	200 × 200	Highly crushed phyllite/slate	Steep slope	Slope failure
LS 8	Panjunaya, Sittad, Ward No. 4	150 × 200	Crushed rock masses with large boulders	Moderate to steep slope	Slope failure
LS 10	Bangabagar, Chameliya River LB	300 × 600	Highly crushed weak, fragile rock masses	Moderate to steep slope	Debris flow
LS 11	Devthala, Chameliya RB	300 × 300	Highly crushed dolomite with phyllite	Steep slope	Slope failure
LS 15	Chameliya RB, above Osap	150 × 300	Highly crushed rock with boulders	Moderate to steep slope	Landslide
LS 22	Magarau Khola U/S, opposite Gokuleshwar	600 × 500	Highly crushed disoriented rock schists/ quartzite	Steep slope	Collapse
LS 27	Lali Gad LB	200 × 100	Highly jointed and fractured rock mass	Moderate to steep slope	Rock fall
LS 28 A	Mahakali – Chameliya confluence	150 × 150	Massive dolomite, highly fractured and jointed	Steep slope, cliff	Wedge failure
LS 28 B	Mahakali – Chameliya confluence	200 × 100	Loose crushed rocks	Moderate to steep slope	Slope failure

Table 4-10: Medium-scale landslides in project area

ID	Location	Size (m ²)	Geology	Geomorphology	Failure
LS 18	Osap, Chameliya RB	300 × 150	Highly crushed and fractured rock masses	Steep slope	Rock fall
LS 25	Dattu, Mahakali LB	250 × 50	Dolomite with slate rock masses	Moderate to steep slope	Rock fall
LS 29	Chameliya RB, above suspension bridge	20 × 100	Highly jointed dolomite	Steep slope	Rock mass failure
LS 32	Dhik Gad – Chameliya confluence	50 × 50	Colluvium, mainly rock pieces	Steep slope	Rock fall
LS 33	Jhulaghat, Mahakali LB	150 × 25	Highly crushed, loose rock	Moderate to steep slope	Rock fall

Table 4-11: Small-scale landslides in project area

ID	Location	Size (m ²)	Geology	Geomorphology	Failure
LS 1	Dhik Gad, road level	40 × 30	Loose soil mix with colluvium	Moderate to steep slope	Slope failure
LS 2	Chameliya LB (2 landslides)	8 × 15 20 × 30	Colluvial	Moderately steep slope	Slope failure
LS 3	Salsena, Chameliya LB at road level	25 × 20	Very weak and crushed phyllite	Moderate slope	Planar failure
LS 4	Chameliya LB	20 × 15	Very weak rock mass in steep slope, seepage	Steep slope	Collapse
LS 6	Near Jamadi, Chameliya LB, above road level	50 × 25	Highly jointed rock masses	Moderate to steep slope	Rock falls
LS 7	Chadati Khola RB, road level	30 × 40	Loose colluvium	Moderate slope	Soil erosion, gullies
LS 9	Panjunaya Gad, Jamadi Gad RB	20 × 30	Colluvium	Moderate slope	Gully erosion
LS 12	Before Luita, Chameliya RB above road level	5 × 40	Loose and fractured rock masses	Moderate to steep	Gulley erosion
LS 13	Opposite Jagan Nath LS School, main road	50 × 20	Colluvium mixed with alluvium	Steep to moderate slope	Slope failure
LS 14	Kuku Khola RB, above Osap	25 × 30	Colluvium	Moderate slope	Soil erosion
LS 16	Osap, Chameliya RB	5 × 50	Phyllite mixed with colluvium	Moderate slope	Gulley erosion
LS 17	Osap, Chameliya RB	20 × 30	Loose rock pieces	Moderate slope	Rock fall
LS 19	Osap, Chameliya RB	20 × 10	Colluvium	Moderate slope	Slope failure, surface erosion
LS 20	Chameliya RB, at confluence with Ghatte Khola	30 × 15	Colluvium with alluvium, loose masses	Gentle to moderate slope	Gulley erosion with slope failure
LS 21	Chameliya LB, opposite Agari Gad	5 × 30	Colluvium with very weak phyllite and quartzite rock fragments	Steep	Slope failure
LS 23	Sarkar village, Mahakali LB	15 × 7	Alluvium, loose gravels with sands and clays	Moderate slope	Slope failure
LS 24	Sarkar village, Mahakali LB	15 × 50	Colluvium soil with silts and mud gravels	Moderate to steep slope	Slope failure
LS 26	Dattu, Mahakali LB	25 × 60	Colluvium, angular rock fragments with silt, sand and clays	Steep slope	Slope failure
LS 30	Chameliya RB, above suspension bridge	20 × 50	Highly jointed dolomite	Steep slope	Plane failure
LS 31	Chameliya RB, above suspension bridge	100 × 3	Highly jointed dolomite	Steep slope	Gully erosion
LS 34	Mahakali LB, near Jhulaghat	30 × 30	Colluvium deposits, nearly highly crushed phyllite, slates thinly bedded	Moderate slope	Slope failure
LS 35	Along newly excavated road to Budda	15 × 50	Colluvium, rock pieces in silt sandy matrix	Gentle to moderate slope	Surface erosion

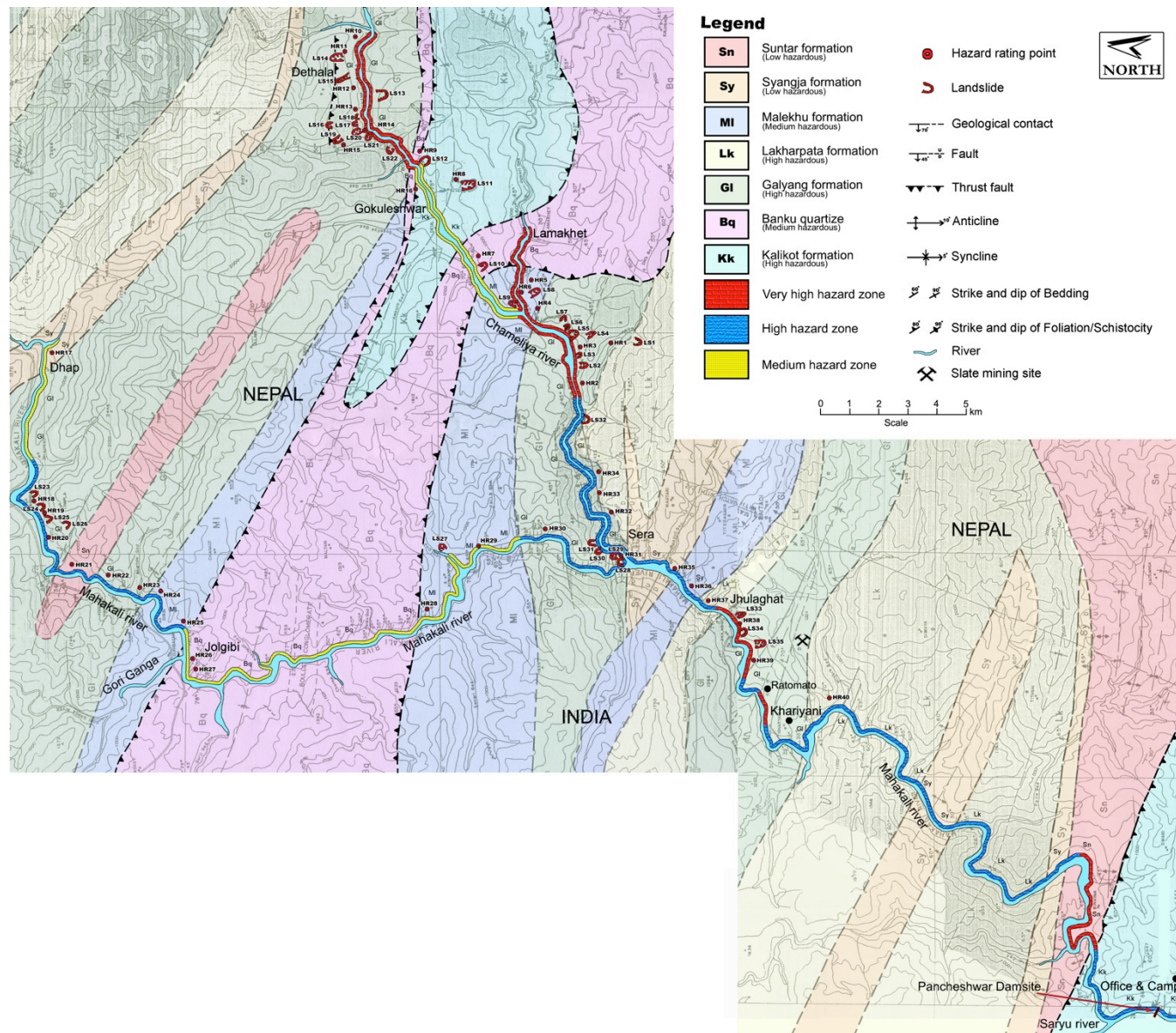


Figure 4-9: Landslide distribution and hazard zonation in project area



Photo 4-3: Landslide at Osap (LS 15)

About a quarter of the recorded landslides are developed within the distribution of the Lakharpata (Lk) formation representing thin alternating beds of carbonate rocks with slate and shale. Although big landslides are not developed within it, this distribution of rock mass also constitutes an area of high susceptibility to small- to medium-scale landslide hazards.

Several landslides are located within the rocks of Malekhu, Kalikot and Banku formations. A very large, active landslide at Jamari (LS 8), located on the left bank of Jamari Gad near its confluence with Chameliya, is developed within the Malekhu (Ml) formation. A similar landslide just opposite Gokuleshwar along Magarau Khola (LS 22, Photo 4-4) is developed within the Kalikot (Kk) formation represented by highly weathered mica schists and quartzite rock mass. It affects three villages located nearby – Kholigaun, Devgaun and Luharkhet. Another very large and active landslide at Banga Bagar (LS 10, Photo 4-5) is located within the phyllite-quartzite rock mass of Banku (Bq) formation. All of these landslides need immediate treatment. Apart from these, small- and medium-scale landslides exist within the distribution limits of the above-mentioned formations. Thus, the distribution areas of Malekhu, Kalikot and Banku formations represent areas of medium susceptibility to landslide hazards.



Photo 4-4: Landslide at Gokuleshwar (LS 22)



Photo 4-5: Landslide at Banga Bagar (LS 10)

No landslides were recorded from the distribution areas of Syanja and Suntar formations. These formations represent areas of low susceptibility to landslides.

4.2.8 Landslide Hazard Zones

Based on the landslide hazard zonation performed during the present study, the project area can be divided into three hazard zones: Very High Hazard Zone (VHHZ), High Hazard Zone (HHZ) and Medium Hazard Zone (MHZ). These hazard zones are shown on Figure 4-9, and the basis for this zonation is described in Appendix B.

The VHHZ is mostly developed over the rock/soil masses of the Galyang formation. Most recorded landslides (Table 4-9) fall under the distribution limits of this unit developed along Chameliya River. Due to better structural conditions, the rock/soil masses of this formation developed along Mahakali River have lower hazard ratings. About 12% of the reservoir rim line falls under the VHHZ.

The HHZ spans across different rock masses developed within the project area. Occurrence of landslides in this zone is rare, but large and active landslides exist around Gokuleshwar due to the presence of very weak rock masses and at Banga Bagar and Panjunaya due to the presence of faults. About 73% of the reservoir rim line falls within this zone.

The MHZ is mostly developed over the rock/soil masses of Banku Quartzite and Malekhu dolomites and limestone. This zone is developed along Mahakali River. Practically no landslides are developed within this zone. About 15% of the reservoir rim line falls within this zone.

Distribution of landslides is very much controlled by the geological conditions of the area and the geological condition of specific site is governed by the rock formation developed at the particular site. As the geological conditions of the individual rock formation is not going to change in near future, the existing pattern of landsliding will also continue in near future following the principle “Present is the key to the Future”. Accordingly, the area with the development of Galyang formation (Gl) will represent High Hazard Zone, the areas with the development of Lakharpata formation (Lk) will represent Medium Hazard Zone and areas with the rock formations of Malekh (Ml), Kalikot (Kk) and Banku (Ba) will represent Low Hazard Zone for the entire project area. The area with the distribution of Syangja formation (Sy) and Suntar formation (Sn) will lie in very low hazard zone as no landslides have been recorded within these formations. Limited field study conducted along Chameliya River and

Mahakali river along reservoir rim, also in support of above mentioned conclusions regarding Prediction of future landslides.

Based on distribution of landslides and hazard rating conducted along the reservoir rim area, the un-surveyed area does not contain rock mass belonging to Galyang (Gl) formation or Banku Quartzite (Bq) corresponding high or low hazard zone respectively. As such, based on the study conducted in upper part of the reservoir area, it seems that the remaining part downstream the reservoir area is mainly composed rock mass having intermediate level of landslide hazard. Previous studies have recorded existence of some landslides from this area.

4.2.9 Seismicity

The seismicity in Himalaya owes its origin to the continued northward movement of Indian plate after its collision with Eurasian plate. Results of micro-seismic investigations, geodetic monitoring and tectonic studies in the Nepal Himalaya show that more frequent medium sized earthquakes, of magnitude 6 to 7 on the Richter scale, are confined either to the flat decollement beneath the Lesser Himalayas or to the upper part of the middle crustal ramp which occurs at a depth of about 15 km below the foot of the Higher Himalaya south of the MCT surface exposure. Big events of magnitude greater than 8 on the Richter scale are nucleated near the ramp flat transition and ruptures, the whole ramp flat system up to the blind thrusts north of the Sub-Himalaya.

The seismicity map of the Nepal prepared by the Department of Mines and Geology, GoN, shows a high concentration of seismic events in far-western Nepal where the project lies (Figure 4-10). It also shows that the recorded seismic events around the project area have generally been of magnitudes between 2.5 and 4, but some events of magnitude 5 have also occurred.

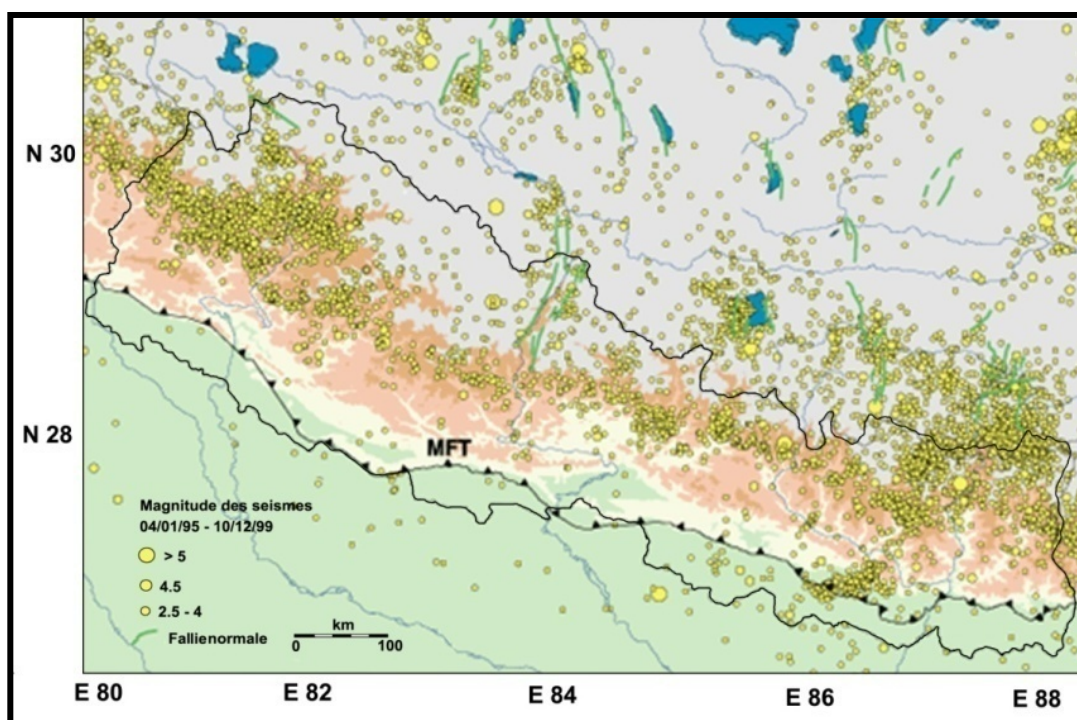


Figure 4-10: Seismicity map of Nepal (Pandey, Chitrakar, Kafle, Sapkota, Rajaure, & Gautam, 2002)

A seismicity map of Nepal prepared by the United States Geological Survey (Figure 4-11) also shows that the occurrence of seismic events around the project site between 1990 and 2006 is higher compared to that in the other parts of the country. This map indicates that the most of the earthquakes in the regions have originated at depths less than 35 m.

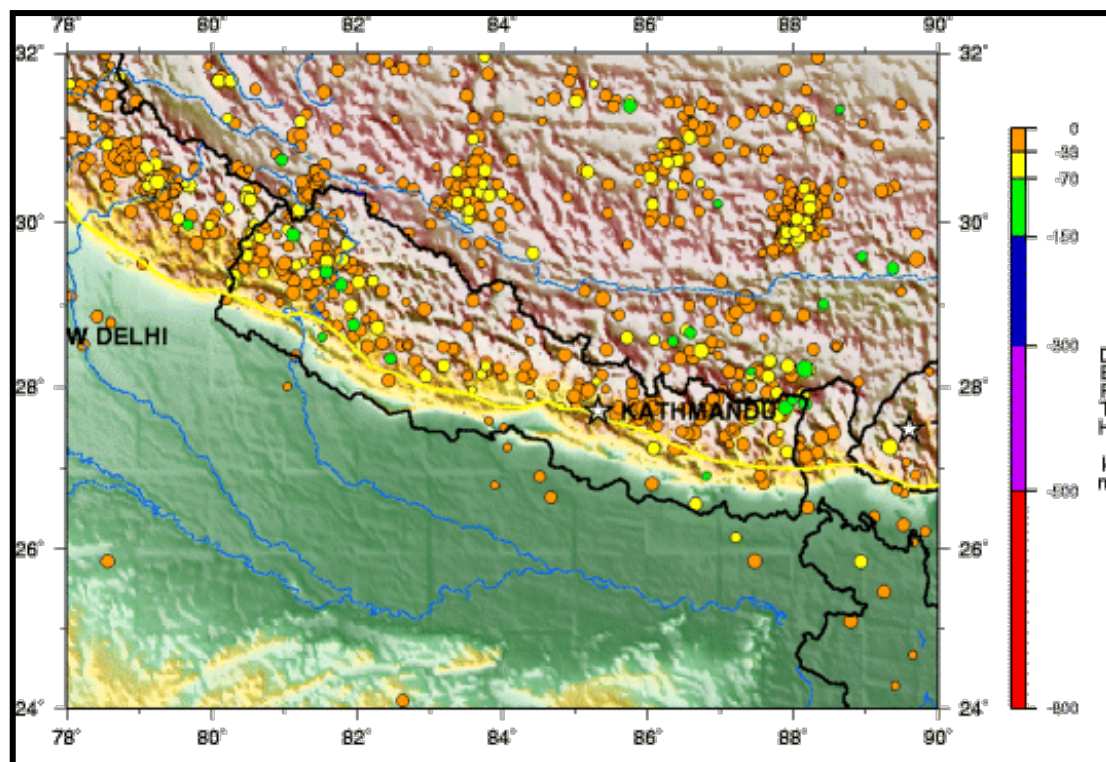


Figure 4-11: Seismicity of Nepal between 1990 and 2006 (USGS, 2010)

The most important potentially active fault that could affect the project area is the 80 km long Rangun Khola Fault, pertaining to the Main Boundary Active Fault System (EDC, 1995). Its closest distance to the PHD site is about 30 km. Micro-seismic investigations have also detected a seismically active belt striking north-northwest over a length of about 110 km, some 80 km northeast of the PHD site.

