Draft Report

Biodiversity Impact Assessment (BIA)

of

Marsyangdi Corridor 220kV Transmission Line Project in Annapurna Conservation Area

Prepared and submitted by:

Nepal Electricity Authority

Environment and Social Studies Department

Lazimpat, Kathmandu, Nepal

Phone No.: 01-4435800

Email: env.social@nea.org.np

July, 2022

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 PROJECT DESCRIPTION

The proposed Marsyangdi Corridor 220kV Transmission Line project (MCTLP) is located in Gandaki and Bagmati Provinces of Nepal. The MCTLP passes through Manang, Lamjung, Tanahu and Gorkha districts of Gandaki Province and Chitwan district of Bagamati Province. The total length of the project is about 109.70km and is divided into two main sections (45.25km Manang-Udipur Section and 64.45km Udipur-New Bharatpur Section). Altogether 5 Rural Municipalities (Nasong RM of Manang; Marsyangdi RM and Dordi RM of Lamjung; Anbukharieni RM of Tanahu; and Ichchyakamana RM of Chitwan) and 6 Municipality (Besishahar Municipality, Sundarbazar Municipality and Rainas Municipality of Lamjung; Gorkha Municipality and Palungtar Municipality of Gorkha district; and Bharatpur Metropolitan City (MC) of Chitwan district) are to be affected by the project.

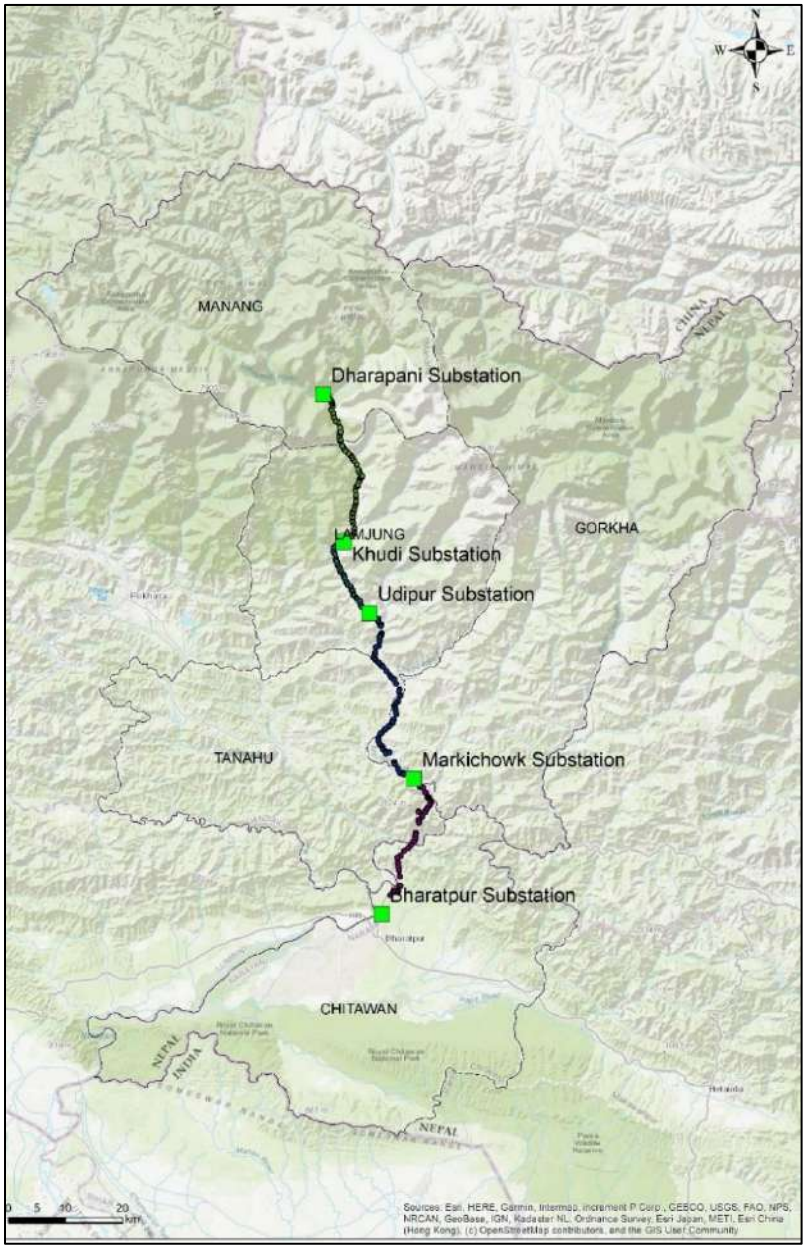


Figure 1: Project Location Map

The voltage level of the project will be 220kV. The proposed TL will be double circuit and the standard tower base dimensions will be 20m x 20m (for 220kV) of each tower leg foundation/ footing. The right of way (RoW) of the proposed TL is 15m on each side from the centerline from 220kV as per the Electricity Regulation, 2050 (1993).

The Marsyagdi Corridor TL project area also covers some part of Annapurna Conservation Area. Out of the total length of 109.07km, about 27.034km of the TL lies within the Annapurna Conservation Area (ACA) which is the first Conservation Area and largest Protected Area in Nepal. ACA covers an area of 7,629 sq. km. and is home to over 100,000 residents of different cultural and linguistic groups. ACAP is rich in biodiversity and is characterized by 1,226 species of flowering plants, 105 mammals, 518 birds, 40 reptiles and 23 amphibians. Considering the ecological sensitivity of the ACAP, the Biodiverity Impact Assessment (BIA) is carried out for the Manang –Udipur Section of the 220kV MCTLP.

The Manang-Udipur Section of the proposed project is located in Lamjung and Manang districts of Gandaki Province of Nepal. Altogether 2 Rural Municipalities (Nasong RM of Manang and Marsyangdi RM of Lamjung) and 1 Municipality (Besishahar Municipality of Lamjung) will be affected by the project. It has two sections namely; (i) Khudi-Manang Section and (ii) Khudi-Udipur Section. The Khudi-Manang section starts from the proposed Khudi substation at Marsyangdi RM and end at the proposed Dharapani substation at Ghelanchowk, Nasong RM. Similarly, Khudi-Udipur section starts from the proposed Khudi substation at Marsyangdi RM and end at the proposed substation at Udipur, Besishahar Municipality. The total length of the proposed TL is about approximately 45.25km (29.623km for Khudi-Manang section and 15.627km for Khudi-Udipur section).

1.1 Scope of the Work

The biodiversity impact assessment was carried out as EIA addendum so as to meet the EIB standards (Environmental and Social Sandard 3 on Biodiversity and Ecosystems) and the EIB Guidance Note for Standard 3 on Biodiversity and Ecosystems. The Biodiversity impact assessment was focus in particular on the Project's potential impacts to the Annapurna Conversation Area Project (ACAP).

The objective of this study was to develop a standalone Biodiversity Impact Assessment (BIA) for the Marsyangdi Corridor (Manang-Udipur) 220kV TL project.

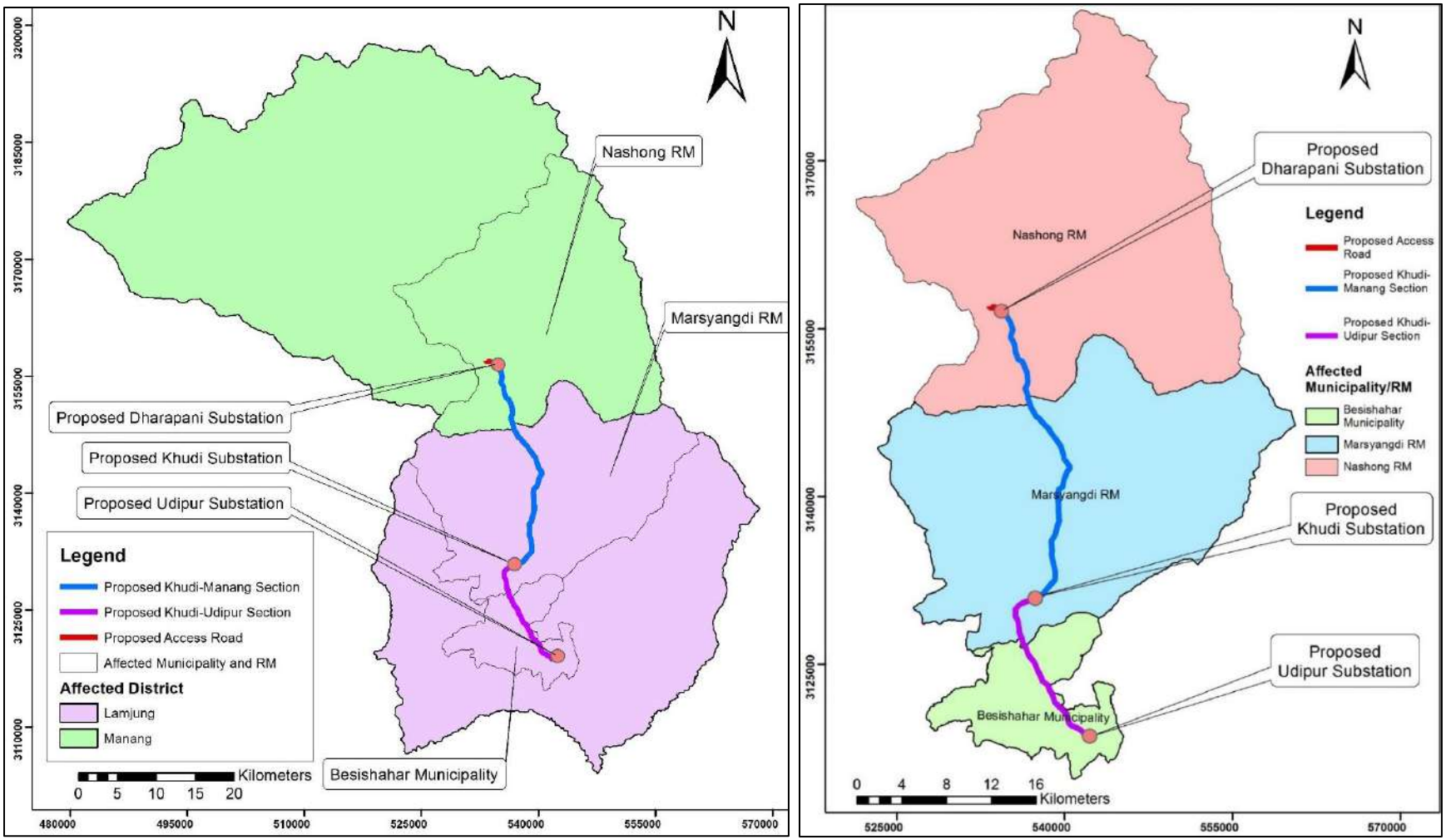


Figure 2: Manang-Udipur Section of 220kV MCTLP

2 APPROACH AND METHODOLOGY

2.1 Literature Review

EIA and other relevant Project related documents available was reviewed. Following informations were gathered from the literature review:

- The total range or area the project cover.
- Size and other specifications of the project.
- The relationship (e.g. key distances etc.) between the project and the ACAP site.
- Baseline information of the ACA in the transmission line alignment

In addition, the following information about ACAP were collected through literature review.

- The reasons for the designation of the ACAP site.
- The conservation objectives of the site and the factors that contribute to the conservation value of the site.
- The existing baseline condition of the site.
- The key attributes of any protected nationally or internationally species or critically endangered, endangered or vulnerable species on the site.
- The dynamics of the habitats, species and their ecology.
- Those aspects of the site that are sensitive to change.
- The key structural and functional relationships that create and maintain the site's integrity.
- The seasonal influences on the key protected nationally or internationally species or critically endangered, endangered or vulnerable species on the site.
- Supporting documentation and permits, various permitting processes.

2.2 Data Collection

The study supplement the esisting baseline data of the EIA report with field survey data and informations. During this BIA study, a detail survey of birds, wildlife, forest and vegetation were conducted adopting scientific tools and methodologies. The detail of the tools and methodologies used is discussed in the following section.

The study area surveyed includes as many as habitat type, taxnomic groups and bioclimatic zone as possible. The methodologies used in this BIA is repeatable and has collected the quantitative data.

Field study plans was formulated in line with 'Assessment of plans and projects significantly affecting Natura 2000 sites - Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive' of the European Commission. Further key informant interviews (KII) and focus group discussion (FGD) was also carried out during the field study enrich the field survey information.

2.2.1 Wild Animals

Forest, grassland and other suitable habitats were selected using GIS and updated landcover maps. Within these habitats, grids of 1x1 sq.km. were laid within 2km corridor of the proposed transmission line. For the study, we considered 2 km on either side of the transmission line.

For logistic simplicity while conducting the study, we divided the randomly selected sample sites into five different clusters. Two clusters spread across Manang and Lamjung district, two clusters spread across Lamjung district, and a single cluster in Chitwan district concentrated in the Barandabar area around the vicinity of the NEA power station.

2.2.1.1 Camera Trapping

A. First Camera Trap Survey - March 2022

During the first survey in March, the 20 camera trap units were distributed across two clusters at any given time. Each of the camera trap units monitored their assigned station site for an average period of a week after which they were collected in the same order of deployment and moved to a new location at a different cluster. This allowed us to smoothly circulate the available 20 units across the 51 sites maintaining a constant number of trap nights for each unit.

For the first survey, we started our monitoring work from the northernmost camera trap site in Bagarchhap village in Manang and moved southwards towards Lamjung as time progressed and finally completed the first phase survey in Chitwan (Figure.1). Detail information of camera trap setup date and retrived date with the coordinate and camera trap nights is given in Appendix A.

B. Second Camera Trap Survey - May and June 2022

During the second survey in May and June, the 20 camera trap units were distributed across the four clusters from Manang and Lamjung. We selected 20 sites out of the 41 sites from the first study. These 20 sites for the second survey were selected based on habitat representation and logistics. We deployed the camera trap units in fewer locations but increased the survey duration from the previous average of a week to 16 days per camera trap station.

For the second survey, we started placing the camera trap units from the northernmost grid site in Bagarchhap village in Manang and gradually moved to sites in Lamjung. After deploying the 20 available camera trap units within a period of a week, we returned back from the field. We later went to retrieve the camera trap units in the same order they were placed, thus each unit was able to collect data for 16 days. Detail information of camera trap setup date and retrived date with the coordinate and camera trap nights is given in Appendix A.

2.2.1.2 Social survey

Focus Group Discussion (FGD) and Key Informant Interviews (KII) were conducted with local communities and key stakeholders in the project area to supplement the data collected from camera traps and live sightings.