It is estimated that the Maximum Credible Earthquake (MCE) produced by the Rangun Khola Fault would have a magnitude of 7.4 and a hypocenter in the order of 20 km. Different attenuation models for such MCEs have led to estimates of the maximum peak acceleration at the site ranging from 122 to 256 gals. On the other hand, statistical analysis of available historical records have yielded peak accelerations of 90 and 104 gals for return periods of 100 and 200 years, respectively, considering the most conservative attenuation model.

4.2.10 Soil Profile

Based on the interpretation of the soil analysis data and the georeference position of the soil observation points, soil maps of the project area depicting the following the characteristics were prepared:

- Soil texture (Figure 4-12)
- Soil alkalinity and acidity (Figure 4-13)
- Soil organic matter content (Figure 4-14)
- Soil total nitrogen content (Figure 4-15)
- Soil available phosphorus content (Figure 4-16)
- Soil available potassium content (Figure 4-17)

The workability class of soil texture, nutrient status and acidity/alkalinity class assigned in these maps are based on the rating listed in Table 4-12 to Table 4-17.

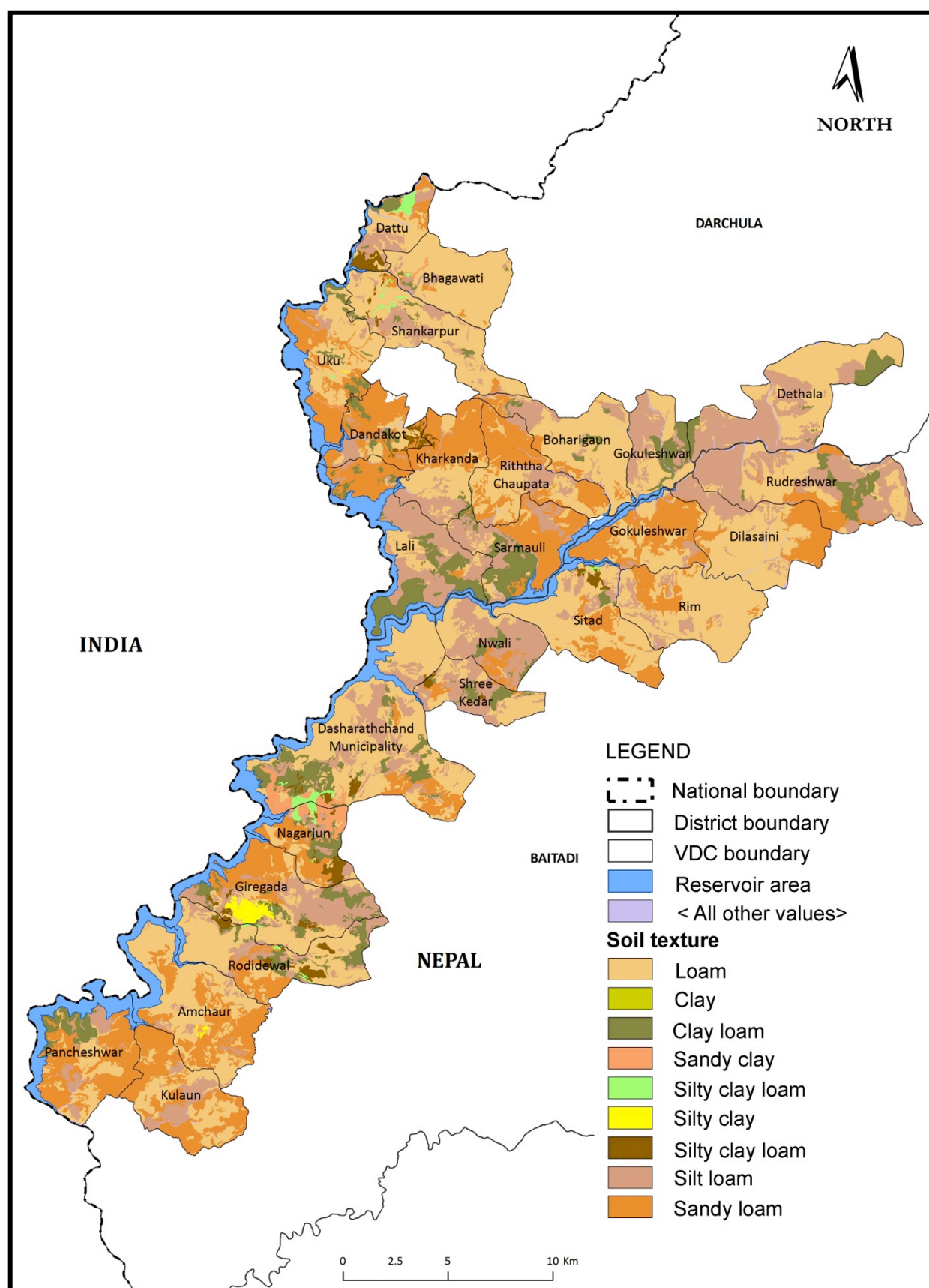


Figure 4-12: Soil texture map

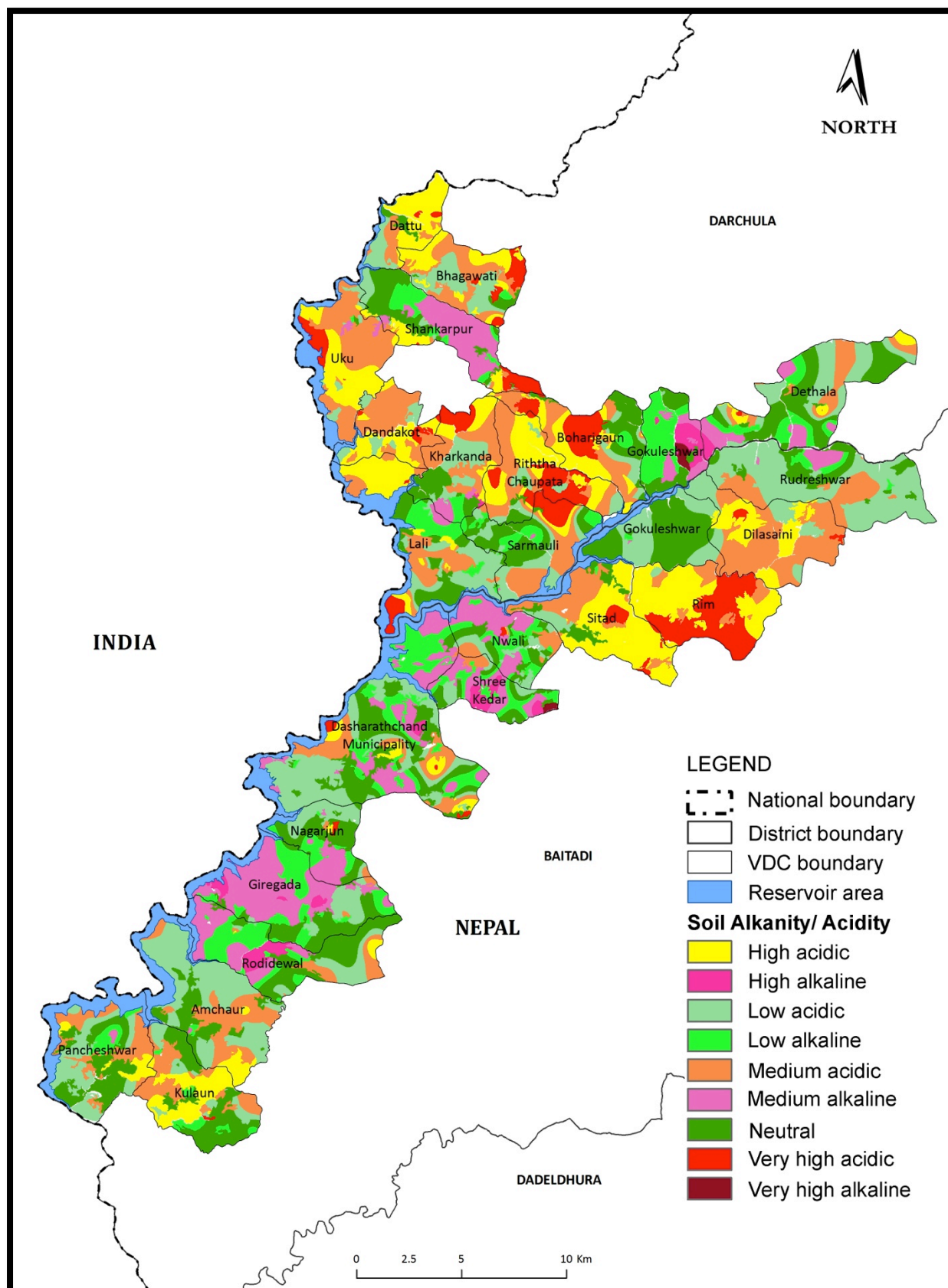


Figure 4-13: Soil alkalinity and acidity map

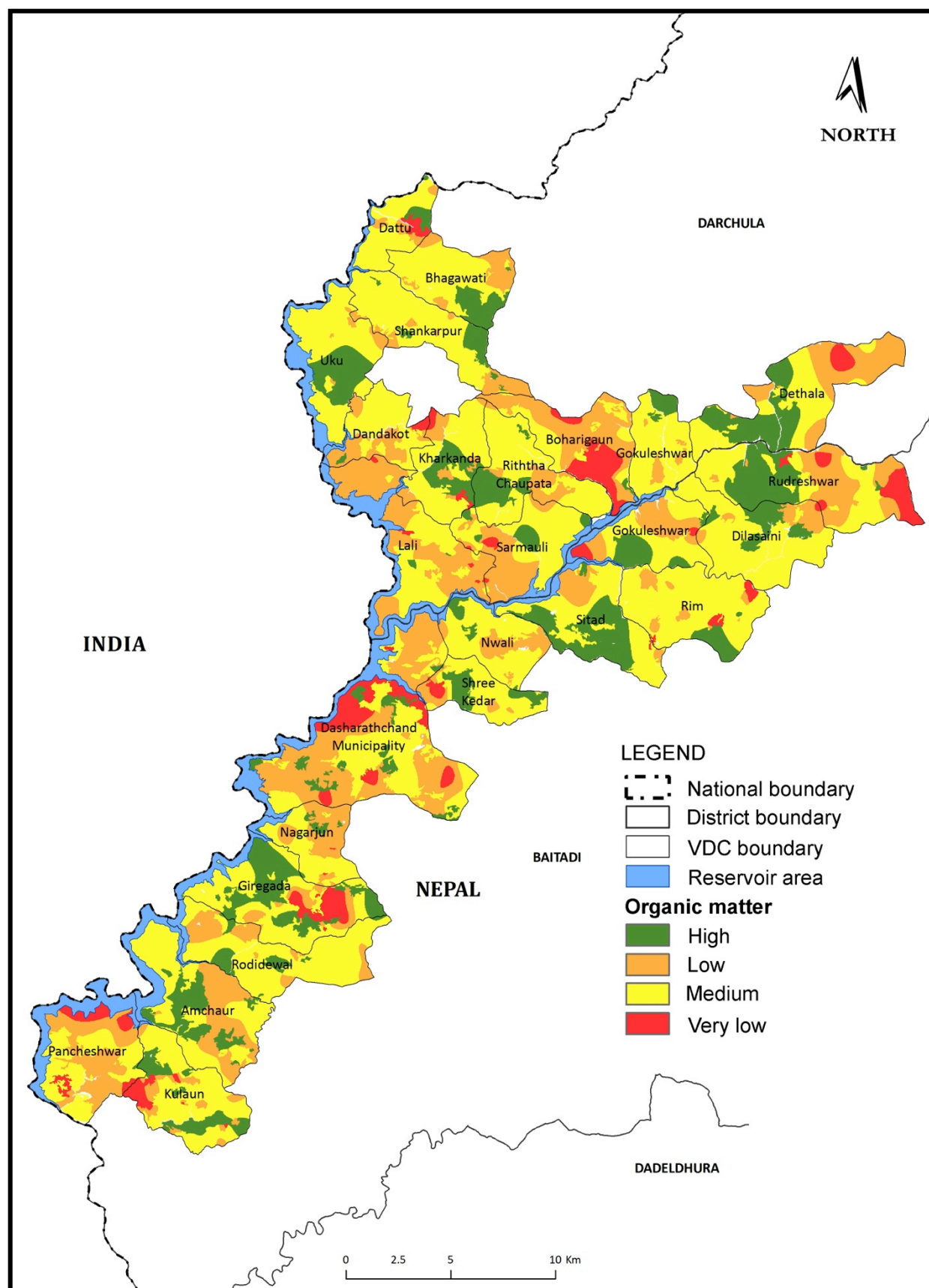


Figure 4-14: Soil organic matter content map

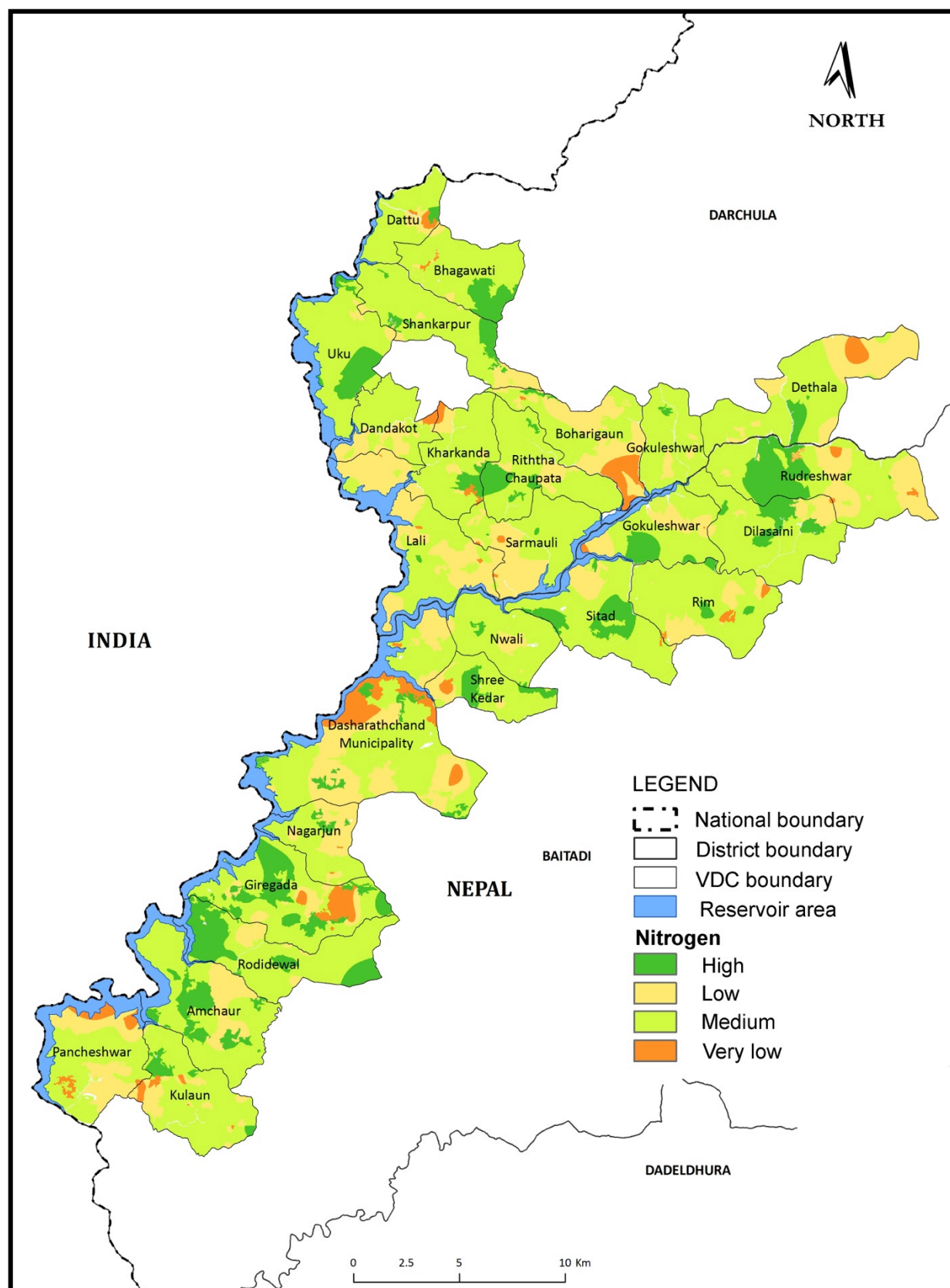


Figure 4-15: Soil total nitrogen map

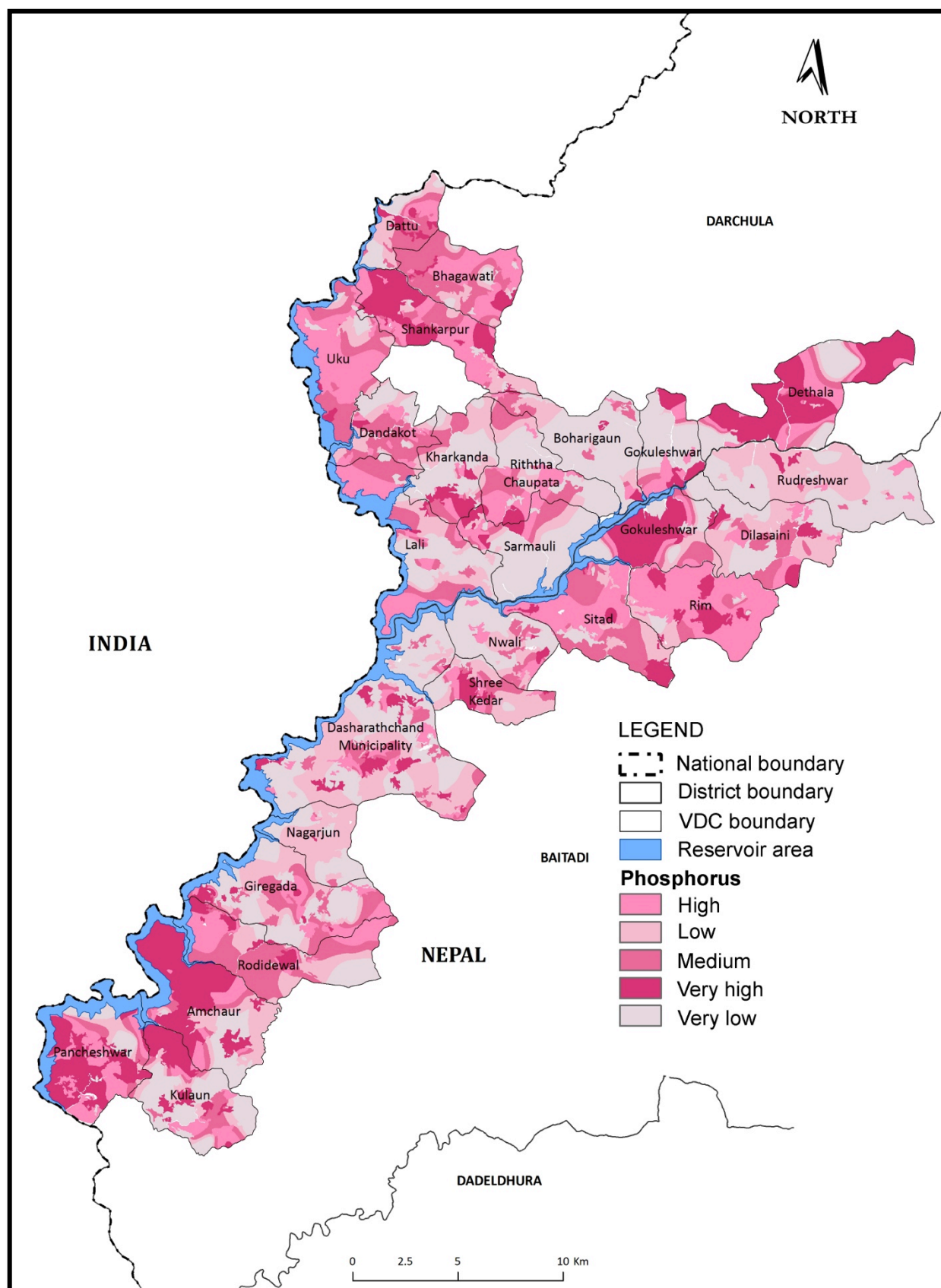


Figure 4-16: Soil available phosphorus map

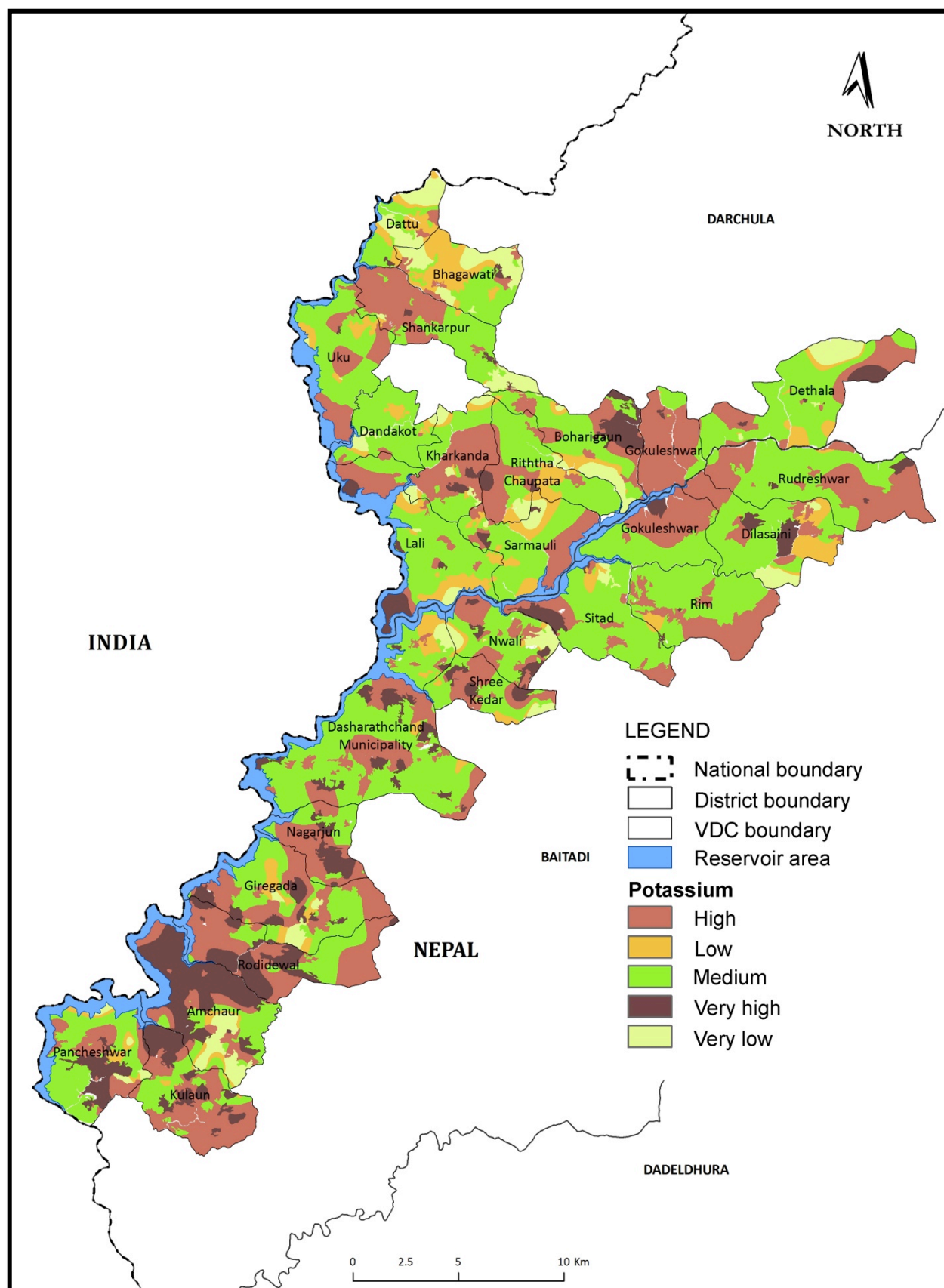


Figure 4-17: Soil available potassium map

Table 4-12: Soil texture (workability)

Texture	Status	Suitability
l (Loam)	Good	High
Silt Loam	Good	
Sandy Loam	Good	
cl (Clay Loam)	Moderate	
sicl (Silty Clay Loam)	Moderate	
sic (Silty Clay)	Fair	
c (Clay)	Poor	Low

Table 4-13: Soil alkalinity and acidity rating

pH	Status	Suitability
< 5.0	Very strongly acidic	Low
5.1 – 5.5	Strongly acidic	
5.6 – 6.0	Moderately acidic	
6.0 – 6.5	Slightly acidic	
6.6 – 7.3	Neutral	Most Suitable
7.4 – 7.8	Slightly alkaline	
7.9 – 8.4	Moderately alkaline	
8.5 – 9.0	Strongly alkaline	
>=9	Very strongly alkaline	Low

Table 4-14: Soil organic matter (OM) content rating

Percentage	Status	Suitability
>5	High	High
2.5 – 5	Medium	
1.0 – 2.5	Low	
<1	Very low	Low

Table 4-15: Soil total nitrogen (N) rating

Percentage	Status	Suitability
>0.2	High	High
0.1 – 0.2	Medium	
0.06 – 0.1	Low	
<0.06	Very low	Low

Table 4-16: Soil available phosphorous (P₂O₅) rating

Percentage	Status	Suitability
>110	Very high	High
55 – 110	High	
30 – 55	Medium	
16 – 30	Low	
< 16	Very low	Low

Table 4-17: Soil available potassium (K₂O) rating

Percentage	Status	Suitability
>550	Very high	High
280 – 550	High	
110 – 280	Medium	
70 - 110	Low	
>70	Very low	Low

4.2.11 Ambient Air Quality

Being non-industrial, the project area is free from industrial air pollution. However, dust pollution from vehicles and household activities is significant.

The settlements along the earthen road section of the Mahakali Highway, Jhulaghat-Baitadi feeder road, and Gokuleshwar-Dethala feeder road experience dust pollution. The level of pollution rises during the dry seasons. During informal discussions, the local residents complained of dust allergies, coughs, breathing difficulties and eye problems.

The major market centers of the project area, such as Gothalapani in Baitadi, Khalanga Bazaar and Gokuleshwar in Darchula, are the points of possible vehicular pollution. On an average, about 25 to 35 light and heavy vehicles ply through and/or idle in these markets. The idling of vehicles releases harmful pollutants such as carbon monoxide, sulphur oxide, nitrogen oxide, etc.

Almost all households in the project area use firewood and traditional stoves for cooking. Hence, indoor air pollution is significant, resulting in incidences of respiratory diseases such as chronic bronchitis and asthma. Discussions with health officials reveal that these diseases are two of the top ten diseases prevalent in Baitadi and Darchula Districts.

4.2.12 Water Sources and Quality

Almost all settlements along the Mahakali and Chameliya Rivers use river water for drinking and other purposes. Other streams and springs form the sources of water for settlements located away from these rivers. Piped water supply and community taps are available in the larger settlements.

Results of water quality tests at various locations along the Mahakali and Chameliya Rivers during the present study are listed in Table 4-18. As shown, all samples exhibit E. Coli contamination. Water samples from community taps also show E. Coli contamination.

The turbidity of all samples from the Mahakali River is much higher than the standard set by the National Drinking Water Quality Standard, 2005. This is a result of higher levels of sediments in the river due to increased discharges caused by snow melting.

In general, the residents of the project-area settlements do not treat drinking water before consumption. This results in a high incidence of diarrhea, dysentery, skin diseases, cataracts, worm infection and abdominal infection.

Table 4-19 shows the results of DO measurements conducted during the present study. DO levels were found to be highest in the Mahakali River (8.9 mg/l), followed by Gokule Gad, a tributary of Chameliya River at Gokuleshwar. The lowest DO level (5.6 mg/l) was recorded at at Parmoli Gad, a tributary of Mahakali River at Sera.

pH measurements at various locations show that the Mahakali water is acidic, especially in the upper reaches of the river (Table 4-19). Water from the Chameliya River is slightly alkaline. Likewise, water from other sources is neutral to slightly alkaline.

Table 4-18: Water quality test results from different sources

Parameter	Mahakali River at				Chameliya River at			Tap water at				Acceptable limits	
	Joljibi	Darchula	Jhulaghat	Pancheshwar	Dethala	Sera	Gokuleshwar	Gokuleshwar	Gothalapani	Jhulaghat	Dhamkudi	WHO	NDWQS
<i>Physical</i>													
Turbidity (NTU)	56.0	58.0	84.0	71.0	8.0	3.0	7.0	<1	<1	<1	<1	5	5 (10)
Conductivity (µS/cm)	226.0	351.0	258.0	233.0	232.0	232.0	223.0	500.0	412.0	832.0	274.0	-	1,500
Total Suspended Solid (mg/l)	18.0	24.0	52.0	22.0	2.0	<1	1.0	<1	<1	<1	<1.0	1,000	1,000
Total Dissolved Solid (mg/l)	140.0	220.0	162.0	146.0	146.0	146.0	140.0	314.0	258.0	520.0	170.0	-	-
<i>Chemical</i>													
pH	7.5	7.60	7.9	7.90	8.0	7.90	8.0	7.9	8.20	8.30	7.7	6.5-8.5	6.5-8.5
Total hardness (mg/l)	108.0	126.0	120.0	112.0	108.0	116.0	108.0	284.0	232.0	478.0	116.0	500	500
Ammonia (mg/l)	<0.02	<0.02	0.02	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1.5	1.5
Iron (mg/l)	1.5	1.4	1.6	1.50	0.23	0.15	0.24	0.05	0.04	0.02	0.15	0.3	0.3 (3)
<i>Biochemical</i>													
BOD (mg/l)	2.8	3.3	2.3	2.10	0.34	0.23	2.4	2.90	2.80	1.1	2.90	-	-
COD (mg/l)	5.0	6.0	4.0	3.0	1.0	1.0	3.0	5.0	4.0	2.0	5.0	-	-
<i>Biological</i>													
Coliforms (CFU/ 100 ml)	80.0	50.0	50.0	62.0	48.0	70.0	67.0	86.0	90.0	45.0	50.0	Nil	Nil
E. Coli (CFU/ 100 ml)	16.0	15.0	19.0	21.0	12.0	20.0	24.0	22.0	10.0	18.0	25.0	Nil	Nil

Table 4-19: Temperature, pH and DO measurements on Mahakali and Chameliya Rivers

Source	Sampling location	Temperature (°C)	pH	DO (mg/l)
Mahakali	Jhulaghat	14	6.7	8.9
	Khalanga, Darchula	13	6.9	6.9
	Joljibi, Uku	15	6.7	7.5
	Rolghat, Pancheshwar	14	7.2	6.7
Chameliya	Panjyunaya	16	8	7.1
	Gokuleshwar	15	7.7	7.5
	Karkale, Dethala	14	7.9	8.1
	Gokuleshwar	14	7.9	6.7
	Sera	13	8.1	7
Gokule Gad	Near Chameliya confluence	13	7.1	8.2
Bhartola Gad	Dattu	12	7	7.7
Baku Gad	Baku, Uku	16	7.6	6.9
Parmoli Gad	Sera	14	7.5	5.6

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Ecological Character

The project area lies in Nepal's far-western mid-hill ecological region, spreading across the upper tropical, sub-tropical and temperate ecological zones of Nepal. It is mountainous and rugged, with rocky slopes, scrubs and bushes, grasslands, forests and agricultural farms. The area can be classified into primary forests, secondary forests, rocky slopes, shrub-grasslands, sand and gravels, wetlands and croplands. The gentle slope areas are terraced for agricultural farming causing with patches of remnant habitats. The farming system is traditional. The narrow riparian belts along the two major rivers, viz. the Mahakali and Chameliya, are rich in wildlife. Higher altitude regions have relatively fewer species diversity.

The project area does not have any protected areas, but it is close to three protected areas of Nepal – Shukla Phanta Wildlife Reserve in the south (western Terai region), Khaptad National Park in the east (western middle mountain region) and Api Nampa Conservation Area in the north (western high mountain region). Owing to its geophysical location, the project area forms an important corridor and connectivity linking the three protected areas.

4.3.2 Habitat and Species Diversity

Major habitat types in the project area are different types of forests, shrub lands, grasslands, rocky slopes, riparian belts, boulder bands, sandy shingle banks, wetlands and boulder farmlands, harbouring a variety of wildlife species. The important wildlife habitats are the forests of Baku, Sleti and Amtola of Uku VDC, Chuchche bagar of Sarmauli VDC, Garudani, Maichi, Eklegada and Ratauda of Lali VDC, Chauda of Nwali VDC, Jhulaghat of Dasarathchand Municipality, Sugarikhal, Rolghat, Dumnola, and Parkoti of Pancheshwar VDC, including forested areas to the south of the main campsite.

Forests of Pancheshwar, Giregada, Lali and Amchaura VDCs are very good habitats for various wildlife species. The abandoned tunnel in the PHD area is one of the best habitats for Himalayan Leaf-nosed Bats.

4.3.3 Wetlands

The Mahakali River system is an important wetland supporting a variety of wildlife species. It includes river, flood plain, stream, secondary channel and back water wetlands. These

wetlands have rich plant diversity, in particular *Acacia catechu*, *Bombax ceiba*, *Aegle marmelos*, *Shorea robusta*, *Calamus tenuis*, etc.

Large flood plains are formed at the confluences of Lali Gad and Mahakali River at Gaje Gad, Lali, Chameliya River and Mahakali River at Sera, Chaudali Khola and Mahakali River at Binayak and Panjunaya Khola and Chameliya River. These flood plains feature sand bars, gravels, large boulders and gorges. They are important wetlands, rich in riverine vegetation. These floodplains contain tree, shrub and grass species such as *Dalbergia sissoo*, *Acacia catechu*, *Vetiveria* spp, *Themeda* spp, *Saccharum* spp, etc. and different associations of vegetation such as *Imperata–Saccharum*, *Saccharum–Phragmites*, *Saccharum–Tamarix*, etc.

The river channel comprises rapids, slow flowing river channel including secondary channel, backwater, floodplains, swamp, marshes, boulders/rocks and sandbars. Several river channels are important for fish spawning. Extensive floodplains with sand bars are found in Panjunaya, Sera, Lali, and Binayak areas.

Wetland habitats of the PHD area feature earthen holes, drift logs, pebbles, etc., which serve as habitats for Otters, Periphytons (snails, nymphs and damselfly), lizards, fishes, algae, etc. Major habitat types in the Mahakali River are fast flowing river, backwater, tributaries, streams, inlet brooks, flood plains, swamps, marshes, pebbles, sandbars, etc.

4.3.4 Forests and Vegetation

4.3.4.1 Forest Types and Vegetation in Project Area

The vegetation in the project area varies with climate and altitude. Sub-tropical forests exist at lower elevations, but temperate forests are present at higher altitudes.

The forests of the project area can be classified into the following categories (Figure 4-18):

- a. Sal/Terai Mixed Hardwood Forest.
- b. Khote Salla/Lower Mixed Hardwood Forest.
- c. Khote Salla Forest
- d. Quercus/Upper Mixed Hardwood Forest.
- e. Quercus Forest.
- f. Khair Sissoo Forest.
- g. Scrubs.