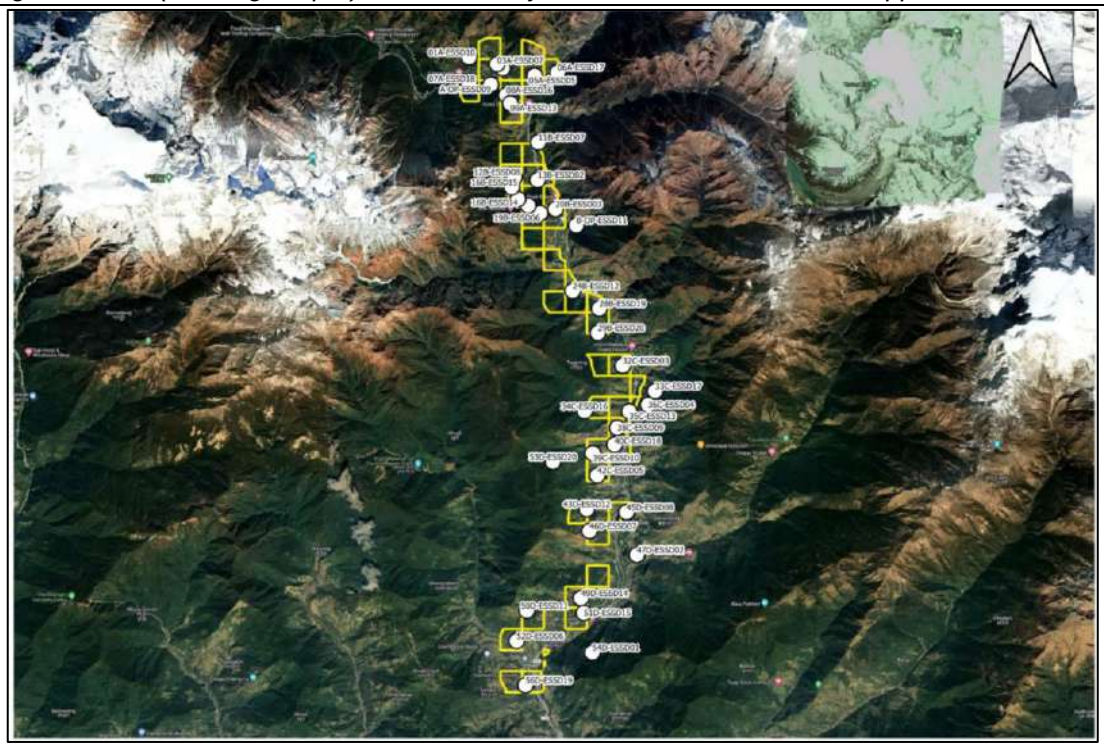


Figure 3: Camera Trap Station and Grids Overlaid for BIA in First Season

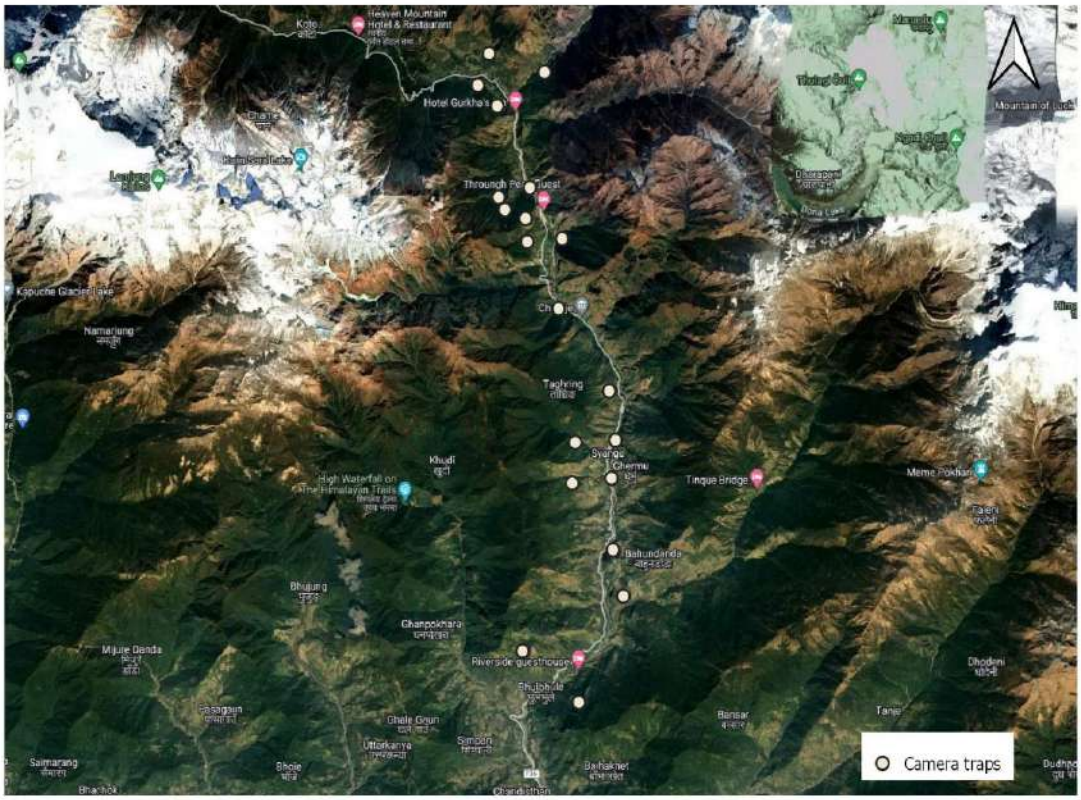


Figure 4: Camera Trap Station and Grids Overlaid for BIA in Second Season

2.2.2 Avi-fauna (Birds)

2.2.2.1 Vantage Point Count

A total of 71 vantage points were plotted along the proposed transmission line at a distance of 1.5 km interval. Minimum of 30 minutes was spent at these vantage points to carry out survey of birds. Additionally, bird survey was carried out in 5 substations and surrounding areas, as well. The section of transmission line and number of vantage points included for the survey of birds is given in Table 2.

2.2.2.2 Data collection and analysis

The collected data of the birds was categorized and analysed based on: 1) IUCN red list – both global and national threatened status (critically endangered, endangered, vulnerable), 2) CITES list, 3) Restricted Range species, 4) Biome Restricted species, 5) presence of nest colonies 6) migratory species and 7) habitat status of the bird species (residential and migratory species). The habitats important for birds were also identified during the survey.

"Birds of Nepal: An Official Checklist" published in 2018 by Department of National Parks and Wildlife Conservation (DNPWC) and Bird Conservation Nepal (BCN) has been followed to prepare the list of bird species recorded in the project site.

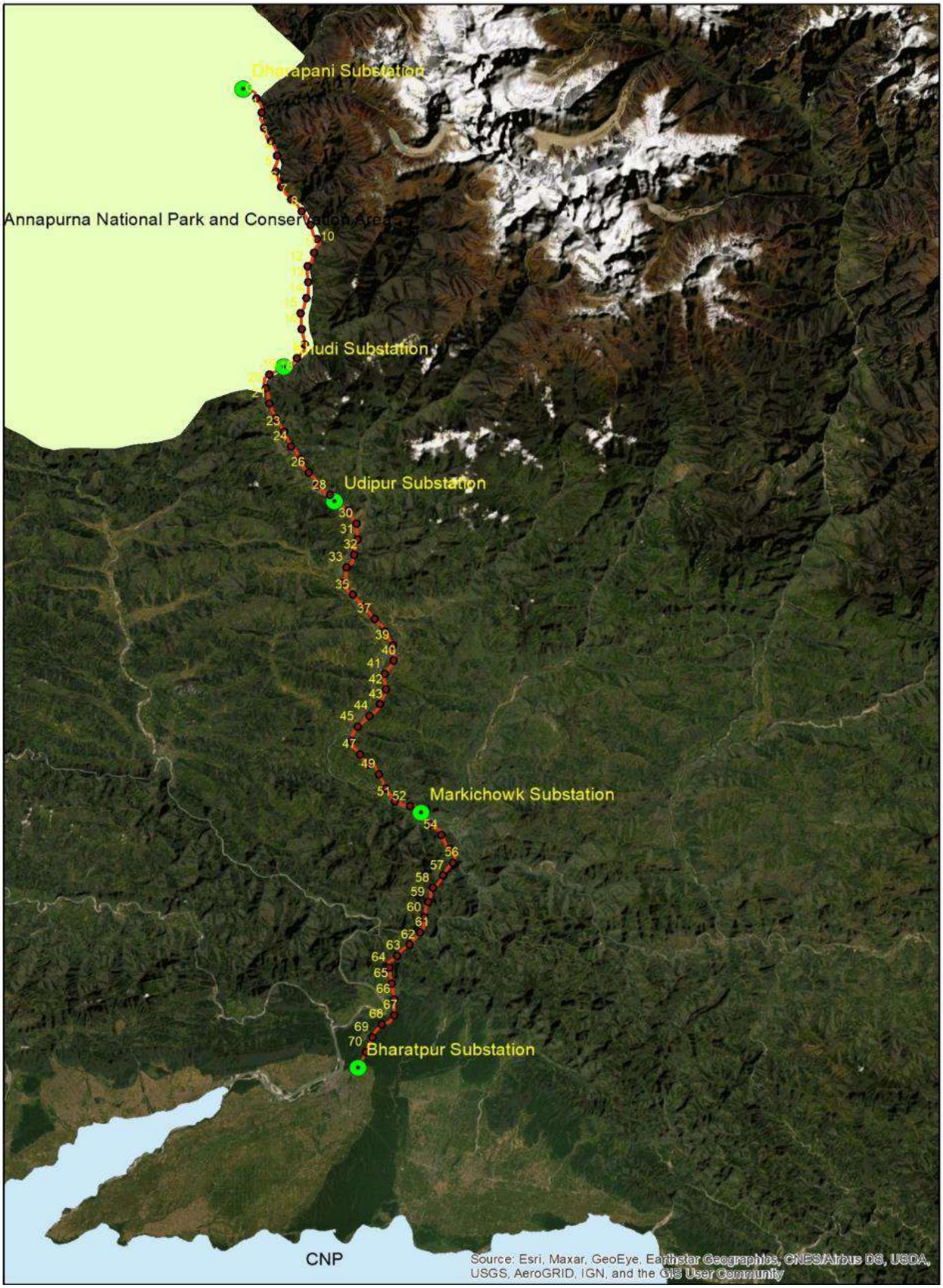


Figure 5: Location of Vantage Point

2.2.3 Flora/Vegetation

2.2.3.1 Study Area Mapping

The project area was divided into four strata namely Manang Khudi, Khudi Udipur, Udipur Markichowk and Markichowk Bharatpur Sections. The project area was surveyed with 120 nested plots. The number of sample plots was determined with the help of graph showing cumulative number of species and number of plots. The size of plot was 20m x 25m for tree, 10m x 10m for pole, 5m x 5m for sapling and 5m x 2m for seedling including herbs and medicinal plants (ENREF_32 DoF, 2003).

Table 1: Number of plots allocated in the section

S.N.	Section	No of plots	Remarks
1	Manang Khudi Section	8×4=32	Nested plots
2	Khudi Udipur Section	8×4=32	
3	Udipur Markichowk Section	11×4=44	
4	Markichowk Bharatpur Section	8×4=32	
	Total Sample Plots	35×4=120	

2.2.3.2 Data Collection and Analysis

Data Collection

The diameter at breast height and height of plants were measured in the plot, their species were noted. The tree, pole and regeneration species found in the plots were recorded in check list (Annex C). Similar process was applied to list out the herbs, shrubs and grass species found in the plot. In addition, the interaction with local people, community forest users' group and authority personnel were conducted during field visit. The first field visit was done from January to February, 2022 and second visit was done in May.

Moreover, the secondary data were collected from different source. The sources are environment impact assessment reports of i. Marsyangdi Corridor (Manang – Udipur) 2020kv Transmission Line Project and ii. Initial environmental examination Marsyangdi Corridor (Udipur – New Bharatpur) 220 KV double circuit transmission line. Moreover, policy document and related published and unpublished papers were collected and desktop review was done.

Analysis of biophysical data: The data analysis was focused on to calculate a. biodiversity index, b. Importance value index, c. protection status c. conservation status of vegetation and flora. The biodiversity indexes were calculated using Shannon - wiener diversity index, Simpson index of diversity and Evenness. The importance value index was calculated estimation of relative density, frequency and dominance. In addition, the conservation status of the flora and vegetation was analyzed comparing with the list of species according to government of Nepal, Forest Act 2019, National Park and Conservation Act 1973, International Union for Conservation of Nature (IUCN) Red list, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Annex I, II, III) (Marshall et al., 2020, Al-Namazi et al., 2021).

Species diversity calculation:

Alpha, Beta, Gamma diversity was also calculated

Shannon Wiener index (H') = $-\Sigma P_i \log p_i$.....(i)

Simpson's diversity, (D) = $1- \Sigma P_i^2$ .....(ii)

Evenness E = H / log (N) ..... (iii)

Where,

P_i is the relative abundance of each species, i.e., the proportion of individuals of a given species relative to the total no. of individual in the community (Baumgartner, 2002).