The Sal/Terai Mixed Hardwood forests, consisting of Sal (*Shorea robusta*) mixed with other hardwood species, are mostly found up to elevations of 1,000 m amsl. These forests cover 9,560 ha (about 26%) of the project area. Sal forests are mostly found between elevations of 600 and 800 m amsl. They exist in the form of natural and regeneration forests and have basal areas in excess of 60 m²/ha along the southern and western aspects of the hill slopes.

The Khote Salla/Lower Mixed Hardwood forests and the Khote Salla forests (*Chirpine Pinus roxburghii*) are found between elevation 500 and 1,800 m amsl. The Khote Salla/ Lower Mixed Hardwood forests are mostly found in the lower belts, with chirpine mixed either with Sal or with other broadleaved species. The Khote Salla forests dominate most of the upper belts, covering about 45% of the total project area.

The Quercus/Upper Mixed Hardwood forests occur mostly above elevations of 1,600 m. These forests are associated mainly with Kafal (*Myrica spp.*), Gurans (*Rhododendron spp.*) and Utis (*Alnus nepalensis*). At higher altitudes, Quercus forests occur as pure forests in a few places.

Scrublands are found scattered at higher altitudes. Species such as Ghangharu (*Pyracantha crinulata*), Chutro (*Berberis spp.*), and Aiselu (*Ricinus spp.*), etc., dominate the scrublands.

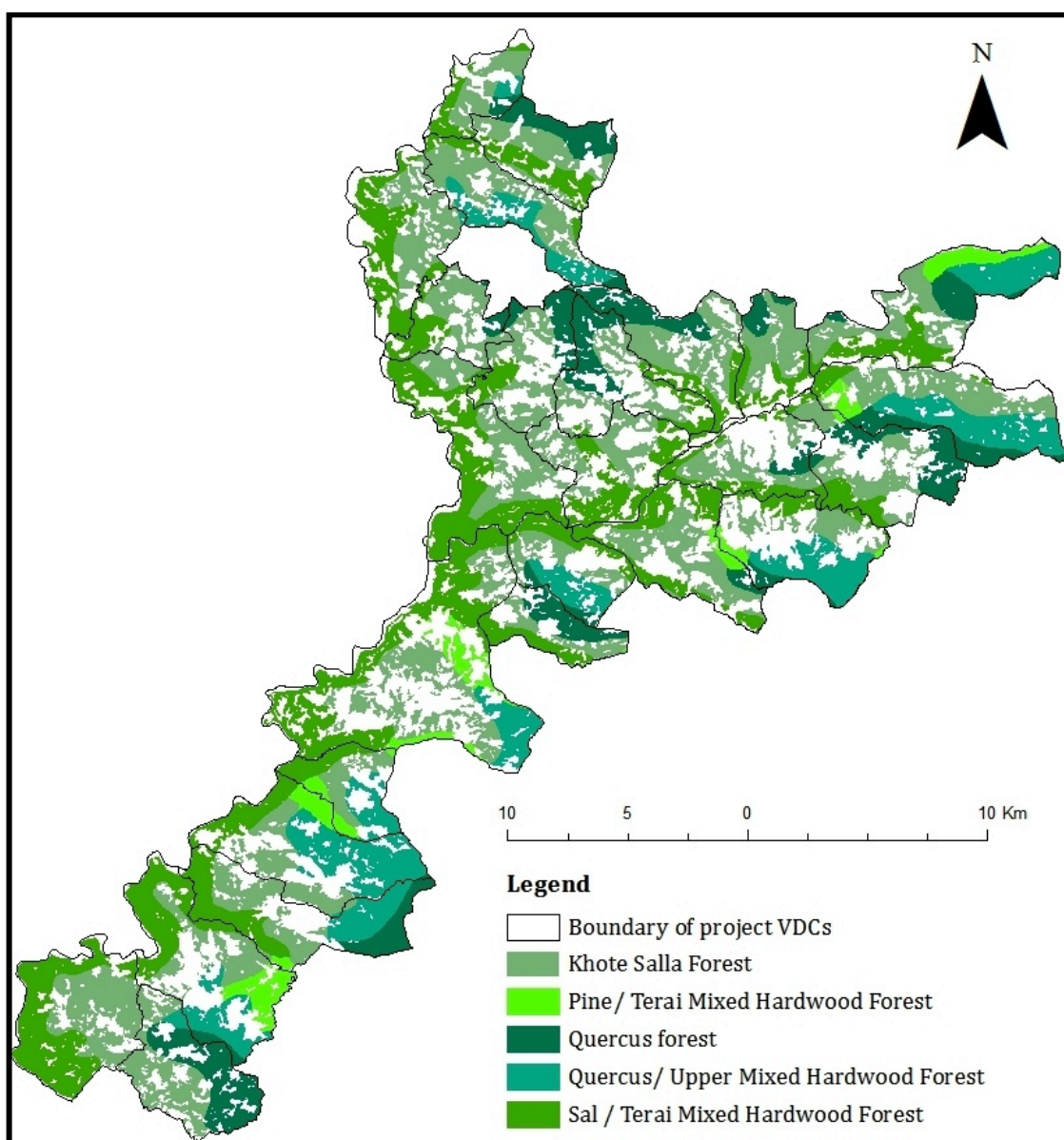


Figure 4-18: Types of forest in project area

Only a very few small patches of Khair forests occurs along the banks of the Mahakali River, with Khair (*Acacia catechu*) associated with other riverine species. Khair and Sissoo plantations are found in a very few places in the valley floors along the Mahakali and Chameliya River banks.

The site quality of forests in most undisturbed areas is medium to high (Figure 4-19). In most areas, vegetation consists of two strata (lower and upper) only with usually open middle stratum. The canopy cover in forests is usually very open near settlements (about 10%) and moderately closed in undisturbed areas (<70%).

4.3.4.2 Species Distribution

Several timber species, fodder, edible plant species, medicinal herbs and several species of lianas and climbers, ferns and orchids are found in the forests. Sal (*Shorea robusta*) is the predominant species in most of the lower belts with Asna/Saj (*Terminalia alata*) and very few other species such as Jamun (*Syzigium cumini*), Karma (*Adina cordifolia*), Khair (*Acacia catechu*), Simal (*Bombax ceiba*) and Tooni (*Toona ciliata*). The upper belts are mostly Chirpine and Quercus forests.

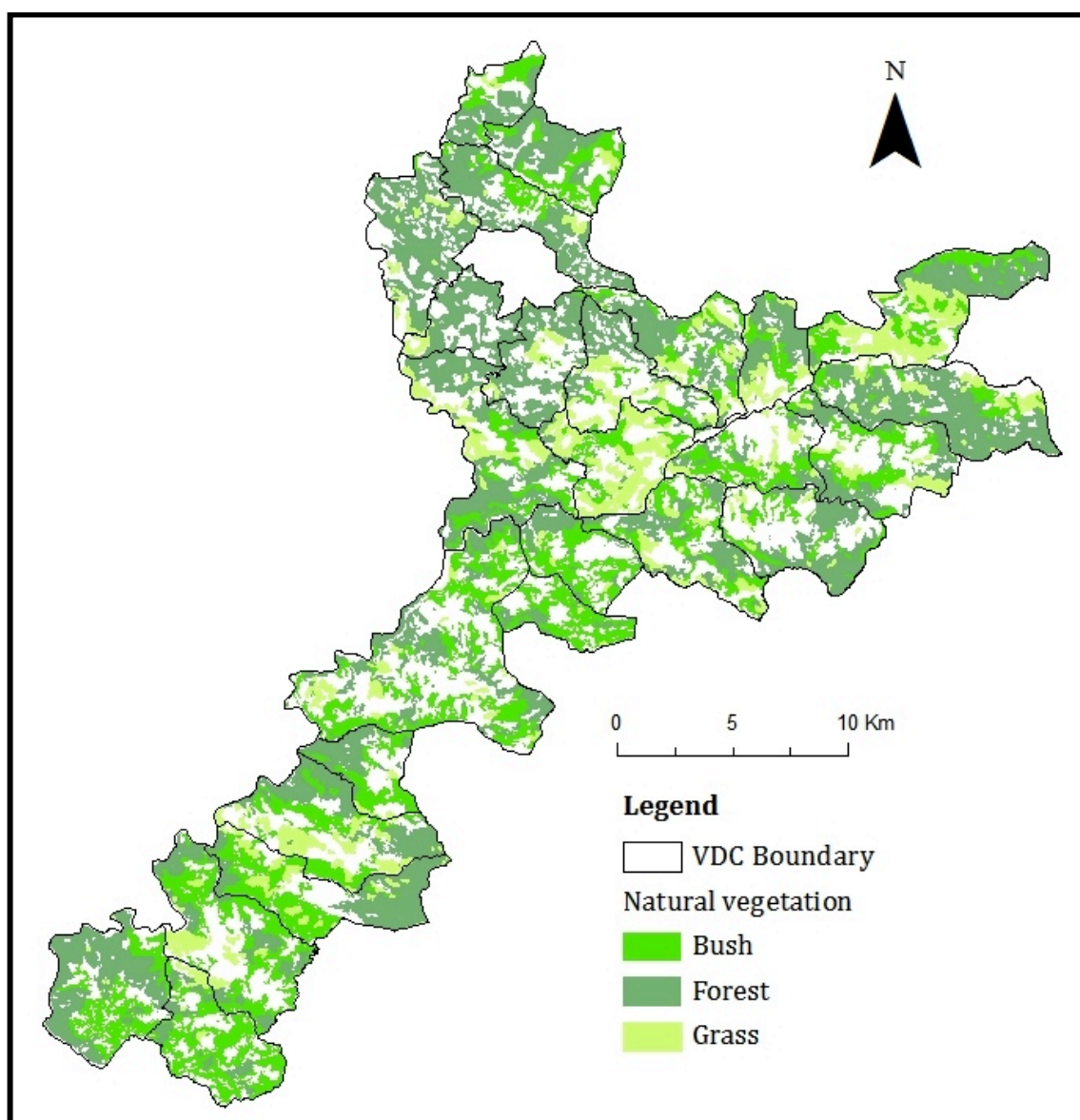


Figure 4-19: Forest condition in project area

Major shrub and herb species found in the project area are *Murraya exotica*, *Indigofera pulchella*, *Nyctanthes arbortristis*, *Barleria cristata*, *Cassia tora*, *C. odoratissimus*, *Careya arborea*, *Justicia adhatoda*, etc. Lianas and climber species, such as *Bauhinia vahlii*, *Spatholobus roxburghii*, *Vitis* spp. and *Smilax macrophylla*, are found in the lower Sal/Terai Mixed Hardwood forests.

Grassland patches are found along with rocky outcrops in dry valley slopes of the western region. These mainly consist of *Saccharum munja*, *Phragmites karka*, and *Eulaliopsis binata*. Some of the orchids found in the area are *Coelogyne*, *Dendrobium*, and *Rhyncostylis*.

Tree species such as Tooni (*Toona ciliata*), Simal (*Bombax ceiba*), Bains (*Salix* spp.), Okhar (*Juglans regia*), Rohini (*Mallotus philippinensis*) and Siris (*Albizia* spp.), fodder species such as Tanki (*Bauhinia* spp.), Khanyo (*Ficus cunia*), Kutmero (*Litsea polyantha*) and Berula, Kasreto, Kimbu (*Morus alba*), Timilo, and Haldu (*Adina cordifolia*) are found scattered in the lower regions. Bel (*Aegle marmelos*) forests are found in drier regions along the southern slopes near the confluence of the Mahakali and Chameliya Rivers. The banks of the Mahakali River are dominated by species like Rohini (*Mallotus* spp.), Banmara (*Lantana* spp.), *Eupatorium* spp., Asuro (*Adhatoda* spp.), Khirra, Amla, Bel, curry leaf (*Murraya* spp.) and Sajiwan (*Jatropha* spp.). Species such as Katahar, Chiuri, and Aanp are grown in agricultural lands.



Figure 4-20: Pine forests

4.3.4.3 Rare and Endangered Tree Species

Several plant species recorded in the DIZ and IIZ of the project are rare and threatened (Table 4-20). Sal (*Shorea robusta*), Khair (*Acacia catechu*), Simal (*Bombax ceiba*), Chhatiwan (*Alstonia scholaris*), Sugandha kokila (*Cinnamomum glaucescens*) and Okhar (*Juglans regia*) are legally protected under GoN's Forest Regulations 1995 (amended in 2001). Khair (*Acacia catechu*), Simal (*Bombax ceiba*) and Sal (*Shorea robusta*) are banned for felling, transportation and export. Khair, which grows naturally in riverine forests, is also a threatened species under the IUCN category. The bark of Okhar (*Juglans regia*) is banned for extraction from government-managed forests, while fruits of Sugandha kokila (*Cinnamomum glaucescens*) are banned for export in crude form.

Table 4-20: Major rare and endangered species in the area

SN	Species name		Occurrence	GoN protection status	IUCN category ³
	Local	Scientific			
1	Sal	<i>Shorea robusta</i>	Lower Sal forest region, DIZ/IIZ	Banned for felling, transport and export	
2	Khair	<i>Acacia catechu</i>	Riverine forest in DIZ	Banned for felling, transport and export	T
3	Simal	<i>Bombax ceiba</i>	Lower regions/ agricultural land	Banned for felling, transport and export	
4	Okhar	<i>Juglans regia</i>	DIZ	Bark banned for collection, distribution and export	
5	Sugandha kokila	<i>Cinnamomum glaucescens</i>	Middle hills, DIZ	Banned for export in crude form	
6	Chhatiwan	<i>Alstonia scholaris</i>	DIZ		R
7	Tatelo	<i>Oroxylum indicum</i>	Middle region		V
8	Orchids	<i>Orchidaceae</i>		Banned for extraction and export	

³ V: Vulnerable; R: Rare; T: Threatened

4.3.4.4 Non-timber Forest Products

The project area is rich in Non-timber Forest Products (NTFPs). The economically important NTFPs that are commonly collected and traded in the two districts are Ritha (*Sapindos mukorossi*), Jhyau (*Permelia spp.*), Pakhanbed (*Bergenia ciliata*), Amla (*Phyllanthus emblica*) and Pine resin. Other economically important species are Satuwa (*Paris polyphylla*), Chiraito (*Swertia chirayita*), Sugandawal (*Valeriana jatamansi*), Bojho (*Scorus calamus*), Timur (*Zanthoxylum armatum*), Tejpat (*Sinamum tamala*), Chutro (*Berberis spp.*), Kurilo (*Asparagus spp.*), Somlata (*Ephedra gerardiana*), Chyau (Wild mushroom), Sungava, Kakadsinghi (Gall of *Pisticia*), Sunakhari, Bel (*Aegle spp.*) and Jurgo (*Tinospora sinensis*). About 30 types of NTFPs grow naturally in Darchula District and 9 species in Baitadi District.

Table 4-21: Major NTFPs in project area

SN	Species	
	Nepali name	Scientific name
1	Ritha	<i>Sapindos mukorossi</i>
2	Jhyau (Lichens)	<i>Permelia spp.</i>
3	Pakhanbed	<i>Bergenia ciliata</i>
4	Amla	<i>Emblica officinalis</i>
5	Khoto (Pine resin)	<i>Pinus roxburghii</i>
6	Satuwa	<i>Paris polyphylla</i>
7	Chiraito	<i>Swertia chirayita</i>
8	Sugandawal	<i>Valeriana jatamansi</i>
9	Bojho	<i>Scorus calamus</i>
10	Timur	<i>Zanthoxylum armatum</i>
11	Tejpat (leaves)	<i>Cinnamomum tamala</i>
12	Chutro	<i>Berberis spp.</i>
13	Kurilo	<i>Asparagus spp.</i>
14	Somlata	<i>Ephedra gerardiana</i>
15	Chyau (wild mushrooms)	<i>Agaricus bisporus</i>
16	Sungava	<i>Orchidaceae</i>
17	Kakadsinghi	(Gall of <i>Pisticia</i>)
18	Sunakhari	<i>Orchid</i>
19	Bel	<i>Aegle marmelos</i>
20	Gurgo	<i>Tinospora sinensis</i>
21	Nigalo	<i>Arundinaria spp.</i>
22	Bans	<i>Bambusa spp.</i>
23	Bhorla pat	(leaf of <i>Bauhinia vablii</i>)
24	Lokta	<i>Daphne spp.</i>
25	Allo	<i>Girardiana diversifolia</i>
26	Kaulo/Pawan barks	<i>Persea spp.</i>

4.3.4.5 Ethno-botanical and Medicinal Plant Species

During the present study, a total of 366 medicinal plants were identified in the project area. A complete inventory of these plants, with details on local and scientific names, locations of availability in the project area, medicinal usage, commercial importance, etc., is presented in Appendix E.

Out of the recorded medicinal plants, 15 plants have been identified as being attractive for commercial plantation (Table 4-22). This has been done considering the commercial value of plants, usage by locals, medicinal values and potential for cultivation.

Table 4-22: Commercially attractive medicinal plants

SN	Name	
	Local	Scientific
1	Mahajadi	<i>Stellaria monosperma</i>
2	Chiuri	<i>Diplokenema bnutyraea</i>
3	Ashwagandha	
4	Kurilo	<i>Asparagus species</i>
		<i>Asparagus recemosus</i>
		<i>Asparagus officinalis</i>
5	Musali	<i>Curculigo orchioides</i>
		<i>Curculigo capitata</i>
		<i>Rascoeia capitata</i>
6	Satyabati	<i>Mentha piperata</i>
7	Lodhsalla	<i>Taxus baccata</i>
8	Dalchini	<i>Cinnamomum zeylanicum</i>
9	Ratochyau	<i>Ganoderma applanatum</i>
10	Paanchaunle	<i>Dactylorhiza hatagirea</i>
11	Timur	<i>Zanthoxylum armatum</i>
12	Kalo tulsi	<i>Ocimum santalum</i>
13	Nishoth	<i>Operculina turpethum</i>
14	Okhar	<i>Juglans regia</i>
		<i>Salvadora oleoides</i>
15	Amala	<i>Phyllanthus embelica</i>

4.3.4.6 Forest Uses

Forest resources are very important for the livelihood of the project-area residents. Forests are used for collection of timber, fuel wood, grass, thatch, fodder and NTFPs. In a few places, sand, gravel and stones are also collected from the forests.