Importance Value Index (IVI)

Importance Value Index is sum of relative frequency, relative density and relative dominance.

IVI= Relative Frequency+ Relative Density+ Relative Dominance

Frequency, Density and Dominance

Frequency: Frequency of individual species will be calculated by using standard method (Zobel et al. 1987) as follows:

Frequency (F) = No. of plots with individual species

. Total no. of plots studied

Relative Frequency (F) = No. of plots with individual species × 100

. Total no. of plots studied

Density (D) = Total no. of species in all sample plots

Total no. of sample plots studied

Total no. of species in all sample plots × 100

Total no. of sample plots studied

Dominance: Degree of predominance of one or a few species in an ecological community.

Dominance= $\frac{\pi D^2}{4}$

Relative Dominance = Dominance×100/Total dominance

a) ***Analysis of potential impact:*** The descriptive analysis was done to show the potential impacts caused by Marsyangdi Transmission Line Corridor.

b) Social survey

Focus Group Discussion (FGD) and Key Informant Interviews (KIIs) was conducted with local communities and key stakeholders in the project area to supplement the data collected from camera traps and live trapping. The key informants was identified in the field with the help of government officials, elected representatives and local communities.

c) Impact Identification

Based on the data collected, likely impacts of a project on the biological environment of ACAP site was predicted. It was carried out within a structured and systematic framework and completed as objectively as possible.

2.3 Study Team

The BIA team adopted a participatory approach with maximum involvement of different stakeholders of the project at the local and district levels to generate relevant information for the BIA. A team of following members was involved in the field study for preparation of the BIA report.

Table 2: List of Experts involved in BIA

S.N.	Name	Designation	Field of Specialization	Remarks
Experts from ESSD				
1	Rabindra Prasad Chaudhary	Coordinator	Zoology	NEA-ESSD
2	Prakash Gaudel	Team Leader	Environment, Water Resources Management	
3	Binod Pyakurel	Team Member	Environment	
7	Krishna Prasad Joshi	Team Member	Data Analysis	
Outsourced Experts				
8	Mitra Pandey	Bird Expert	Ornithology	
9	Krishna Bhusal	Bird Expert	Ornithology	
10	Jeevan Rai	Wildlife Expert	Wildlife	
11	Bidhan Adhikary	Wildlife Research Assistant	Wildlife	
12	Narayan Ghimire	Terrestrial Ecologist	Botany	

2.4 Public Consultation and Information Disclosure

The BIA draft report along with CIA report will be sent for consultation with the relevant stakeholders as identified. The BIA report will be made public through the NEA website.

2.5 Limitation of the Study

I. Since wildlife and camera trap studies are better when the camera traps are left for longer durations in the study area, we recommend a longer time frame for future studies. As the trap sites and number of days decrease, the detection probability decreases. This decrease sometimes results in data that are unusable for occupancy analysis. In other words, the confidence intervals are so large that they do not have any practical importance.

II. Vandalism and theft of our camera trap units in three camera trap stations during the first phase survey resulted in loss of some data for that time period.
    a. At station ESSD05-42C, the camera trap unit ESSD05 was missing when we went to collect it. When we asked the local villagers, we discovered that a village child had taken it. It was later recovered safely.
    b. At station ESSD14-49D, the camera trap unit ESSD14 was vandalized and stolen by breaking the safety iron chain. We were later successful in recovering the camera trap unit from the police station at Bhulbhule. The strap was missing and the external housing case of the unit was partly damaged.

c. At station ESSD14-43D, the camera trap was vandalized. Someone had cut the strap and tied it to the camera trap unit covering the camera lens.

III. This bird survey covered mainly the bird species of two seasons (Autumn and Winter). This survey has mostly covered the residential and some winter migratory birds. The study team chooses the late winter time for the second survey aiming to cover the winter migratory birds those returned through the Marsyangdi corridor to their breeding sites in the northern hemisphere. There is still need of additional 1 survey (summer) to cover more migratory bird species as well.

3 BASELINE CONDITION OF THE BIOLOGICAL ENVIRONMENT

3.1 Wildlife

3.1.1 Mammals recorded during the first season

We set up 41 camera trap stations for the BIA in ACAP and near ACAP with minimum number of camera trap nights being 2 and maximum number of camera trap nights being 10. The camera traps were deployed from 7 March 2022 to 4 April 2022. In total, the camera traps were able to capture 14 species of mammals excluding rodents and unidentified species. Apart from the camera traps, we also used interviews and FGD to collect information about wildlife in the area.

Table 3: Mammals recorded in the project area

S. N.	Common Name	Scientific Name	National Status	Global Status	National Legal Status	Evidence*
1	Assamese Macaque	*Macaca assamensis*	Vulnerable	Near Threatened	Protected	DS, CT, IN
2	Barking Deer	*Muntiacus vaginalis*	Vulnerable	Least Concern		CT, IN
3	Bat					DS, IN
4	Ferret Badger	*Melogale sps*	Data Deficient	Least Concern		CT
5	Jungle Cat	*Felis chaus*	Least Concern	Least Concern		CT
6	Langur	*Semnopithecus schistaceus*	Least Concern	Least Concern		CT, IN
7	Large Indian Civet	*Viverra zibetha*	Near Threatened	Least Concern		CT
8	Leopard	*Panthera pardus*	Vulnerable	Vulnerable		CT, IN
9	Leopard Cat	*Prionailurus bengalensis*	Vulnerable	Least Concern	Protected	CT
10	Malayan Porcupine	*Hystrix brachyura*	Data Deficient	Least Concern		CT, IN
11	Masked Palm Civet	*Paguma larvata*	Least Concern	Least Concern		CT
12	Rhesus Macaque	*Macaca mulatta*	Least Concern	Least Concern		DS, CT, IN
13	Rodents					CT
14	Squirrel					CT
15	Yellow Throated Marten	*Martes flavigula*	Least Concern	Least Concern		CT, IN
16	Himalayan Black Bear	*Ursus thibetanus*	Endangered	Vulnerable		CT (ACAP), IN
17	Himalayan Goral	*Naemorhedus goral*	Near Threatened	Near Threatened		CT (ACAP), IN
18	Himalayan Serow	*Capricornis sumatraensis*	Data Deficient	Vulnerable		CT (ACAP), IN
19	Musk Deer	*Moschus sps*		Endangered	Protected	CT (ACAP), IN
20	Flying Squirrel					IN

S. N.	Common Name	Scientific Name	National Status	Global Status	National Legal Status	Evidence*
21	Red Fox	*Vulpes vulpes*	Data Deficient	Least Concern		IN
22	Lynx	*Lynx lynx*	Vulnerable	Least Concern	Protected	IN
23	Golden Jackal	*Canis aureus*	Least Concern	Least Concern		IN
24	Yellow-bellied Weasel	*Mustela kathiah*	Data Deficient	Least Concern		DS, IN
25	Himalayan Tahr	*Hemitragus jemlahicus*	Near Threatened	Near Threatened		IN

* Note: CT = Camera trap, IN = Interview, LT = Literature, DS = Direct sighting, CT (ACAP) = Camera trap set by ACAP

In the camera traps, Masked Palm Civet was captured in most independent captures (n=38) followed by Leopard Cat (n = 22). Humans were captured in all of the camera trap stations showing that almost all of the area within 2km of the transmission line has some anthropogenic disturbance. Livestock was also captured in 25 of the stations.

Table 4: Species captured with total number of independent photographs and number of stations captured

S.N.	Species	Independent captures	Number of stations captured
1	Assamese Macaque	4	2
2	Barking Deer	11	5
3	Birds	46	21
4	Ferret Badger	3	2
5	Humans	259	41
6	Jungle Cat	2	1
7	Langur	3	2
8	Large Indian Civet	8	6
9	Leopard	5	5
10	Leopard Cat	22	10
11	Livestocks	104	25
12	Malayan Porcupine	2	1
13	Masked Palm Civet	38	15
14	Rhesus Macaque	2	1
15	Rodents	17	9
16	Squirrel	1	1
17	Unidentified	15	12
18	Yellow Throated Marten	5	5

(Note: Total number of stations considered for this table is 41)

Although it seems that the southern part of the project area (Lamjung district) from the native species richness map (Figure 2), we suggest precaution in interpreting this as such. Our trap nights were not more than 10 in any of the camera trap stations, we think that the camera trap stations in Manang might have missed a lot of potential high importance species such as Himalayan Black Bear, Himalayan Serow.

3.1.2 Mammals recorded during the second season

We set up 20 camera trap stations for the second survey season of BIA in ACAP. The camera traps were deployed from 19 May 2022 to 9 June 2022. In total, the camera traps were able to capture 9 species of mammals excluding rodents and unidentified species (Table 4).