Photo 4-6: Fodder collection

About 53% of the fuel wood demand and 56% of the fodder demand in Darchula are met from private forests. In Baitadi, 58% of the total fuel wood demand and 55% fodder demand are met from private forests/*kharbari*, while 46% of the timber demand is met from the private forests. The balance demands are met from the national forests or leasehold forests.

Most households in the project area fulfill their needs for forest products from community forests, private forests/*kharbari* and leasehold and national forests. In the PHD area, the locals meet their firewood and fodder demands mostly from their private forests or *kharbari*.

The major source of energy in the project area is fuel wood. Only a few hotels and restaurants in the main markets – Gothalapani and Darchula Bazaar – use gas or electricity for cooking. Only a very few households use cow-dung and biogas for cooking and heating.

4.3.4.7 Forest Management

The DFOs of Darchula and Baitadi directly manage the national forests in the project area. Most of the forests of the area have been handed over to CFUGs, Leasehold Forest User Groups (managed under lease agreement) and Religious Forest User Groups (managed by local religious communities). Some private forests are managed by their owners.

As of July 2011, a total of 2095.65 ha of forests in Darchula District have been handed over to 86 CFUGs (Table 4-23). These forests benefit 4,938 households with a total population of 31,258. In Baitadi District, 72 community forests spread over 365.25 ha have been handed over to CFUGs, benefitting 522 households with a population of 3,964.

Table 4-23: Community forests in project districts (DFO Darchula, 2011; DFO Baitadi, 2011)

District	Total CFUGs	Total forest area (ha)	Benefitted households	Benefitted population
Darchula	86	2,095.65	4,938	31,258
Baitadi	72	365.25	522	3,964
Total	158	2,460.90	5,460	35,222

4.3.5 Wildlife

The project area is home to a diverse variety of fauna. To date, 23 species of mammals, 122 species of birds, 23 species of fishes and 21 species of herpeto-fauna have been reported from the area. These numbers could increase on further studies on the wildlife of the area.

4.3.5.1 Mammals

The common mammals in the project area are Leopard, Jungle Cat, Bengal Fox, Indian Grey Mongoose, Wild Boar, Indian Hare, Common Goral, Barking Deer, Rhesus Macaque, Terai Grey Langur and Indian Crested Porcupine. Among the wildlife found in the area, the Sloth Bear is a rare animal. Local residents report the presence of the Royal Bengal Tiger and/or Lion in the southwestern Pancheshwar area, but this could not be confirmed during the field studies.

4.3.5.2 Avi-fauna

The project area, especially the PHD area and Gokuleshwor area, is very rich in birdlife. A total of 122 bird species have been recorded from the PHD area, project facility sites, borrow sites and spoil disposal site. Altogether 172 species of bird have been recorded in Pancheshwar, mainly along the Mahakali River and south of Pancheshwar.

Several species recorded in the area are of national and international importance. The Tawny Fish Owl and Tawny Eagle are rare species, while the Asian Brown Flycatcher, Greater Spotted Eagle, Long-billed Vulture, Red-headed Vulture, Rufous Woodpecker and Spot-winged Starling are listed uncommon species by Birdlife International. All these species are reported from the PHD area.

The riverine forests along the Mahakali River are important habitats for breeding birds, passage migrant, winter and summer visitors. The river provides important aquatic habitat and resting place for long distance migratory waders and waterfowls.

Table 4-24: Mammal species in project area

SN	English name	Nepali name	Scientific name	Major habitat
1	Leopard*	Chituwa	<i>Panthera pardus</i>	Forests
2	Jungle Cat	Ban Biral	<i>Felix chaus</i>	Scrub and grassland
3	Golden Jackal*	Syal	<i>Canis aureus</i>	Scrub, marginal area
4	Bengal Fox	Phusro Fyau	<i>Vulpes bengalensis</i>	Open country
5	Indian Grey Mongoose	Thulo Nyaurimusa	<i>Herpestes edwardsi</i>	Cultivated and open land, scrubs
6	Sloth Bear	Kathe Bhalu	<i>Melursus ursinus</i>	Dense forest and rocky shelter
7	Wild Boar*	Bandel	<i>Sus scrofa</i>	Mixed Sal forest
8	Indian Hare	Khairo Kharayo	<i>Lepus nigricollis</i>	Bushy jungles
9	Eurasian Otter	Kalo Oat	<i>Lutra lutra</i>	Mahakali, Chameliya River
10	Mountain Weasel	Pahadi Malsapro	<i>Mustella altaica</i>	Mahakali River
11	Siberian Weasel	Siberiali Malsapro	<i>Mustella sibirica</i>	Mahakali River area
12	Yellow-throated Marten	Malsapro	<i>Martes flavigula</i>	Jungle, rocky places
13	Northern Palm Squirrel*	Paanch Dharke Lokharke	<i>Funambulus pennanti</i>	Mango trees
14	Common Goral*	Ghoral	<i>Naemorbedus goral</i>	Steep rocky mountains
15	Barking Deer*	Ratuwa	<i>Muntiacus muntjak</i>	Riverine forests
16	Terai Grey Langur*	Terai Langur	<i>Semnopithecus hector</i>	Rocks & cliffs
17	Rhesus Macaque*	Rato Bandar	<i>Macaca mulatta</i>	Marginal area, Bare land, River banks
18	Indian Crested Porcupine*	Jure Dumsi	<i>Hystrix indica</i>	Rocky jungles, caves
19	Leaf-nosed bat	Chamero		Tunnels and caves
20	Pipistrelle	Chamero		Houses
21	Greater Short-nosed Fruit bat	Nepte Chamero	<i>Cynopterus sphinx</i>	Chiuri trees
22	Grey musk shrew	Chuchundro		Houses
23	House rat	Ghar Muso	<i>Rattus rattus</i>	Houses

Source: PMP EIA Report and field survey (June 2012)

4.3.5.3 Herpeto-fauna

Important amphibians reported from the area are the Himalayan toad (*Bufo himalayanus*), Common Asian toad (*B. melanostictus*) and Indian bullfrog (*Hoplobatrachus tigerinus*). The common reptiles found in the area are common garden lizard (*Calotes versicolor*), Himalayan rock lizard (*Laudakia tuberculata*), Yellow bellied house gecko (*Hemidactylus flaviviridis*), Indo-Pacific gecko (*Hemidactylus garnotii*), Brahminy skink (*Mabuya carinata*), Striped grass skink (*Mabuya dissimilis*), Bengal monitor lizard (*Varanus bengalensis*), common blind snake (*Rhynchophis bhamini*), Chequered keelback water snake (*Xenochrophis piscator*), Asiatic rat snake (*Ptyas mucosa*), Common cat snake (*Boiga trigonata*), Indian Python (*Python molurus*), Green cat snake (*Boiga cyanea*), Monocled cobra (*Naja kaouthi*) and Pit vipers (*Trimeresurus spp.*). Local residents claim to have sighted Mugger Crocodile in the Mahakali River near Pancheshwar about six years ago, but it has not been sighted since then.

4.3.5.4 Invertebrates

Very little is known on invertebrates of the project area. Butterflies, dragonflies and mollusks reported from the area are several species of Papilionid, Danaid, Lycaenid, Pierid and Hesperid butterflies, abundant Libellulid, Gomphid and Aeshnid dragonflies and *Macrochlamys* spp., *Sitala* spp., *Clausilia* spp. and *Kaliella* spp. of mollusks.

4.3.5.5 Rare and Endangered Species

Several wild animals found in the area are globally important. Several species are listed as rare and endangered in IUCN (The Conservation Union) Red Data, CITES (Convention on International Trade in Endangered Species of Fauna and Flora) and GoN's National Parks and Wildlife Conservation Act 1973 (NPWCA).

Sloth Bear is categorized as vulnerable in the IUCN Red List of Threatened Animals (Table 4-25). Five mammal species are listed in CITES Appendix I, one in Appendix II and six in Appendix III. The CITES Appendix I are protected species under GoN regulations.

Table 4-25: Threatened wildlife species in project area

SN	Common name	Zoological name	IUCN category ⁴	CITES Appendix ⁵
1	Leopard	<i>Panthera pardus</i>		I
2	Golden Jackal	<i>Canis aureus</i>		III
3	Bengal Fox	<i>Vulpes bengalensis</i>		III
4	Indian Grey Mongoose	<i>Herpestes edwardsi</i>		III
5	Yellow-throated Marten	<i>Martes flavigula</i>		III
6	Siberian Weasel	<i>Mustela sibirica</i>		III
7	Mountain Weasel	<i>Mustela altaica</i>		III
8	Eurasian Otter	<i>Lutra lutra</i>		I
9	CommonGoral	<i>Naemorhedus goral</i>		I
10	Sloth bear	<i>Ursus ursinus</i>	V	I
11	Rhesus Macaque	<i>Macaca mulatta</i>		II
12	Terai Grey Langur	<i>Semnopithecus hector</i>		I

Among birds of the PHD area, Tawny Fish Owl and Tawny Eagle are rare species while Asian Brown Flycatcher, Greater Spotted Eagle, Long-billed Vulture, Red-headed Vulture, Rufous Woodpecker and Spot-winged Starling are uncommon species. Similarly, Cinerous Vultures are listed as near threatened, Long-billed, White-rumped and Red-headed Vultures are listed as critically endangered and Cheer Pheasant, Greater Spotted Eagle and Egyptian Vulture are listed as vulnerable species in Birdlife International Red Data. Among the birds found in the area, Black-headed Jay and Grey-hooded Warbler are species of which Nepal may hold globally significant breeding populations.

Among herpeto-fauna, Indian python (*Python molurus*) is a protected species (Appendix I) under the NPWCA. It is also listed as a CITES Appendix I species. The Asiatic rat snake (*Ptyas mucosa*) is a CITES Appendix II species, and Chequered keelback and water snake (*Xenochrophis piscator*) are CITES Appendix III species. Among amphibians, *Hoplobatrachus tigerinus* is a CITES Appendix II species.

⁴ IUCN category: V = Vulnerable

⁵ CITES I: species threatened with extinction, CITES II: species that could become threatened if their trade is not properly controlled, CITES III: species that require international cooperation to control their trade.

4.3.5.6 Trans-boundary Migration

Several wildlife species share the adjoining forest habitats across the Indo-Nepal border, and seasonal trans-boundary migration is common. Wild Boar, Barking Deer, Terai Grey Langur, Rhesus Macaque, Leopard, Golden Jackal, Common Goral and Sloth Bear are common wildlife migrating regularly between Nepal and India across the Mahakali River. The preferred routes of migration lie in areas with forests on both sides of the border. Such important routes are in Saleti of Uku VDC, Garudanim Maichi, Eklegada and Ratauda of Lali VDC, Sungarikhal, Rolghat, Aptyad, Dumnola, Parkoti, Adhkatya, Sutola and Dammar of Pancheshwar VDCs.

Similarly, many wild animals move across the Chamelia River. The important places where such migration occurs are Chauda of Nwali VDC and Jagabagar, Raktadi, Dalibagar, and Kutiyasera of Dasarath Municipality.

The Mahakali riverine areas are also important for migratory birds. Several passage migrants, summer and winter visitors, use the area during migration.

4.3.5.7 Illegal Trade and Poaching

There is limited wildlife poaching in the area. Most of the poachers are local, with possible connections with illegal wildlife traders from outside the area. Leopard and Otter are the two main species killed for their skins, while Porcupine, Goral, Wild Boar and Barking Deer are common species killed for meat. The common poaching methods employed by poachers are gunshots, traps, snares and poisoning.

4.3.5.8 Human – Wildlife Conflict

The major cause of human – wildlife conflict in the area is the loss of crops, followed by livestock depredation by wildlife. Monkeys, Porcupine, Goral, Barking Deer, Hare and Rats are the major wildlife species that cause damage to different agricultural crops and stored grains. Leopard, Jackal, Jungle Cat and Sloth Bear kill livestock. In recent times, there have been reports of increasing attacks on humans by Common Leopard, mostly in the southern parts of the project area.

Crop damage is present throughout the project area. However, it is high in Amtola, Talli Chauki, Joljibi (Uku), Ganet (Ritha Chaupara), Kamedpani (Dadakot), Bayalbata, Kethgaradi (Sarmauli), Gaujegada, Maichi, Eklegada, Garali (Lali), Udai, Bet (Dattu), Deujhadi (Gokuleshwar), Jadabagar, Jebalisera, Naltadi, Ratmata (Dashrathchand) and Jangaltada (Aamchaura).

4.3.6 Fish and Aquatic Life

The status of aquatic ecosystem (fish and fisheries) in the project area was established based on field surveys conducted during the PMP EIA study and the present study.

4.3.6.1 Water Quality

Measurements made in June 2012 showed that river water temperatures in the project area varied from 16.7 °C at Joljibi to 22.3 °C at Gokuleshwar (Table 4-18). Similarly, the pH values ranged between 7.2 at Joljibi and 7.6 at Gokuleshwar.

Seasonal variation in river water temperature and pH values was found to be very low. In October, the water temperature varied between 14 and 15 °C, while the pH values ranged between 6.7 and 7.9. During these measurements, dissolved oxygen in the river water was found to vary between 5.6 and 8.3 mg/l.

The result obtained from water quality analysis of Mahakali River shows that the river water parameters are suitable for the growth of fish and aquatic life. These data validate the finding of the EIA study.

4.3.6.2 Aquatic Plants and Insects

Studies conducted during the PMP EIA show that phytoplankton and zooplankton densities vary greatly at different locations along the Mahakali River (Table 4-26). Along the Mahakali River, phytoplankton density was lowest at its confluence with Baku Gad (286/l) and highest in Jhulaghat area (900/l). Likewise, the zooplankton density was lowest at the Mahakali River's confluence with Gauri Ganga and Uku Gad (53 to 57 /l), and it was highest at Mahakali's confluence with Pramoli Gad (740/l).

Table 4-26: Plankton density at different sampling sites of Mahakali River

S N	Sample sites (Confluence with Mahakali River)	Density of (number/ liter)	
		Phytoplankton	Zooplankton
1	Gauri Ganga	450	57
2	Uku Gad	323	53
3	Baku Gad	286	167
4	Lali Gad	328	95
5	Chameliya	468	178
6	Pramoli Gad	490	740
7	JhulaGhat area	900	220
8	Nil Gad	450	160
9	Garma Gad	600	270
10	Binayak	430	245
11	Saryu	575	297
12	PHD site	687	255
13	Immediately downstream of PHD site	277	163

Source: PMP EIA Report

4.3.6.3 Fish Habitat, Spawning and Rearing

Habitat

Field observations reveal that the Mahakali River and its tributaries have boulder, pebble, gravel, sand, riffles, pool and backwater in different places, offering good spawning grounds for many fish species. At some sites between the PHD site and Jhulaghat, the habitat appears to be less productive due to steeper river gradients and high water velocities as well as high sediment loads during wet season. The Chameliya River, which has a gentler gradient, and other smaller tributaries provide good habitats and are relatively productive.

In general, most river areas harbor rich phytoplankton, zooplanktons, micro and macro-invertebrates and thus have suitable habitats for fish and other aquatic fauna. During the study period, fish species like *Tor* sp., *Labeo* sp., *Neoliossocheilus* sp., *Bagarius* sp. were observed in the deep waters while species like *Schizothorax* sp., *Garra* sp., *Glyptothorax* sp., and *Noemacheilus* sp. were recorded with maximum catch in fast flowing and gorge type areas. Different types of habitat, such as run, riffles and pools, were observed.

Spawning and Rearing Areas

During the 2012 field studies, four major spawning and rearing sites were identified along the Mahakali River (Table 4-27). These sites are located at the Mahakali River's confluences with the Gauri Ganga, Chameliya and Saryu and in Chameliya River at Gokuleshwar. In particular, the confluence areas are rich in planktons and other food organisms in comparison with the tributaries. In addition, these habitats are found to be more suitable, especially for feeding than spawning, due to wide coverage areas with large depths. These areas are also utilized as transit habitats by the migratory species.

Table 4-27: Spawning and rearing areas at different sites of Mahakali River

SN	Study site (Mahakali River confluence area)	Spawning	Rearing	Remarks
		Area		
1	Gauri Ganga	Maximum	Maximum	Upstream and downstream of confluence points
2	Uku Gad	Moderate	Moderate	
3	Baku Gad	Low	Low	
4	Lali Gad	Moderate	Low	
5	Chameliya River	Maximum	Maximum	
6	JhulaGhat area	Low	Moderate	
7	Saryu River	Maximum	Maximum	
8	PHD site	Low	Moderate	
9	Gokuleshwar	Maximum	Maximum	

Source: Field Study, June 2012

4.3.6.4 Fish Species and Migration Pattern

Altogether 23 species of fish under three orders and six families were recorded in the project area during EIA study. In the present study, three species were recorded: *Schizothorax* species, *Tor* species and *Glyptothorax* species (Photo 4-7, Photo 4-8, Photo 4-9). *Schizothorax* species was found at all of the sampling sites in high abundance (Table 4-28). One new resident species, *Glyptothorax alakninda*, was recorded during the present field study.

Photo 4-7: *Tor* speciesPhoto 4-8: *Schizothorax* species

Table 4-28: Fish catch composition in Mahakali River upstream of PHD site

S N	Fish species	Gauri Ganga		Uku Gad		Baku Gad		Lali Gad		Chameliya River		Parmoli Gad		Nil Gad		Garma Gad		Binayak area		Saryu	
		Mahakali River confluence area																			
		Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Site 8		Site 9		Site 10	
		October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May
		October – December: 2005 and May: 2006																			
1	<i>Schizothorax plagiosomus</i>	+	+	++	+	++	+	++	+					+++	+++	++ +	+	++	++	++ +	++
2	<i>S. richardsonii</i>	+	+	++	+	+	+	+	+	++	++	+++	+++	++	++	++	++	+	+	++	++
3	<i>Schizothoracichthys progastus</i>	+	+	++	+	+	+	+	+	+	+		+	+	+				+		
4	<i>Garra gotyla</i>	++	+	++	++	+	+	++		+	+	++		++	++			+	+		
5	<i>G. annendalei</i>		+	+			+	+	+	+	+	+		+	+	+		+			
6	<i>Glyptothorax trliniatus</i>	+		++		++	+	++	+					++	++						
7	<i>G. telchitta</i>	+	+			+		+		+	+	++	++	+	++	++	++	++	++	+	+
8	<i>Glyptothorax alakeninda</i>		+																		
9	<i>Pseudocheneis sulcatus</i>	+		++		++	+	++	+	+	++	+	++	+	++	++	++	++	++	+	+
10	<i>Labeo dyocheilus</i>				+					+	++ +	+	++		+						
11	<i>Labeo pangusia</i>		+		+		+				+				+				+		
12	<i>Neolissocheilus hexagonolepis</i>		++		+												+		+	++	++
13	<i>B. bendelisis</i>		+				+		+						++						
14	<i>B. barila</i>		+		+				+		+		+		++		+				+
15	<i>B. barna</i>											+			+				+		
16	<i>Chagunius chagunio</i>				+		+	+							+						

S N	Fish species	Gauri Ganga	Uku Gad		Baku Gad		Lali Gad		Chameliya River		Parmoli Gad		Nil Gad		Garma Gad		Binayak area		Saryu		
		Mahakali River confluence area																			
		Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Site 8		Site 9		Site 10	
		October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May	October – December	May
		October – December: 2005 and May: 2006																			
17	<i>Tor tor</i>	++	+	++	+	++	++	++	++		++	++	+	++	+++	+	+	+	++	++	++
18	<i>Tor putitora</i>	++	+++	++	++	+	++	++	++	++	++	++	++	++	+++	+	+	++	++	++	+++
19	<i>Mastacembelus armatus</i>						+		+	++	++	+++	++				+				
20	<i>Amphionus cuchia</i>					+												+			
21	<i>Noemacheilus sp.</i>		+	+			+	+							+						
22	<i>Bagarius bagarius</i>	+				+			+			+		+						++	
23	<i>Bagarius yarillii</i>	+									+						+			++	+

Source: Field survey in October – December 2005 and May 2006

* DEMP Field survey 2012

Abundance: +++ = high; ++ = Medium; + = Low

Photo 4-9: *Glyptothorax* species

4.3.6.5 Migration Pattern

Based on their migration pattern, seasonal occurrence and feeding behavior, the fish species are categorized as long distance migratory, mid/short distance migratory and resident (Table 4-29).

Table 4-29: Migration pattern of fish species

S N	Name		Migration Pattern		
			Distance		Resident
	Scientific	Common	Long	Mid/Short	
1	<i>Schizothorax plagiosomus</i>	Asla		+	
2.	<i>S. richardsonii</i>	Asla		+	
3	<i>Schizothoracichthys progastus</i>	Asla		+	
4.	<i>Garra gotyla</i>	Buduna			+
5.	<i>G. annendalei</i>	Laharebuduna			+
6.	<i>Glyptothorax trliniatus</i>	Telchapre			+
7.	<i>G. telchitta</i>	Telchapre			+
8	<i>Glyptothorax alakninda</i>	Kapre/Kapdyal			+
9	<i>Pseudo cheneissulcatus</i>	Kabre			+
10	<i>Labeo dyocheilus</i>	Gardi		+	
11	<i>Labeo pangusia</i>	Pangusia		+	
12	<i>Neolissocheilus hexagonolepis</i>	Katle		+	
13	<i>Barilinus Bendelisis</i>	Fageta			+
14	<i>B. barila</i>	Fageta			+
15	<i>B. barna</i>	Fageta			+
16	<i>Chagunius chagunio</i>	Rewa			+
17	<i>Tor tor</i>	Mahaseer	+		
18	<i>Tor putitora</i>	Mahaseer	+		
19	<i>Mastacembelus armatus</i>	Chusi bam			+
20	<i>Amphionus cuchia</i>	Aandho bam			+
21	<i>Noemacheilus sp.</i>	Stone Loach			+
22	<i>Bagarius bagarius</i>	Gonch	+		
23	<i>Bagarius yarillii</i>	Gonch	+		
	Total		4	6	13

Source: DEMP Field study 2012 and EIA Report

Long Distance Migratory Species

Four long distance migratory species were recorded in the project area. These species are *Tor tor*, *Tor putitora*, *Bagarius bagarius*, and *Bagarius yarillii*. These were considered long distance migratory species as they generally have tolerance to a higher range of water temperatures and habitat environments.

Tor species was found at all sampling sites with medium to high abundance. However, FGDs during the present field studies revealed that the *Bagarius* spp were not observed in the last five to six years.

Short Distance Migratory Species

Six species of short or mid distance migratory species were recorded in the project area. They include *Schizothorax plagiostomus*, *S. richardsonii*, *Schizothoracichthys progastus*, *Labeo dyocheilus*, *Labeo pangusia* and *Neolissocheilus hexagonolepis*. These species can generally adapt to a lower or limited range of habitat environments.

Resident Species

Fish species found only locally were considered as resident species. Altogether 13 resident species were recorded in the project area. These included *Garragotyla*, *G. annendalei*, *Glyptothorax trliniatus*, *G. telchitta*, *Glyptothorax alakeninda*, *Pseudo cheneissulcatus*, *Bariliu bendelisis*, *B. barila*, *B. barna*, *Chagunius chagunio*, *Amphionus cuchia*, *Mastacembelus armatus* and *Noemacheilus* sp. *Mastacembelus armatus* was found only between Mahakali's confluence with Baku Gad and Garma Gad, and its abundance was low.

4.4 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

4.4.1 District Context

Darchula and Baitadi, the two project districts, lie in the mountain and hill ecological zones, respectively (Table 4-30). Despite covering a substantially larger area than Baitadi, Darchula has a low population density because of its difficult terrain and greater remoteness. Both districts exhibit nearly equal sex ratios (defined as number of males per 100 females). The average household sizes of both districts are comparable but higher than the national figure.

Table 4-30: Key indicators of project districts

Indicator	Darchula	Baitadi	Nepal
Ecological zone	Mountain	Hill	Mixed
Area (sq. km)	2,322	1,591	141,181
Population	133,274	250,898	26,494,504
Sex ratio	91.30	87.95	94.16
Density (person/sq. km)	57	158	180
No. of households	24,618	45,191	5,427,302
Average household size	5.4	5.5	4.88
Total VDCs	41	62	3,912
Municipalities	0	1	99
Human Development Index (HDI)	0.424	0.391	0.471
HDI ranking	52	63	-
Human Poverty Index (HPI)	45.4	48.7	39.6
HPI ranking	45	56	-
Gender-related Development Index (GDI)	0.394	0.361	0.452
GDI ranking	55	64	-

Source: CBS, 2012; UNDP HDI Report 2004

Both districts are divided into municipalities and VDCs, the lowest political-administrative units of governance. Only one municipality, viz. Dasharath Chand in Baitadi district, exists in the entire project area. Thus, almost the entire population of the project area is rural.

Both project districts remained relatively isolated from the rest of Nepal till a few decades ago. This history of relative isolation has partly contributed to their underdeveloped status. Despite continued government commitment for development, the districts still lag behind other parts of Nepal in terms of socioeconomic, poverty and development indicators.

4.4.2 VDC/Municipality Context

The total population of the 25 VDCs and one municipality, which constitute the DIZ and IIZ, is 104,933 (Table 4-31). More than 61% of this population resides in Baitadi District. The average sex ratio of these VDCs/municipality is 85.13. The total number of households in this area is 20,095, and the average household size is 5.2.

Table 4-31: Population composition of project VDCs/municipalities

VDC/ Municipality	Population			Sex ratio	Total HHs	Av. HH size
	Male	Female	Total			
Darchula						
Dattu	946	1,240	2,186	76.29	458	4.8
Bhagabati	1,389	1,629	3,018	85.27	594	5.1
Sankarpur	1,411	1,570	2,981	89.87	600	5.0
Uku	1,626	1,946	3,572	83.56	721	5.0
Dadakot	871	1,036	1,907	84.07	365	5.2
Kharkada	1,367	1,610	2,977	84.91	575	5.2
Lali	1,273	1,535	2,808	82.93	552	5.1
Sharmauli	2,002	2,346	4,348	85.34	812	5.4
Rithachaupata	2,112	2,593	4,705	81.45	912	5.2
Bohorigaun	1,967	2,244	4,211	87.66	760	5.5
Gokuleshwar	2,122	2,150	4,272	98.70	657	6.5
Dethala	1,831	1,990	3,821	92.01	633	6.0
Sub-total	18,917	21,889	40,806	86.42	7,639	5.3
Baitadi						
Rudreshwar	1,740	1,972	3,712	88.24	696	5.3
Dilasaini	2,785	2,910	5,695	95.70	1,054	5.4
Gokuleshwar	1,786	2,287	4,073	78.09	771	5.3
Rim	1,975	2,157	4,132	91.56	711	5.8
Sittad	2,154	2,501	4,655	86.13	749	6.2
Nwali	1,180	1,562	2,742	75.54	550	5.0
Shree Kedar	879	1,100	1,979	79.91	405	4.9
Dasharath Chand	7,682	9,109	16,791	84.33	3,788	4.4
Nagarjun	857	1,104	1,961	77.63	412	4.8
Giregada	1,374	1,715	3,089	80.12	574	5.4
Rodidewal	1,533	2,021	3,554	75.85	734	4.8
Aamchaura	2,117	2,685	4,802	78.85	891	5.4
Kulau	1,419	1,551	2,970	91.49	487	6.1
Pancheshwar	1,853	2,119	3,972	87.45	634	6.3
Sub-total	29,334	34,793	64,127	84.31	12,456	5.1
Total	48,251	56,682	104,933	85.13	20,095	5.2

Source: CBS, 2012

4.4.3 Major Settlements of Project Area

Settlements of the project area that fall in the DIZ are listed in Table 4-32. As shown, a total of 107 settlements, consisting of 56 from Baitadi and 51 from Darchula, are present within the DIZ. These settlements are spread across one municipality and 16 VDCs. Six VDCs in Baitadi and three in Darchula fall completely within the IIZ.

Table 4-32: Settlements within DIZ

SN	Municipality/VDCs	Settlements in DIZ	
		Name	No.
Darchula			
1	Bohorigaun	Dewal	1
2	Dadakot	Kamedpani	1
3	Dattu	Bet, Chuchhai, Dattu and Udai	4
4	Gokuleshwar	Baskot, Debal, Dhanakheti, Gajari, Gokuleshwor, Kumali, Nayal, Sansera and Sinyadi	9
5	Kharkada	Bachpali	1
6	Lali	Aurpali, Bagarpata, Bamtdad, Bhulhali, Eklegada, Garali, Garudani, Gaujegada, Jangal, Khamtdad, Killali, Lali, Maichi, Radam, Ratauda, Salani and Tallo Makanna	17
7	Rithachaupata	Ganet	1
8	Sarmauli	Bayalbata, Bharadkot, Chauda, Chuchebagar and Khetali	5
9	Uku	Amtola, Baku, Dinsi, Jadani, Joljibi, Kuchakot, Kurjyani, Pithi, Saleti, Selpya, Shantipur and Uku	12
10	Dethala	—	0
11	Bhagawati	—	0
12	Shankarpur	—	0
Total			51
Baitadi			
1	Amchaura	Binayak, Jangaltada, Kaiyanpani, Marthala,	4
2	Dasharathchand Municipality	Bakwana, Baram, Baujerasera, Bhekkar, Dalibagar, Jadabagar, Jebalisera, Jhulaghat, Kharyani, Kutiyasera, Majhsera, Matela, Naltadi, Naulegaun, Raktadi, Ratamata, Satpali, Sera, Singtari	19
3	Dilasaini	Darkhet and Naginiserajajar	2
4	Giregada	Ballar, Manail and Tarakot	3
5	Gokuleshwar	Banga Bagar, Betalthala, Chausera, Deojhadi, Kalchaude	5
6	Nwali	Chauda, Salsena	2
7	Pancheshwar	Aptyad, Chamtda, Devkot, Dumnola, Melsipu, Sugarikhal, Dumarikhan, Ganakatyia, Lek/Paladi, Rolghat, Siunani, Suryakhal	12
8	Sittad	Amaltad, Chamtda, Desada, Deuli, Grippal, Kanset, Keladi (Sada), Panjyunaya, Sauda	9
9	Rim	—	0
10	Nagarjun	—	0
11	Rodidewal	—	0
12	Shreekedar	—	0
13	Rudreshwar	—	0
14	Kulau	—	0
Total			56

4.4.4 Socioeconomic Condition of Project Affected Families

This section describes the socioeconomic and cultural baseline of the project area. It is based on the outcome of a baseline survey of 701 households located in the DIZ and IIZ.

4.4.4.1 Population and Demographic Features

Population and Households

The total population of the 701 surveyed households is 5,332, with females accounting for 48.9% of this figure (Table 4-33). The average size of these households is 7.6 persons, and the sex ratio is 104.7.

Table 4-33: Surveyed population and households

District	Population				Total HHs	Av. HH size
	Male	Female	Total	Sex ratio		
Darchula						
DIZ	346	339	685	102.1	90	7.6
IIZ	684	705	1,389	97.0	183	7.6
Total	1,030	1,044	2,074	98.7	273	7.6
Baitadi						
DIZ	445	405	850	109.9	113	7.5
IIZ	1,252	1,156	2,408	108.3	315	7.7
Total	1,697	1,561	3,258	108.7	428	7.6
Total of project districts						
DIZ	791	744	1,535	106.3	203	7.6
IIZ	1,936	1,861	3,797	104.3	498	7.6
Total	2,727	2,605	5,332	104.7	701	7.6

Source: Field survey, 2012

Broad Age Structure

As shown in Table 4-34, the surveyed population comprises 34.1% children (0-15 years), 57.4% people in the economically active category (15-65 years) and 8.5% aged people (above 60 years). Therefore, by demographic standards, the surveyed population may be considered mature.

Table 4-34: Distribution of surveyed population by broad age groups

Age (years)	Darchula			Baitadi			Total	
	Male	Female	Total	Male	Female	Total	No.	%
< 5	114	125	239	245	260	505	744	13.95
5 – 15	230	220	450	315	309	624	1074	20.14
15 – 50	446	457	903	760	650	1,410	2313	43.38
50 – 65	147	137	284	246	216	462	746	13.99
> 65	93	105	198	131	126	257	455	8.53
<i>Total</i>	<i>1,030</i>	<i>1,044</i>	<i>2074</i>	<i>1,697</i>	<i>1,561</i>	<i>3,258</i>	<i>5,332</i>	<i>100</i>

Source: Household survey, 2012

Age at Marriage

Among the surveyed population aged 18 years or more, nearly 57% were married while about 42% were unmarried. The remaining 1.9% were single.

Table 4-35: Marital status of surveyed population aged 18 years or more

Marital status	Darchula (%)		Baitadi (%)		Total (%)	
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ
Married	55.8	53.6	57.4	58.5	56.6	56.6
Unmarried	42.5	44.1	40.3	40.1	41.3	41.6
Single	1.8	2.3	2.3	1.4	2.1	1.8
Total	100	100	100	100	100	100

Source: Household survey, 2012

4.4.4.2 Social Characteristics

Literary Status

Nearly 26% of surveyed population is illiterate (Table 4-38), with illiteracy among women being higher than that of men in both districts. The gender gap in literacy is marginal up to the secondary level; however, this gap widens at higher levels.

Table 4-36: Literacy status and educational attainment

Status	Darchula				Baitadi				Total	
	Male		Female		Male		Female		Total	
	No.	No.	No.	%	No.	No.	No.	%	No.	%
Illiterate	225	295	520	25.1	395	475	870	26.7	1,390	26.1
Primary (up to 5)	325	367	692	33.4	539	530	1069	32.8	1,761	33.0
Secondary (5 to 10)	254	230	484	23.3	414	377	791	24.3	1,275	23.9
SLC (10 to 10+2)	161	120	281	13.6	271	140	411	12.6	692	13.0
Bachelors and above	65	32	97	4.7	78	39	117	3.6	214	4.0
Total	1030	1044	2074	100	1697	1561	3258	100	5332	100

Source: Household survey, 2012

The overall illiteracy level (26%) of the surveyed population is less than the national illiteracy level of 34.1% recorded during the 2012 population census. Similarly, the male illiteracy level of 22.7% is less than the 2012 national level of 24.9%; however, the female illiteracy level of 29.6% among the surveyed population is much lower than the corresponding 2012 national level of 42.6%.

Educational attainment among the surveyed population is not satisfactory. Only a third of this population has a primary level education, whereas about a quarter has secondary level education. About 13% have passed the School Leaving Certificate (SLC), and about 4% had a bachelor's or higher degree. In general, female participation at various levels of education, especially beyond secondary education, is much lower than that of males.

Dropout of School-aged Children

About 32.2% of children between six and 18 years were reported to have dropped out from school due to various reasons, such as extensive involvement in household activities, lack of transport facilities, poverty, etc. The dropout rate of girls is higher than that of boys.

Caste and Ethnic Composition

The project area is diverse in terms of caste/ethnic composition. Chhetri, Brahmin and occupational castes are the major caste/ethnic groups constituting the surveyed population

(Table 4-37). Chhetri form the largest group (48.9%), followed by Brahmin (23%), Thakuri (13.7%), occupational castes (13%) and the Janjati (1.43%).

Table 4-37: Number of respondent households by ethnicity

Ethnicity	Zone	Households in		Total households	
		Darchula	Baitadi	No.	Percent
Brahmin	DIZ	27	15	42	22.97
	IIZ	59	60	119	
Chhetri	DIZ	37	62	99	48.93
	IIZ	91	153	244	
Thakuri	DIZ	12	22	34	13.69
	IIZ	13	49	62	
Janjati	DIZ	0	0	0	1.43
	IIZ	0	10	10	
Occupational caste	DIZ	14	14	28	12.98
	IIZ	20	43	63	
Total	DIZ	90	113	203	100
	IIZ	183	315	498	

Source: Household survey, 2012

Religious Composition

The vast majority of the population (99.4%) in the project area follows the Hindu religion (Table 4-38). This religion is practiced by all the surveyed households in the IIZ in Darchula and the DIZ in Baitadi. Only 0.3% of the surveyed households are Buddhists. None of the households practice Christianity and Islam.

Table 4-38: Number of respondent households by religion

Religion	Darchula		Baitadi		Total	
	DIZ	IIZ	DIZ	IIZ	Nos.	%
Hindu	88	183	113	313	696	99.43
Buddhist	0	0	0	2	2	0.29
Christian	0	0	0	0	0	0.00
Islam	0	0	0	0	0	0.00
Other	2	0	0	0	2	0.29
Total	90	183	113	315	701	100.00

Source: Household survey, 2012

The Hindus of the project area follow the *Varna-Jati* framework. A strong limitation of this framework in this area is the absence of *Vais*.