Table 5: Mammals recorded in the project area

S. N.	Common Name	Scientific Name	National Status	Global Status	National Legal Status	Evidence*
1	Barking Deer	*Muntiacus vaginalis*	Vulnerable	Least Concern		CT
2	Langur	*Semnopithecus schistaceus*	Least Concern	Least Concern		CT
3	Large Indian Civet	*Viverra zibetha*	Near Threatened	Least Concern		CT
4	Leopard Cat	*Prionailurus bengalensis*	Vulnerable	Least Concern	Protected	CT
5	Malayan Porcupine	*Hystrix brachyura*	Data Deficient	Least Concern		CT
6	Masked Palm Civet	*Paguma larvata*	Least Concern	Least Concern		CT
7	Rodents					CT
8	Yellow Throated Marten	*Martes flavigula*	Least Concern	Least Concern		CT
9	Himalayan Goral	*Naemorhedus goral*	Near Threatened	Near Threatened		CT
10	Yellow-bellied Weasel	*Mustela kathiah*	Data Deficient	Least Concern		CT
11	Golden Jackal	*Canis aureus*	Least Concern	Least Concern		DS
12	Mongoose	*Herpestes sps.*				DS
13	Assamese Macaque	*Macaca assamensis*	Vulnerable	Near Threatened	Protected	DS

* Note: CT = Camera trap, IN = Interview, LT = Literature, DS = Direct sighting, CT (ACAP) = Camera trap set by ACAP

In the camera traps, Masked Palm Civet was captured in most independent captures (n=53) followed by Leopard Cat (n = 38).

Table 6: Species captured with total number of independent photographs and number of stations captured

S.N.	Species	Independent captures	Number of stations captured
1	Barking Deer	9	5
2	Goral	1	1
3	Langur	4	3
4	Large Indian Civet	9	3
5	Leopard Cat	38	11
6	Malayan Porcupine	1	1
7	Masked Palm Civet	53	17
8	Rodents	29	13
9	Yellow Bellied Weasel	1	1
10	Yellow Throated Marten	13	9

(Note: Total number of stations considered for this table is 20)

3.1.3 Noteworthy species

We present some of the species from our camera trap study that we think should be paid more attention.

- **Assamese Macaque:** Assamese Macaque are listed as Vulnerable in National Red List and are also protected species under the National Parks and Wildlife Conservation Act 1973. A major concern for this species will be conflict with local farmers and electrocution from the transmission lines.
- **Ferret Badger:** Although the global status in IUCN Red List of this species in Least Concern, there are very few records of the species from the country. This lack of data makes this species a Data Deficient species for the country.
- **Leopard Cat:** Leopard Cat is a protected species under the National Parks and Wildlife Conservation Act 1973. It is also listed as Vulnerable species in the National Red List.
- **Leopard:** Leopard is classified as Vulnerable in both National and Global IUCN Red List making it a species of concern for the project area. However, it doesn't have any special legal protection under the National Parks and Wildlife Conservation Act 1973.This big cat is also one of the most problematic species due to livestock depredation.

3.1.4 Status of wildlife in different Clusters of ACAP

Cluster A: Bagarchhap, Dharapani, Odar periphery (Manang)

From 9 camera trap stations in cluster A in Manang, we captured 7 different species including rodents that could not be identified to species level. Apart from the camera trapping, we also directly sighted Yellow-bellied Weasel (below Odar) in this cluster.

Table 7: Nine species were captured in cluster A.

S.N.	Species	Independent captures
1	Goral	1
2	Humans	112
3	Langur	2
4	Leopard	1
5	Leopard Cat	11
6	Livestocks	85
7	Masked Palm Civet	21
8	Rodents	1
9	Yellow Throated Marten	8

People with guns at night were also captured from this cluster which points out that hunting is common in this cluster. Participants in the FGDs were also concerned about hunting in this area.

Cluster B: Taal, Khotro (Manang), Chyamche (Lamjung) periphery

Nine species were recorded from 14 camera trap stations in this cluster. A Golden Jackal (near Gherang) was also directly sighted in this cluster.

Table 8: Nine species were captured from cluster B.

S.N.	Species	Independent
1	Barking Deer	3
2	Ferret Badger	2
3	Humans	104
4	Langur	3
5	Leopard	3
6	Leopard Cat	10
7	Livestock	78
8	Masked Palm Civet	20
9	Rodents	7
10	Yellow Bellied Weasel	1
11	Yellow Throated Marten	4

Alternative trekking route has also been opened through this section.

Cluster C: Jagat, Syange, Ghermu, Taghrin (Lamjung)

Nine species were captured from 10 camera trap stations in this cluster. Mongoose (Taghrin) and Assamese Macaque (Syange) were also sighted directly from this cluster.

Table 9: Nine species were captured from10 stations in cluster C.

S.N.	Species	Independent captures
1	Barking Deer	2
2	Ferret Badger	1
3	Humans	124
4	Jungle Cat	2
5	Langur	2
6	Large Indian Civet	14
7	Leopard Cat	17
8	Livestock	48
9	Masked Palm Civet	15
10	Rodents	19
11	Yellow Throated Marten	3

Cluster D: Bhulbhule, Khudi, Kalaghirin, Bahundanda, Bhusme (Lamjung)

This was the richest cluster in terms of naive species richness in all of our camera trap clusters. Eleven species were captured in 12 camera trap stations.

Table 10: Eleven species were captured from cluster D.

S.N	Species	Independent captures
1	Assamese Macaque	4
2	Barking Deer	15
3	Humans	158
4	Large Indian Civet	3
5	Leopard	1
6	Leopard Cat	22
7	Livestock	52
8	Malayan Porcupine	3
9	Masked Palm Civet	35
10	Rhesus Macaque	2
11	Rodents	19
12	Squirrel	1
13	Yellow Throated Marten	3

3.1.5 Species Richness of Camera Trap Sites

Although it seems that the southern part of the project area (Lamjung district) from the native species richness map (Figure 6), we suggest precaution in interpreting this as such. Our trap nights were not more than 10 in any of the camera trap stations in the first season. In the second season the camera traps were left for 15-16 days. These are not significant efforts to capture all the species in the project site.

The cumulative species richness of northern sites with Cluster A and B combined is 10 different species compared to 13 species in the southern sites with Cluster C and D combined. For the trap efforts we put, this cannot distinguish which sites were more biodiverse.

We think that the camera trap stations in Manang might have missed a lot of potential high importance species such as Himalayan Black Bear and Himalayan Serow. The habitats in the northern part were also less disturbed compared to the northern sites. This also is an important factor to take into account as most of the species in the southern sites are species tolerant to slight to mid-level human disturbances. Barking deer, macaques, langur, marten, and Malayan porcupine don’t suffer as much as Gorals, Himalayan Black Bear, Musk deer and Himalayan Serow in comparison. We suspect that the northern sites might have more elusive core-species in our camera traps but were reported in our FGDs.

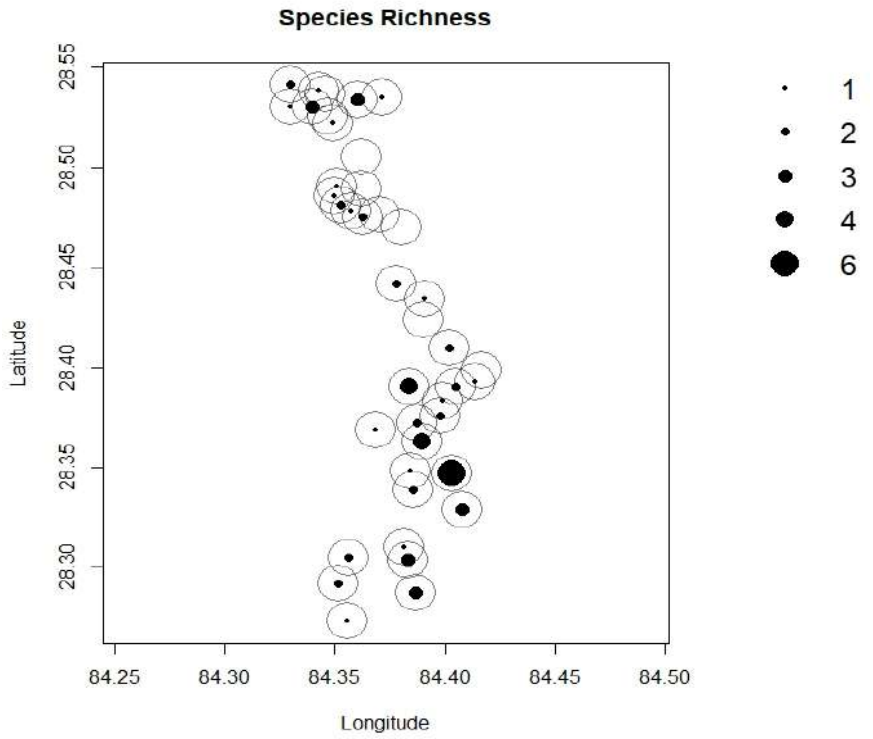


Figure 6: Species richness from the camera trap images in the cameras set for the BIA for the first season.