4.4.4.3 Cultural Characteristics

Language

Doteli is the main language spoken by the surveyed households in Darchula, where 93.3% households in the DIZ and 99.4% in the IIZ use this language (Table 4-39). It is also the major language spoken in the DIZ and IIZ of Baitadi, where 73.4% and 80.9%, respectively, of the surveyed households speak this language. About 25% and 14%, respectively, of the households in the DIZ and IIZ of Baitadi speaks Baitadeli. Nepali is also used by a small percentage of the households in both districts.

Table 4-39: Number of household according to spoken language

Language (Mother tongue)	Zone	Darchula		Baitadi		Total	
		No.	%	No.	%	No.	%
Baitadeli	DIZ	0	0	28	24.8	28	10.4
	IIZ	0	0	45	14.3	45	
Doteli	DIZ	84	93.3	83	73.5	167	86.2
	IIZ	182	99.5	255	81.0	437	
Nepali	DIZ	6	6.7	2	1.8	8	2.7
	IIZ	1	0.6	10	3.2	11	
Nepali and Baitadeli	DIZ	0	0	0	0	0	0.7
	IIZ	0	0	5	1.6	5	
Total	DIZ	90	100	113	100	701	100
	IIZ	183	100	315	100		

Source: Household survey, 2012

Archeological and Historical Sites

Sri Mahal, built in the 12th century by the Pal dynasty, is the only site of archeological and historical significance in the project area. Located in Ward No. 4 of Uku VDC, this site contains ruins of ancient palaces and temples spread over half a hectare of land. Statues of Hindu deities, stone scriptures, artistic pillars, beams, windows and other artifacts, covered with climbers and bushes, are scattered across the site (Photo 4-10).

Sri Mahal bears high religious and cultural significance for local residents. In particular, the Pal communities, which live in Uku and in Uttarakhand, India, gather in this area in July and *Kartik Chaturdashi* for worshipping their family deity at Mallikarjun and other deities at Sri Mahal.



Photo 4-10: Ruins of Sri Mahal

Temples and Shrines

A large number of temples and shrines, usually dedicated to ancestral deities of different clans, are present in the project area. Special annual worships are performed at these temples and shrines by the respective clans.

Temples dedicated to Bhumi Raj, the god of land, are common in the project area. These temples, which are places of worship of natural elements like river, land and mountain, are very popular among the local Hindu population.

The project within Darchula is home to 69 temples/shrines. Of these, Jagannath temple of Lali, Hunainath and Malikarjun temples of Uku and Saipal temple of Dadakot have regional significance, as devotees from Mahakali zone in Nepal and Uttarakhand in India visit them for worship. Most of the other temples and shrines in the area are important locally only.

A total of 33 temples and shrines, mostly with local religious significance, are present in the DIZ of Baitadi district. The only temple in this area having regional importance is the Pancheshwar Mahadev temple located near the dam site. This temple, along with two other identically named temples on the right bank of Mahakali, forms the vertex of an equilateral triangle.



Photo 4-11: Rataudi Mandir at Ratuada, Lali VDC

Ghats (Cremation Sites)

Several *ghats* (cremation sites) exist within the project area. These *ghats* serve as sites for performing the last rites of Hindus and for other religious purposes.

Most *ghats* in the project area are located on the banks of the Mahakali River, Chameliya River and their tributaries. However, *ghats* located on river confluences have higher religious value than those on riverbanks.



Photo 4-12: Cremation site at Sera

Residents of both the DIZ and the IIZ use the *ghats*. Caste-based discrimination is evident in the usage of these *ghats*, with the lower castes (*Kami*, *Damai* and *Sarki*) being disallowed to use the *ghats* used by the upper castes.

4.4.4.4 Economic Characteristics

Occupation Status

The major livelihoods of the surveyed households are agriculture and service. Agriculture is practiced by about 31% of the economically active population of these households (Table 4-40). Almost a third of the population is engaged in service and wage labor, either locally or outside the project area. About 24.2% of the population of the surveyed households is students (dependent), and a small fraction (3.6%) is unable to work due to various reasons.

Table 4-40: Occupational composition of surveyed households

Occupation	Darchula		Baitadi		Total	
	DIZ	IIZ	DIZ	IIZ	No.	%
Agriculture	199	431	254	624	1,508	30.6
Business/industry	13	17	22	49	101	2.1
Service/pension	258	469	261	609	1,597	32.4
Labor and wages	6	18	16	68	108	2.19
Student	189	378	193	446	1,206	24.5
Household works	12	11	45	127	195	4.0
Unable to work	19	49	21	72	161	3.3
Others	11	6	8	32	57	1.2
Total	707	1,379	820	2,027	4,933	100.0

Source: Field Survey, 2012

Skills

Less than a tenth of the population of the surveyed households is skilled. The skilled among this population works as masons, carpenters, ironsmiths, cobblers, tailors, drivers, plumbers, electricians and construction workers.

Table 4-41: Skills of surveyed population

Skill type	Darchula		Baitadi		Total	
	DIZ	IIZ	DIZ	IIZ	No.	%
Mason	2	5	1	5	13	1.2
Carpenter	1	2	-	1	4	0.4
Sweeper	2	4	-	10	16	1.5
Ironsmith	-	1	-	2	3	0.3
Cobbler	-	-	-	2	2	0.2
Tailor	1	2	4	6	13	1.2
Heavy driver	-	1	1	4	6	0.6
Light driver	-	-	2	1	3	0.3
Construction	-	1	1	3	5	0.5
Electrician	1	3	-	4	8	0.8
Plumber	-	-	-	1	1	0.1
Others	2	3	3	12	20	1.9
No skills	226	423	125	179	953	91.0
Total	235	445	137	230	1,047	100.0

Source: Field Survey, 2012

Agriculture

Agriculture is the main source of livelihood of the people inhabited in the project area. The major crops grown in the PHD project-affected area are paddy, wheat, maize, oilseeds and pulses, while vegetables and fruit cultivation is limited. Most of the paddy cultivation is done in *khetis* along the banks of the Mahakali River and Chameliya River during the wet season. Maize is the major crop cultivated in the *baris*. The other major crops cultivated are pulses, root crops and oilseeds. Fruit crops are cultivated in *bari* land.

The farming system of the area is characterized as integrated crop-livestock production systems that comprise cereal crops, seasonal vegetables, fruits, livestock, fodder and forages, and other natural resources. Cattle, buffalo and goats are the major livestock kept by the households.

Of the total affected farmland, 64% are prime irrigable with multiple cropping practices and 26.5% are non-irrigated and rain-fed uplands. The remaining 9.5% are uncultivated thatch grass and tree vegetation area.

Floriculture

During field studies, none of the households within the project area were observed to grow seasonal flowers in kitchen gardens or elsewhere. Even key informants appeared unaware of flowers grown in the area. The absence of any form of floriculture is corroborated by the fact that the local residents use green shrub leaves instead of flowers in worships and other social, cultural and religious events. Notwithstanding this, the area has the potential for growth of a wide range of sub-tropical and temperate species of flowers.

Fishing

Fishing is practiced by a limited number of the surveyed households along the Mahakali, Chameliya and their tributaries (Table 4-42). Only a few people adopt fishing as a full-time profession. A slightly larger population practices seasonal fishing.

Table 4-42: Fishing in project area

VDC/ Municipality	HHs	Full-time fishing			Seasonal fishing		
		Persons	Annual fish catch (kg)	Annual income (Rs.)	Persons	Annual fish catch (kg)	Annual income (Rs.)
<i>Baitadi</i>							
Aamchaur	2	-	-	-	5 - 10	345	21,600
Dashrathchand	5	5	1,800	120,000	10 - 15	1,350	105,600
Giregada	2	-	-	-	5 - 10	900	48,000
Rodit†	2	-	-	-	-	-	-
Rudreshwar	1	-	-	-	-	-	-
<i>Darchula</i>							
Gokuleshwar	3	1 - 5	1,500	79,200	1 - 5	1,100	43,200
Ritha	1	-	-	-	1 - 5	450	-
Uku	1	1 - 5	720	180,000	1 - 5	90	5,400

Source: Field survey, 2012

†† Income information not available for Rodi, Rudreshwar and Ritha

Off-farm Income Generating Activities

For improvement of their livelihood conditions, the residents of the project-affected VDCs depend on salaried jobs also. The locations and nature of the salary-based jobs are presented in Table 4-43 and Table 4-44.

Table 4-43: Location of salary or wage based jobs

Location	Darchula		Baitadi		Total		Total
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	
	Percentage						
Project area	40.7	42.0	26.9	26.1	32.2	31.0	31.3
Rural area	7.4	13.6	20.0	15.9	15.2	15.2	15.2
Urban area	22.2	21.9	24.6	17.5	23.7	18.8	20.2
Abroad	29.6	22.5	28.5	40.5	28.9	35.0	33.3
Total	100	100	100	100	100	100	100

Source: Field survey, 2012

Table 4-44: Nature of salary or wage based jobs

Nature	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	Total
	Percentage						
Regular and constant	86.3	75.6	51.1	68.3	72.1	70.5	71.0
Partial and constant	8.8	14.3	37.0	7.9	16.4	9.9	11.8
Occasional and insecure	5.0	10.1	12.0	23.8	11.5	19.6	17.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Field survey, 2012

Industry, Trade and Business

Barring a few electric and water mills (*ghatta*), the project area does not have any industries. It has some retail shops, hotels/lodges and teashops, which are mainly concentrated in and around market centers. A limited number of shops and hotels are found along the foot trails running between Dattu and Pancheshwar via Sera and Jhulaghat.

Gothalapani and Jhulaghat in Baitadi and Khalanga Bazaar in Darchula are the main market centers in the project area. Other smaller but important markets are located at Dehimandu in Baitadi and Dattu, Jolgibi and Gokuleshwar in Darchula.

Jhulaghat and Khalanga are the major business centers in the reservoir area. Other smaller business centers in the area are Dattu and Jolgibi. Each center is connected with India through pedestrian suspension bridges.

The main imports to the project area are consumable goods, food grains and construction materials. Likewise, the main exports from this area are maize, potato, bean, goat/sheep and herbs. Porters play an important role in transportation of goods in the area.

Landholding Pattern

Out of the 25 project VDCs and municipality in Baitadi and Darchula Districts, 22 VDCs possess cultivated lands. A total of 1,948.7 ha of cultivated land is in the reservoir area. Of this, 37% lies in Darchula and 67% in Baitadi. About 59% of the total 412.4 ha of *khet* land lies in Darchula, and the remaining 41% lies in Baitadi. In contrast, 62.6% *bari* lands are in Baitadi, and the remaining 37.4% in Darchula. Similarly, 86% of the *kharbari* lies in Baitadi compared to 14% in Darchula.

Uku VDC alone possesses 43% of the total *khet* land in the project-affected areas falling in Darchula. This accounts for 25.7% of the total affected *khet* land in the entire project area. Sarmauli and Gokuleshwar VDCs of Darchula and Sittad, Gokuleshwar and Dasharath Chand Municipality (Sera settlement) of Baitadi are other VDCs/municipality with relatively

larger affected *khet* lands. Dethala VDC of Darchula and Nwali and Shreekedar VDCs of Baitadi have smaller areas of affected *khet* lands (0.09, 0.02 and 0.13 ha, respectively).

Lali, Uku and Gokuleshwar VDCs of Darchula and Dasharath Chand, Gokuleshwar and Sittad of Baitadi have larger affected areas of *bari* land, accounting for about 77.2% of total affected *bari* lands. About 45.3% of total 413.5 ha *kharbari* lies solely in Pancheshwar VDC.

Land Ownership

The 2012 household survey reveals that about 3% of the surveyed households (4.9% in DIZ and 1.8% in IIZ) are operationally landless. The average landless households are more in Baitadi (6.7%) than in Darchula (2.5%). About 28.5% of the households have access to irrigation during winter and 42.7% in summer. In both project districts, access to irrigation facilities is higher in the DIZ than in the IIZ.

4.4.4.5 Infrastructure Services

Health

Each project district has a district-level hospital and several secondary health facilities (Table 4-45). However, the available medical facilities are inadequate to meet the needs of the local population. These facilities are inadequately staffed, poorly equipped and lack sufficient medicine supplies. As a result, they are capable of offering very basic medical services only, forcing local residents to rely on better medical centers at Pithoragadh and other places in Uttarakhand, India, for treatment of major diseases.

The project area residents resort to different types of treatment practices. A majority of the sampled households (44%) visits health posts for treatment (Table 4-46). Nearly 21% of the households still use the services of traditional healers like *Dhami*, *Jhakri* and *Pujari*, and about 18.5% opt for treatment in hospitals.

Table 4-45: Health facilities in the project districts

SN	Health facilities	Darchula	Baitadi
1	District hospital	1 (15 bed)	1 (15 bed)
2	Primary health center	1	2
3	Health post	11	10
4	Sub-health post	28	55
5	Ayurvedic clinic	2	2
6	Ayurvedic health center	1	1
7	PHC outreach (mobile)		204
8	Private health clinic	12	35

Source: Field survey, 2013

Table 4-46: Treatment practices in sampled households

Treatment methods	Darchula (% HH)		Baitadi (% HH)		Overall (% HH)		
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	Total
Self treatment	1.5	0.7	2.5	1.3	2	1.1	1.4
Local <i>Dhami</i>	12.4	11.3	30.4	26.3	22	20	20.6
Ayurvedic	2.9	3.3	5.7	0.8	4.4	1.8	2.6
Medical shop	2.9	2.9	6.3	6.1	4.7	4.8	4.8
Health post	45.3	45.5	29.7	48.4	36.9	47.2	44
Hospital	23.4	26.2	15.8	12.2	19.3	18.1	18.5
Others	11.7	10.2	9.5	4.8	10.5	7.1	8.1
Total	100	100	100	100	100	100	100

Source: Field survey, 2012

Traditional treatment methods and health posts are widely used due to easier access (Table 4-47). Despite longer access times, about a quarter of the sampled households in Darchula visit hospitals for treatment.

Table 4-47: Accessibility to health facilities

Facilities	Darchula				Baitadi			
	DIZ		IIZ		DIZ		IIZ	
	Dist. (km)	Time (hours)	Dist. (km)	Time (hours)	Dist. (km)	Time (hours)	Dist. (km)	Time (hours)
<i>Dhami</i>	1.4	0.3	1.7	0.4	1.6	0.4	1.6	0.3
Ayurvedic	2.4	1.1	4.5	0.9	NA	2.0	4	2.2
Medical shop	4.65	1.1	5.83	1.6	4.93	1.0	4.6	1.1
Health post	2.9	1.5	3.5	1.3	3.6	1.1	3.2	1.2
Hospital	39.6	3.6	38.17	4.9	61.2	1.2	43.5	3.8

Source: Field survey, 2012

Sanitation

About 63% of the sampled households have toilets (Table 4-48). About 37.4% of these households have simple pit toilets, 28% have improved drained pit toilets and 34.4% have flushed toilets (Table 4-49).

Amongst the 37% households without toilets, 23.9% defecate in fields, 29.6% in nearby forests and 46.5% on banks of nearby rivers or streams (Table 4-50). After defecation, only about 27% people wash hand with soap or ashes, 41% with plain water, 9% with ashes only and 21% with mud.

Table 4-48: Toilet availability in sampled households

Status	Darchula (%)		Baitadi (%)		Overall (%)		Total (%)
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	
Available	55.8	66.7	66	61.9	61.5	63.7	63
Not available	44.2	33.3	34	38.1	38.5	36.3	37
Total	100	100	100	100	100	100	100

Source: Field survey, 2012

Table 4-49: Type of toilet facility in sampled households

Type	Darchula		Baitadi		Overall		Total
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	
Simple pit toilet	48.1	36.4	25.4	37.6	35.5	38.2	37.4
Pit toilet with drainage	35.2	29.8	26.9	23.8	30.6	26.9	28
Flush toilet	16.7	33.9	47.8	38.1	33.9	34.6	34.4
Others	0	0	0	0.5	0	0.3	0.2
Total	100	100	100	100	100	100	100

Source: Field survey, 2012

Table 4-50: Defecation sites for households without toilet

Defecation location	Darchula (%)		Baitadi (%)		Overall (%)		Total (%)
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	
<i>Khet/Bari</i>	10.8	8.3	18.8	41.3	12.7	29.3	23.9
Nearby forest	27	43.3	21.9	27.9	21.5	33.5	29.6
Nearby river/stream bank	62.2	48.3	59.4	30.8	65.8	37.2	46.5
Total	100	100	100	100	100	100	100

Source: Field survey, 2012

Water Supply

In general, drinking water facilities in the project area are very poor. As shown in Table 4-51, the major sources of drinking water for the samples households are private taps (30.3%), community taps (38.8%) and rivers/streams (16.1%). Community taps are present mostly in growth centers such as Dattu, Joljibi, Jhulaghat and Gokuleshwar, but drinking water distribution facilities in most settlements are at a rudimentary stage. Settlements along the riverbanks use water from Mahakali River, Chameliya River, Jamadi Gad, Garda, Jadani and Mugaru and other streams/rivulets.

Table 4-51: Drinking water sources

Source	Darchula (%)		Baitadi (%)		Overall (%)		Total (%)
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	
Private tap	45.3	41.3	26.7	20.8	35.5	28.2	30.3
Community tap	18.8	28.3	47.3	47.9	33.9	40.8	38.8
Tube well	6.8	6.7	3.8	8.7	5.2	8	7.2
Well	0.9	4	3.1	7.4	2	6.2	5
Stream	26.5	18.4	14.5	12.3	20.2	14.5	16.1
Stone spout	1.7	1.3	1.5	2.6	1.6	2.1	2
Others	0	0	3.1	0.3	1.6	0.2	0.6
Total	100	100	100	100	100	100	100

Source: Field survey, 2012

Almost the entire sampled population (92%) use untreated water for drinking (Table 4-52). This results in widespread waterborne diseases in the area.

Table 4-52: Treatment methods adopted for drinking water

Treatment method	Darchula (%)		Baitadi (%)		Overall (%)		Total (%)
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	
Boiling	8.9	2.7	6.2	3.2	7.4	3	4.3
Filtering	0	0	8	4.1	4.4	2.6	3.1
Use of medicine	0	0	0	1.6	0	1	0.7
Without treatment	91.1	97.3	85.8	91.1	88.2	93.4	91.9
Total	100	100	100	100	100	100	100

Source: Field survey, 2012

Waste Management

The sampled households manage their household and livestock wastes in different ways (Table 4-53). More than half the households dispose of their household wastes at locations away from their homes, about 36% of the households in compost pits and nearly 8% near their homes. Almost the entire livestock waste (85%) is collected in compost pits.