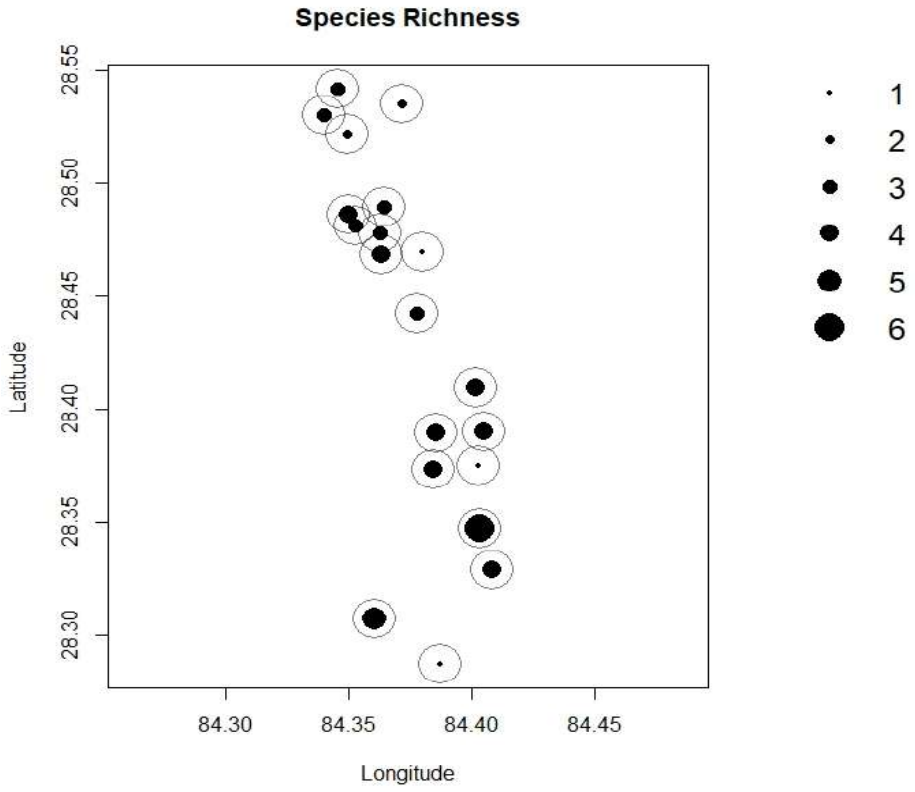


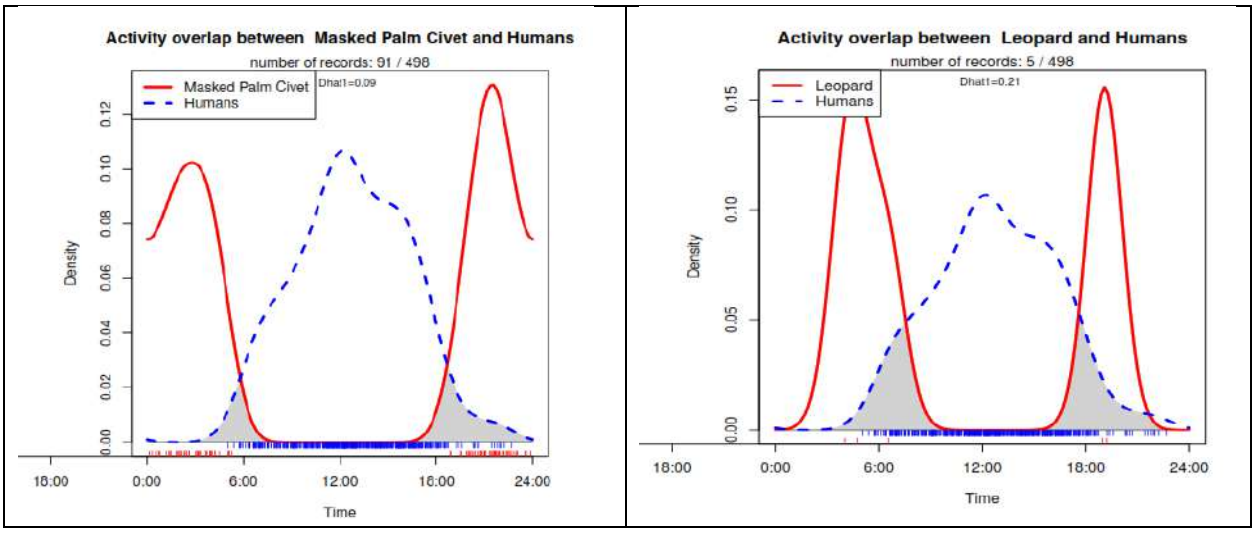
Figure 7 Species richness from the camera trap images in the cameras set for the BIA for the second season.

3.1.6 Temporal Activity of the Species

Apart from space use, it is also crucial that we take the temporal impact of the project into consideration to formulate effective mitigation measures. We used activity plots and activity overlap plots with humans from our camera trap images to assess the potential impacts of the project on the wildlife species of the project site.

Activity overlap plots for seven species with humans were plotted (Figure 8), 1. Masked Palm Civet, 2. Leopard, 3. Leopard Cat, 4. Yellow-throated Marten, 5. Langur, 6. Barking Deer and 7. Large Indian Civet. Rest of the species were ignored due to low detection number (less than 5). Four species, Masked Palm Civet, Leopard, Leopard Cat and Large Indian Civet had distinct temporal avoidance with humans. These species are nocturnal. Due to their activity pattern, they won't have much direct encounters with the construction crew. However, the risk is that if the crew is working on their crucial habitat sites, they might highly disturb these species without even knowing because they are active at night.

On the other hand, Yellow-throated Marten and Langur had high temporal overlap with humans. Barking Deer had overlap during dusk and dawn and avoided peak human activity time. These species have higher chances of having direct encounters with the construction crew. That might lead to three negative consequences: 1. Killing of species to avoid threats to workers: The construction crews might take these species as a threat to the safety of their crews and opt for eradicating them from their site. These species can also end up in their temporary or permanent structures being a nuisance for the crew. 2. Killing of species as bushmeat and medicine: With increased encounters, the crew will have knowledge on where these species can be caught/trapped. Since a lot of communities in Nepal hunt and use bushmeat for medicine, this can happen with these species too. 3. Habituation of the wildlife with human presence: Although this can seem harmless, it will cause problems in future increasing conflict with local communities in future. The crew might feed the wildlife they encounter frequently. In some cases, the species can become bolder with increased exposure to human presence. In both cases, after the crew leaves, the wildlife habituated with humans can raid human settlements for food, avoid human presence and cause nuisances for locals even after the construction has been completed.



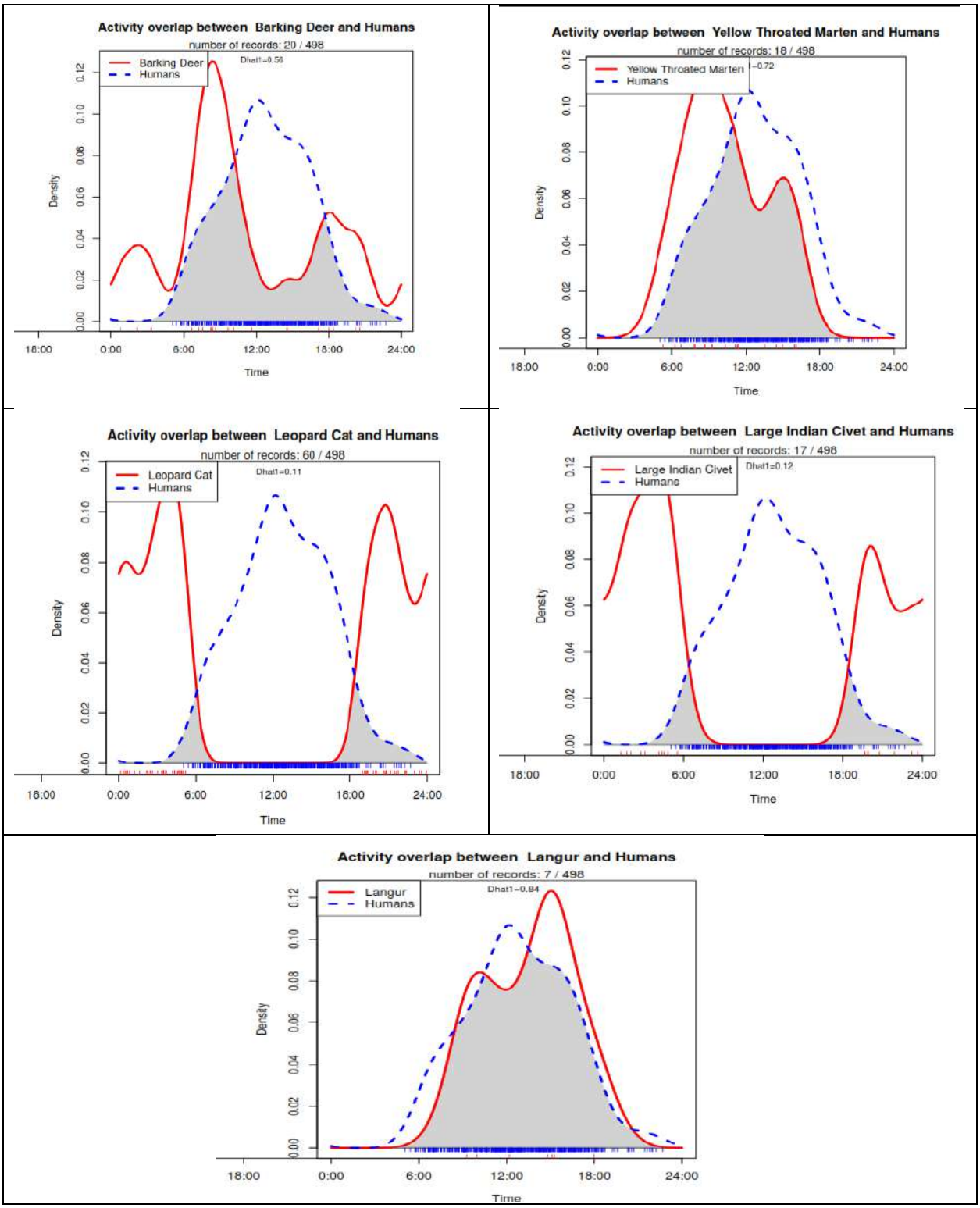


Figure 8: ***Activity-overlap of wildlife species with human activity in the project area***

(Note: Species with low independent detections (n < 5) have been ignored for this graph)

Figure 9: Wildlife Captured in Camera Trap

3.2 Avi-fauna (Birds)

There are 886 bird species recorded in Nepal (DNPWC and BCN 2018). The survey carried out from 15 – 24 May 2022, a total of 183 species of birds were recorded that belong to 16 orders and 55 families. 3 species of globally threatened birds (Egyptian Vulture, Red-headed Vulture and White-rumped Vulture) and 9 species of nationally threatened birds (Satyr Tragopan, Barred Cuckoo-dove, Bearded Vulture, Egyptian Vulture, Red-headed Vulture, Himalayan Griffon, White-rumped Vulture, Yellow-rumped Honeyguide and Red-breasted Parakeet) were recorded.

In the bird survey carried out in winter season from 2-13 March 2022, 171 species of birds were recorded that belong to 14 orders and 47 families. 5 species of globally threatened birds (Common Pochard, Egyptian Vulture, Red-headed Vulture, White-rumped Vulture and Steppe Eagle) and 9 species of nationally threatened birds (Bearded VultureEgyptian Vulture, Red-headed Vulture, Himalayan Griffon, White-rumped Vulture, Cinereous Vulture, Steppe Eagle, Yellow-bellied Warbler and Hume's Bush-warbler) were recorded. Nepal's endemic bird species Spiny Babbler was also recorded during the survey.

Similarly, in the bird survey carried out in autumn season from 19 – 31 October 2021, 142 species of birds were recorded that belong to 16 orders and 47 families. 4 species of globally threatened birds (Egyptian Vulture, Red-headed Vulture, Greater Spotted Eagle and Steppe Eagle) and 7 species of nationally threatened birds (Bearded Vulture, Egyptian Vulture, Red-headed Vulture, Himalayan Griffon, Greater Spotted Eagle, Steppe Eagle and Hume's Bush-warbler) were recorded.

Combining the result of first, second and third bird survey, there are a total of 256 bird species recorded from the project sites. The detail list of the birds recorded in the three season surveys is given in Appendix B.

Birds of prey, also known as raptors, include species of bird that primarily hunt and feed on vertebrates that are small to large. Additionally, they have keen eyesight for detecting food at a distance or during flight, strong feet equipped with talons for grasping or killing prey, and powerful, curved beaks for tearing flesh. They can fly high, fast. Raptors recorded during the survey are given in the table below:

Table 11: Raptors Recorded in Surveys

SN	English name	Scientific name	Nepali	GTS	NTS	Migration	1st Survey	2nd Survey	3rd Survey
1.	Oriental Honey-buzzard	*Pernis ptilorhynchus*	मधुहा			R/PM	2		2
2.	Crested Serpent-eagle	*Spilornischeela*	काकाकुल			R		10	10
3.	Bearded Vulture	*Gypaetus barbatus*	हाडफोर		VU	R	2	2	3
4.	Egyptian Vulture	*Neophron percnopterus*	सेतो गिद्ध	EN	VU	R	1	3	9
5.	Red-headed Vulture	*Sarcogyps calvus*	सुन गिद्ध	CR	EN	R	3	6	5
6.	Himalayan Griffon	*Gyps himalayensis*	हिमाली गिद्ध		VU	R	4	73	23
7.	White-rumped Vulture	*Gyps bengalensis*	डंगर गिद्ध	CR	CR	R		2	1
8.	Cinereous Vulture	*Aegypiusmonachus*	राजगिद्ध		EN	PM/WV		1	
9.	Mountain Hawk-eagle	*Nisaetusnipalensis*	पहाडी शदलचील			R/WV	1	1	2
10.	Black Eagle	*Ictinaetusmalaiensis*	द्रोणक चील			R	3	1	
11.	Greater Spotted Eagle	*Clangaclanga*	जीवाहार महाचील	VU	VU	WV	1		
12.	Steppe Eagle	*Aquila nipalensis*	गोमायु महाचील	EN	VU	PM/WV	10	14	
13.	Bonelli's Eagle	*Aquila fasciata*	मोरङ्गी चील			R	8	3	4
14.	Booted Eagle	*Hieraaetuspennatus*	काँधचन्द्र चील			R/PM/WV	1	1	
15.	Shikra	*Accipiter badius*	शिक्रा			R	1		4
16.	Besra	*Accipiter virgatus*	वेसरा			R	1		
17.	Eurasian Sparrowhawk	*Accipiter nisus*	वनबाज			R/PM/WV	1		2
18.	Northern Goshawk	*Accipiter gentilis*	बलाकांक्षवनबाज			R			1
19.	Black Kite	*Milvus migrans*	कालो चील			R/PM	42	46	47
20.	Himalayan Buzzard	*Buteo refectus*	श्येनबाज			PM/WV	7	6	
21.	Long-legged Buzzard	*Buteo rufinus*	लामखुट्टे श्येनबाज			PM/WV	2	1	
22.	Upland Buzzard	*Buteo hemilasius*	पहाडी श्येनबाज		DD	R/WV	2	1	
23.	Collared Falconet	*Microhieraxcaerulescens*	पौरी बाज		NT	R	2		
24.	Lesser Kestrel	*Falco naumanni*	सानो बौंडाइ		NT	PM/WV	1		
25.	Common Kestrel	*Falco tinnunculus*	बौंडाइ			R/PM/WV	10	11	14
26.	Peregrine Falcon	*Falco peregrinus*	शाहीबाज			R/PM/WV	2	1	2

Note: GTS-Globally Threatened Species, NTS-Nationally Threatened Species, EN-Endangered, CR-Critically Endangered, VU-Vulnerable, R-Residential, AL-Altitudinal Migrant, WV-Winter Visitor, PM-Passage Migrant.

Similarly, birds of wetlands and associated habitat were also recorded during the survey. That includes, waterfowl, egrets and herons, cormorants, waders. The list of birds from wetland and associated habitats with their migratory status are given in the table below:

Table 12: Birds of wetlands and associated habitat recorded (Autumn-1st Survey, Winter 2nd Survey and Summer 3rd Survey)

SN	English name	Scientific name	Nepali	GTS	NTS	Migration	1st Survey	2nd Survey	3rd Survey
1.	Goosander	*Mergus merganser*	मणितुण्डक			WV		1	
2.	Ruddy Shelduck	*Tadornaferruginea*	चखेवाचखेवी		NT	WV		8	
3.	Common Pochard	*Aythya ferina*	कैलोटाउके हाँस	VU	NT	PM/WV		1	
4.	Tufted Duck	*Aythya fuligula*	कालीजुरे हाँस			PM/WV	2		1
5.	Gadwall	*Mareca strepera*	खडखडे हाँस			PM/WV	8	4	
6.	Eurasian Wigeon	*Marecapenelope*	सिन्दुरे हाँस			PM/WV	1		
7.	White-breasted Waterhen	*Amaurornisphoenicurus*	सिमकुखुरा			R			2
8.	Indian Pond-heron	*Ardeolagrayii*	आसकोटे बकुल्ला			R	4	14	23
9.	Cattle Egret	*Bubulcus ibis*	वस्तु बकुल्ला			R	29	107	190
10.	Little Egret	*Egrettagarzetta*	सानो सेतोबकुल्ला			R	5	4	4
11.	River Lapwing	*Vanellusduvaucelii*	खोले हुटिट्याउ		NT	R			2
12.	Red-wattled Lapwing	*Vanellus indicus*	हुटिट्याउँ			R			2
13.	Great Cormorant	*Phalacrocorax carbo*	जलेवा		NT	WV	2	111	
14.	Common Sandpiper	*Actitishypoleucos*	चञ्चले सुडसुडिया			PM/WV	1		
15.	Green Sandpiper	*Tringaochropus*	रुख सुडसुडिया			PM/WV	1		
16.	Common Kingfisher	*Alcedoatthis*	सानो माटीकोरे			R		1	2
17.	Crested Kingfisher	*Megacerylelugubris*	ठूलो छिरबिरे माटीकोरे			R		2	
18.	White-breasted Kingfisher	*Halcyon smyrnensis*	सेतोकण्ठे माटीकोरे			R	11	7	23
19.	Brown Dipper	*Cincluspallasii*	खैरो वञ्जुल			R		2	
20.	Little Forktail	*Enicurusscouleri*	गंगाखोलेधोबिनी			R	5	2	3
21.	Slaty-backed Forktail	*Enicurusschistaceus*	फुस्रोढाडे खोलेधोबिनी			R		2	
22.	Black-backed Forktail	*Enicurusimmaculatus*	कालोढाडे खोलेधोबिनी			R	1		1
23.	White-capped Water-redstart	*Phoenicurus leucocephalus*	सेतोटाउके जलखञ्जरी			R	7	8	5
24.	Plumbeous Water-redstart	*Phoenicurusfuliginosus*	नीलाम्बर जलखञ्जरी			R	11	13	11
25.	Grey Wagtail	*Motacilla cinerea*	फुस्रो टिकटिके			WV	14	2	
26.	White-browed Wagtail	*Motacillamaderaspatensis*	खोले टिकटिके			R	1	6	
27.	White Wagtail	*Motacilla alba*	फुस्रो टिकटिके			PM/WV	10	21	

3.2.1 Status of Birds and Habitat in the TL Project Area

3.2.1.1 Dharapani Substation – Khudi Substation

A total of 109 bird species were recorded in summer survey from 20 vantage points present between Dharapani Substation and Khudi Substation section while there was a record of 55 species in autumn survey and 78 species in the winter survey. Almost all the species recorded in this section of the project sites were residential except some species mainly cuckoos.