Table 4-53: Household waste management

HH waste management	Darchula (%)		Baitadi (%)		Overall (%)	
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ
Near house	12.3	15.4	3.3	5.5	7.2	8.9
Compost pit	28.9	34.2	40.7	39.3	35.6	37.5
Away from house	50.9	47.4	55.3	55	53.4	52.4
Others	7.9	3	0.7	0.2	3.8	1.2
Total	100	100	100	100	100	100

Source: Field survey, 2012

Table 4-54: Livestock waste management

HH waste management	Darchula (%)		Baitadi (%)		Overall (%)	
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ
Near house	4.7	0.6	1.1	0.9	2.9	0.7
Compost pit	86.0	92.7	83.1	79.1	84.6	85.0
Away from house	3.5	3.4	9.0	7.7	6.3	5.8
Others	5.8	3.4	6.7	12.3	6.3	8.5
Total	100	100	100	100	100	100

Source: Field survey, 2012

4.4.4.6 Tourism

Tourism is almost nonexistent in the project area due to its remoteness, lack of connectivity and infrastructure and absence of developed tourist destinations, conservation areas and trekking routes. Seasonal internal and regional tourism for religious, cultural and social events are restricted mainly to Tripura Sundari and Dehmandu temples in Baitadi and Shree Mahal in Darchula. Tripura Sundari and Dehimandu are famous *shakti-piths* that can be reached through Gothalapani and Jhulaghat. Similarly, Shree Mahal can be reached on foot through Dattu and Joljibi.



Photo 4-13: Religious gathering at Dehimandu Temple, Baitadi

4.4.4.7 Agriculture

Major Crops and their Production

The overall agriculture productivity in the DIZ and IIZ is considered very low compared to other districts of Nepal. The 2012 household survey reveals that average productivity of all major cereal crops is comparatively higher in the DIZ compared to the IIZ.

The survey shows that the overall productivity of paddy under irrigated conditions is 1,718 kg/ha (1,877 kg in the DIZ and 1,586 kg/ha in the DIZ). The average productivity of paddy under rain-fed conditions is estimated at 1,037 kg/ha (1,132 kg in the DIZ and 782 kg/ha in the IIZ).

Likewise, the overall productivity of wheat under irrigated conditions is 1,243 kg/ha (1,679 kg in the DIZ and 962 kg/ha in the IIZ). The average productivity of wheat under rain-fed conditions is estimated at 969 kg/ha (1,099 kg in the DIZ and 695 kg/ha in the IIZ). Similarly, the average productivity of maize is 1,668 kg/ha (2,122 kg in the DIZ and 1,277 kg/ha in the IIZ).

Besides cereal crops, a majority of the households in the project areas also grow millets, barley, pulses and a few cash crops, such as potatoes, oilseeds, sugarcane, seasonal fruits and vegetables mainly for self-consumption. The average productivity of millets, barley, pulses and cash crops such as potatoes, oilseeds, sugarcane, winter and summer fruits and vegetables is estimated at 1,243, 1,706, 1,010, 2,518, 462, 4,796, 5,459 and 3,300 kg/ha, respectively.

Livestock Holdings

Cattle, buffalo and goats are the main livestock reared by the surveyed households (Table 4-55). Sheep are reared only in the IIZs of both districts. Selected caste/ethnic groups raise pigs and chicken, but duck farming is rare.

The surveyed households generally hold more than one livestock to meet their needs. They rear cows and buffalos for milk and bullocks to plough their fields. They also sell goats and sheep, or their products such as milk and meat, to earn additional income. Some households keep horses and mules for transportation. Livestock waste is used to generate manure and compost.

Table 4-55: Average livestock holdings

Livestock class	Darchula			Baitadi			Overall		
	DIZ	IIZ	Total	DIZ	IIZ	Total	DIZ	IIZ	Total
Cattle (cow/ox)	3.45	3.28	3.34	2.91	2.6	2.68	3.15	2.85	2.94
Buffalo	1.47	1.46	1.46	1.46	1.35	1.38	1.46	1.39	1.41
Goats	2.67	5.95	4.87	5.47	3.7	4.17	4.23	4.53	4.44
Sheep	-	0.04	0.02	-	0.03	0.02	-	0.02	0.02
Chicken	0.71	-	0.23	0.50	0.31	0.36	0.59	0.20	0.31
Pigs	-	-	-	-	0.06	0.04	-	0.04	0.03
Horse/mule	-	0.04	0.03	-	0.03	0.02	-	0.03	0.02
Duck	-	-	0.00	-	0.009	0.01	-	0.01	-

Source: Household survey 2012

4.4.4.8 Migration

The project area witnesses permanent and seasonal migration that is triggered by widespread poverty, unemployment, low agricultural productivity, hardships and the desire for a better quality of life. External and internal migration occurs, mainly for employment and business.

India is the most popular destination for migration. A large number of people, dominantly males, migrate to various Indian cities, such as Kolkata, New Delhi, Pithoragadh, Dehradun, Lohaghat and Dharchula, in pursuit of employment. A few with better resources migrate to Europe, North America, Japan, South Korea, Iraq and Afghanistan.

Internal migration to regional urban centers such as Gothalapani, Jhulaghat, Mahendranagar and Dhangadhi and to other parts of Nepal is common. Such migration is generally seasonal in nature and is aimed at wage employment and business. It occurs mostly during the slack agricultural seasons (winter and dry months), when local employment opportunities are very limited. In particular, the poorer households of the area resort to seasonal migration to supplement their household incomes through herbs collection, porter services, etc.

Migration of active population of the project area has resulted in a high presence of elderly, sick, disabled and minor population in almost all settlements. It has also created shortage of agriculture labor and helping hands, increased the workload on women and children and has affected the social and developmental activities in the area. Some social problems associated with migration, such as loss of lives (death, accidents) and disabilities, lack of guardianship

for dependents, misguided children, family breakups, divorce, separation and remarriage, increase in venereal diseases, increase in family debts due to cheating by brokers, recruiters and employers, etc., have also surfaced. Migration has also become a source of physical and mental torture to the migrant workers at their workplace, alcohol consumption, gambling, loss of property and belongings and trafficking of women.

Despite the above drawbacks, migration has had a positive impact on the local economy. Remittance earned through migrants has helped improve the socioeconomic status of the migrant households, contributing significantly to improvement of their quality of life (food, clothing, education, health, shelter, basic household necessities). A few households have also repaid family debts and accumulated properties and assets from the remittance.

4.4.4.9 Income, Expenditure and Subsistence

Income

The main sources of income of the surveyed households are agriculture, animal husbandry and off-farm (non-agricultural) activities. Off-farm activities include professional services, petty trade, cottage industry, pensions, wage labor, sale of land and remittances.

The weighted average annual income of the surveyed households is Rs. 169,314 (Table 4-56). Almost all households depend on multiple sources of income; however, off-farm activities, especially service, remittance, trade/business and labor, are the major sources of income for these households, contributing 93.9% of their total income. Agriculture, livestock and related works account for only 6% of the annual average income.

Table 4-56: Average annual income of surveyed households by source

SN	Income source	Average annual income	
		Rs.	%
1	Sale of major crops	2,630	1.60
2	Fruit sale	142	0.09
3	Livestock sale	3,905	2.37
4	Livestock product sale	3,214	1.95
5	Trade/business	24,123	14.65
6	Service	41,232	25.04
7	Remittance	49,076	29.81
8	Pension	15,432	9.37
9	Labor	21,314	12.95
10	Rent/interest	195	0.12
11	Sale of land	3,245	1.97
12	Professional fee	125	0.08
	Total	169,314	100

Source: Field Survey, 2012

About 17.3% of the surveyed households earn less than Rs. 50,000 per year, and an almost equal portion of the households earns between Rs. 50,001 and Rs. 100,000 (Table 4-57). Only 7.4% of the households earn more than Rs. 500,000 per year.

Table 4-57: Annual income ranges of surveyed households

SN	Annual income group (Rs.)	Households	
		No.	%
1	<50,000	121	17.3
2	50,001 – 100,000	125	17.8
3	100,001 – 150,000	68	9.7
4	150,001 – 200,000	70	10.0
5	200,001 – 250,000	89	12.7
6	250,001 – 300,000	83	11.8
7	300,001 – 400,000	56	8.0
8	400,001 – 500,000	37	5.3
9	500,001 – 600,000	35	5.0
10	> 600,001	17	2.4
Total		701	100

Source: Field Survey, 2012

Expenditure

The weighted annual average expenditure of the surveyed households is Rs. 89,368 (Table 4-58). A significant amount of this income (42.1%) is spent on fulfilling the basic needs of the families, which mainly include food grains, education, clothing and medicine. A large amount (10.85%) is also spent on purchasing ornaments. On the whole, food items account for 17% of the overall expenditure of the surveyed households.

Table 4-58: Average yearly expenses of surveyed households

SN	Expenditure items	Average annual expenditure	
		Rs.	%
1	Food grains (rice, wheat, pulses, etc.)	25,087	10.60
2	Vegetables and fruits	5,102	2.15
3	Cooking oil, spices, etc.	10,024	4.25
4	Clothing	17,929	7.60
5	Education	42,955	18.19
6	Medicine/treatment	13,490	5.70
7	Fuel (wood, kerosene, gas)	6,423	2.70
8	Drinking water, electricity	9,135	3.85
9	Agricultural inputs (seeds, fertilizer, tools)	1,568	0.80
10	Livestock feed (straw, maize, grass, etc.)	3,248	1.35
11	Loan and interest payment	9,541	4.65
12	Transportation and communication	9,267	3.90
13	Religious functions (puja, marriage)	19,524	8.25
14	Ornament purchase (gold, silver)	25,685	10.85
15	Entertainment	9,875	4.20
16	Donations for social activities	14,536	6.15
17	Tea, cigarette, alcohol	3,248	1.35
18	Meat	9,451	4.00
Total		89,368	100.00

Source: Field Survey, 2012

Considering the annual income and expenditure reported above, the potential average annual saving of the surveyed households comes to Rs. 79,946 per household.

Food Sufficiency

About 16% of the surveyed households in the project areas produce adequate food for the entire year (Table 4-59). The food security status of surveyed households in Darchula (26%) is relatively better than that of Baitadi (10.5%). In both districts, the food security status of households in the DIZ is substantially better than in the IIZ.

Table 4-59: Food sufficiency of households[#]

Food sufficiency for 12 months	Darchula				Baitadi				Overall			
	DIZ	IIZ	Total	%	DIZ	IIZ	Total	%	DIZ	IIZ	Total	%
Sufficient	40	32	72	26.0	18	27	45	10.5	58	55	113	16.1
Insufficient	44	146	190	69.5	90	279	369	86.2	134	425	559	79.7
Total	84	178	262	95.5	108	306	414	96.7	192	480	672	95.8

Source: Field Survey, 2012

Among the food-deficit households, about 12% produce enough food for three months or less, 15% for three to six months, 23.7% for six to nine months and about 6% for nine to a year (Table 4-60). In order to compensate for their food deficiency, the households resort to supplementary sources, such as sale of livestock and their products, services, trade and business, remittance, labor, etc. (Table 4-60).

Table 4-60: Status of food insufficient households^{§§}

Food sufficiency (months)	Darchula				Baitadi				Overall			
	DIZ	IIZ	Total	%	DIZ	IIZ	Total	%	DIZ	IIZ	Total	%
< 3	1	7	8	2.9	18	58	76	17.7	19	65	84	12.0
3 to 6	4	44	48	17.5	10	48	58	13.5	14	92	106	15.1
6 to 9	18	45	63	23.0	26	77	103	24.0	44	122	166	23.7
9 to 12	7	14	21	7.7	7	12	19	4.4	14	26	40	5.7
Total	30	110	140	51.1	61	195	256	59.6	91	305	396	56.5

Source: Field Survey, 2012

Table 4-61: Measures to compensate for food deficit (multiple answers)

SN	Supplementary sources	Households	
		No.	%
1	Service	45	4.21
2	Trade/business	39	3.65
3	Foreign employment/remittance	456	42.66
4	Loan	67	6.27
5	Sale of fruits/vegetables	31	2.90
6	Sale of livestock and their products	20	1.87
7	Labor	339	31.71
8	Sale of agriculture products (cash crops, etc.)	47	4.40
9	Pension, house rent, interest	25	2.34

Source: Field Survey, 2012

[#] About 4 to 5% of the households did not respond.

^{§§} A large number of households did not respond.

Poverty

In order to identify the absolute poor among the surveyed households, the criterion defined by Central Bureau of Statistics, GoN, in its 2010-11 Nepal Living Standard Survey (NLSS) was adopted. According to this criterion, an individual is considered poor if his/her per capita total annual consumption is below Rs. 19,261. Thus, for the project area households having an average size of 7.6, a household can be considered below the poverty line if its annual income is less than Rs. 145,487.

As shown in Table 4-57, about 35.1% of the sampled households have an average annual income less than Rs. 100,000, and 9.7% of the households have an average annual income is between Rs. 100,001 and Rs. 150,000. Thus, going by the above-mentioned criterion, almost 44.8% of the sampled households are absolute poor, and the rest are non-poor. This figure is much higher than the corresponding national figure for rural poverty (27.4%) established by NLSS in 2010-11.

4.4.4.10 Gender Issues

As shown in Table 4-30, both project districts are ranked amongst the lowest in Nepal in terms of GDI, which indicates the status of women in society considering life expectancy, educational attainment and income. These low rankings are a result of gender differences in occupation, education and decision-making that are common in far-western Nepal.

Wide gender differences exist in the project area households. This scenario is corroborated by data on literacy, educational attainment and occupation collected during the 2012 field surveys. The major issues of women in the project area are illiteracy, wage discrimination, domestic violence, reproductive health, alcohol consumption, smoking, over workload and economic dependency.

As in other parts of Nepal, women in the project area are engrossed in domestic chores from early morning to late night; however, compared to their counterparts in other parts of Nepal, women in this area probably appear to bear a higher domestic work burden because of the greater tendency of local young males to opt for seasonal out-migration. The seasonal migration of adults makes their spouses vulnerable to health hazards such as HIV/AIDS. Although reporting of such cases is low, the risk of health hazards among women is a matter of concern.

Although on the decline, the traditional practice of women not being allowed to live in their houses during menstruation still persists in the project area. The *Deuki Pratha*, an ancient ritual in which young girl children were offered to gods in return for fulfilled prayers, is a major issue in the area; however, this practice is gradually declining as a result of increased literacy and awareness programs run by NGOs and INGOs.

Division of Labor

In general, the role of women primarily is bearing, rearing and caring of children and taking care of the sick, elderly and other adult members of the family. Simultaneously, they engage in household chores such as cooking, washing, food processing, household maintenance, hygiene and sanitation-related activities.

During the field survey, women were also found to be involved in agricultural activities like cleaning, processing, manuring, seed broadcasting, harvesting, transportation, storing, and marketing; however, fields were ploughed by male members of the households. About 16% females in the surveyed households were observed to participate in income generating activities (Table 4-62). These women work in as nursing assistants, social mobilizers/volunteers, teachers, etc.

Table 4-62: Female participation in income generating activities

Status	Darchula		Baitadi		Overall			
	DIZ	IIZ	DIZ	IIZ	DIZ	IIZ	Total	%
Participating	2	7	2	13	4	120	124	15.8
Not participating	87	176	106	293	193	469	662	84.2

Source: Household survey, 2012

Women-headed Households

Women head only 5.3% of the sampled households (Table 4-63). Only 2.2% households in Darchula and 7.3% in Baitadi are women-headed. These figures are substantially lower than the 2001 national average of 15%.

Table 4-63: Head of household by gender

HH head	Darchula				Baitadi				Total			
	DIZ		IIZ		DIZ		IIZ		DIZ		IIZ	
	HH	%	HH	%	HH	%	HH	%	HH	%	HH	%
Male	89	98.9	178	97.3	104	92	291	92.4	193	94.57	469	94.1
Female	1	1.1	5	2.7	9	8	22	7	10	4.9	27	5.4
Total	90	100	183	100	113	100	313	99.4	203	99.47	496	99.5

Source: Household survey, 2012

Property Ownership

In the project area, only a very few women belonging to a limited number of households own land (Table 4-64); however, they have high ownership of livestock. A sizeable number of women own jewelry.

Table 4-64: Property owned by females

Property	Darchula				Baitadi				Total	
	DIZ		IIZ		DIZ		IIZ		DIZ	IIZ
	Av.	HH	Av.	HH	Av.	HH	Av.	HH	Av.	Av.
<i>Khet</i> (ha)	5.6	6	0.5	11	0	0	11.75	4	5.6	3.5
<i>Bari</i> (ha)	0.5	3	5	11	0	0	3.4	5	0.5	4.5
Livestock (No.)	3.2	10	2.3	18	4.8	10	4.7	57	4	4.12
Jewelry (Rs.)	144,635	79	88,677	166	78,225	100	79,337	287	107,534	82,759

Source: Household survey, 2012

Decision Making

Although crucial household decisions are made through family consultation and consensus, advice from female members is rarely considered on issues related to agriculture, education, shopping, lending and borrowing, etc.. However, their suggestions on household affairs, such as childcare, health, cleanliness, rituals and religious ceremonies, are generally more valued.

4.4.4.11 HIV/AIDS and STI/STD

Till date, 33 cases of HIV/AIDS – 21 in Darchula and 11 in Baitadi – have been registered in the project districts. In 2009, three HIV/AIDS cases in Darchula and two in Baitadi were recorded. This disease has already resulted in one death in Darchula and two in Baitadi.

During the 2012 public consultations, four cases of HIV/AIDS were noted in the project area. Nearly 76% of the surveyed households were found to be aware of the disease. About 56% of these households reported to have learnt about the disease through radio and/or

television, 30% through newspapers, 13% from neighbors and 1% from social mobilizers. Several organizations were also reported to be working against the spread of HIV/AIDS in the project area.

District records show that a total of 42 cases of STI/STD, 19 in males and 23 females, in Darchula. Similarly, 39 patients of STI/STD, comprising 17 males and 22 females, were recorded in Baitadi.

Similarly, a total of 42 (19 male and 23 female) in Darchula and 39 (17 male and 22 female) in Baitadi were the STI/STD patient's in the district.

4.4.4.12 Human Trafficking

Instances of human trafficking were not reported during the 2012 field surveys. However, different organizations were noted to be working against human trafficking in the project area.