There were 8 raptor species recorded in this section: Crested Serpent-eagle (from vantage points 14 and 16), Bearded Vulture (from vantage points 1 and 2), Himalayan Griffon (from vantage points 'Dharapani',0,1 and 2), Mountain Hawk-eagle (from vantage points 11), Bonelli's Eagle (from vantage points 6 and 11), Eurasian Sparrowhawk (from vantage points 'Dharapani' and 12), Northern Goshawk (from vantage point 11) , Black Kite (from vantage points 10 and 14), Common Kestrel (from vantage points 1,7,10 and 14) and Peregrine Falcon (from vantage point 6).

Nesting colonies of Himalayan Griffon was observed in the cliff present at vantage point 1. Further, no more nesting colonies of the raptors were noticed during the survey. The weather partially sunny most of the time. There is forested area, small patch of grassland (close to vantage point 16), rocky cliffs in this section of the proposed transmission line. Existing transmission lines are also running along.

In the summer bird survey, diversity of bird species was recorded high from vantage point of Dharapani SS (25 species) which was followed by vantage points 12, 10 and 17 (21 bird species in an average). Because of the mixed forest and diverse habitat type, number of bird species were found high in these areas. In this section, there are presence of rocky cliffs and the bird diversity is comparatively less in such places. Figure below shows the bird diversity of 3 seasons.

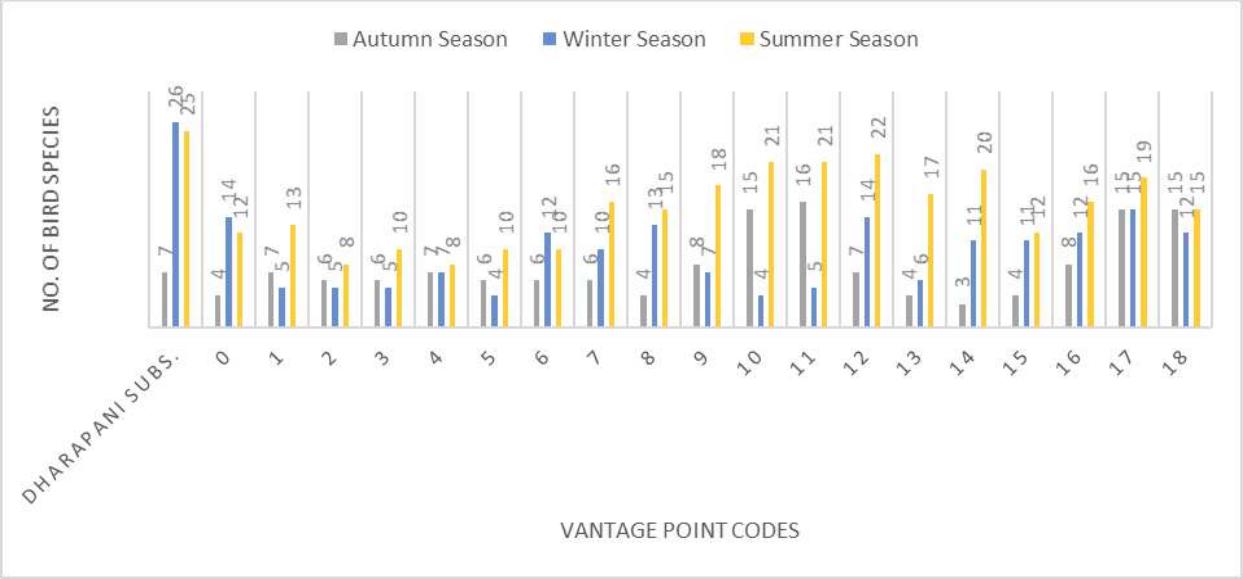


Figure 10: No. of bird species recorded from each vantage points (Dharapani – Khudi Substation section)

3.2.1.2 Khudi Substation – Udipur Substation

A total of 68 bird species were recorded in summer season from 11 vantage points present in between Khudi Substation and Udipur Substation section. Raptor species: Egyptian Vulture (from vantage points 21 and 26), Shikra (from vantage point 21), Crested Serpent-eagle (from vantage points 20,21 and 25), Himalayan Griffon (from vantage points 20,21 and 22), Black Kite (from vantage points 'Khudi', 20, 21, 24 and 27) and Common Kestrel (from vantage points 20 and 21). These birds were sighted soaring up in the sky. Comparatively, more raptors were observed from vantage points 20 and 21. However, no nesting colonies of raptors were observed during the survey.

At Khudi substation, the habitat was found disturbed due to construction work so a smaller number of bird species were recorded. Areas in between vantage points 22 and Khudi SS, has been found important for raptor species. There are rocky cliffs in the east which are potential sites for roosting and nesting of raptors. Near to the vantage point 21 (place name: Simalchaur), there are number of *Bombax ceiba* trees which are considered important for vultures. A migratory wetland bird 'Tufted Duck' was observed at vantage point 28. The site is a reservoir created by a Dam near to Udipur SS.

In the summer season, diversity of bird species was recorded high from the vantage points 25 and 27 (24 bird species in an average). Because of the mixed forest and diverse habitat type, number of bird species were found high in these areas. The figure below shows the bird diversity of 3 seasons.

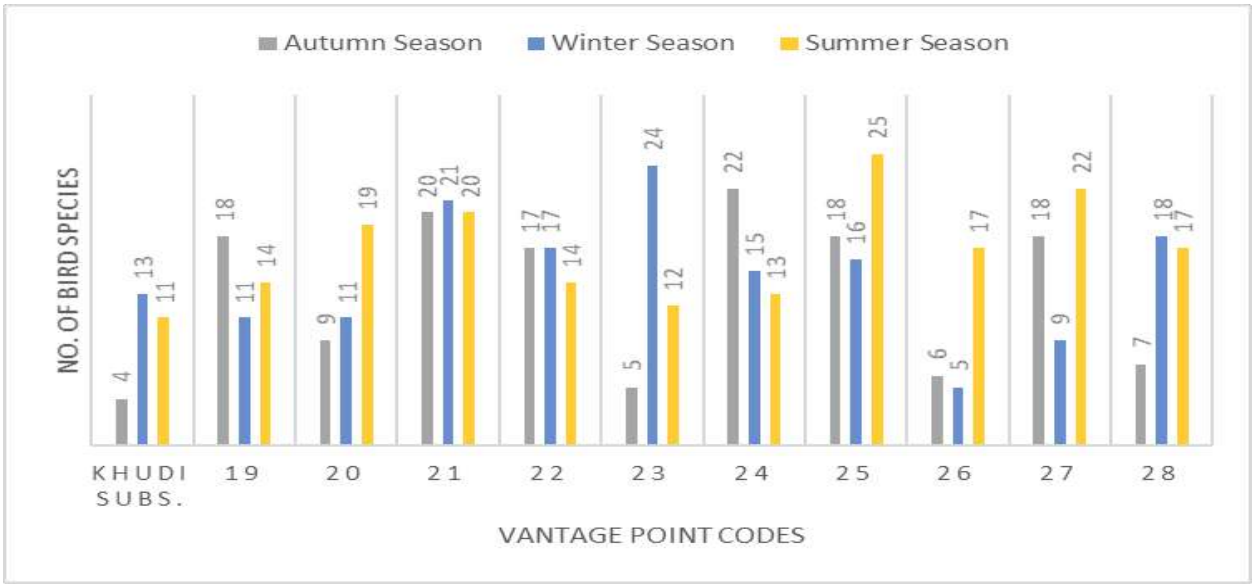


Figure 11:No. of bird species recorded from each vantage points (Khudi – Udipur Substation section)

3.2.1.3 Udipur Substation – Markichowk Substation

A total of 79 species of birds were recorded in summer season from 14 vantage points present in between Udipur substation and Markichowk substation section. In this section of the project site, bird survey was carried out from each alternative vantage points. A globally threatened bird species was also recorded from this section of the transmission line: Red-headed Vulture (from vantage point 49).

Additionally, 5 other raptor species were recorded in this section: Crested Serpent-eagle (from vantage points 'Udipur' and 42), Himalayan Griffon (from vantage point 'Udipur'), Black Kite (from vantage points 'Udipur', 29,31,35,41,49,51 and 52), Common Kestrel (from vantage points 29, 31 and 45), Peregrine Falcon (from vantage point 29). Lower region of this section of the project site is mostly plain with some forest patches. The raptors were found soaring high up in the sky however no nesting colonies were recorded during the survey.

In the summer season, diversity of bird species was recorded high from the vantage point 35 followed by the vantage points 39, 43 and 49) (30 bird species in an average). Because of the mixed forest and diverse habitat type, number of bird species were found high in these areas. The figure below shows the bird diversity of 3 seasons.

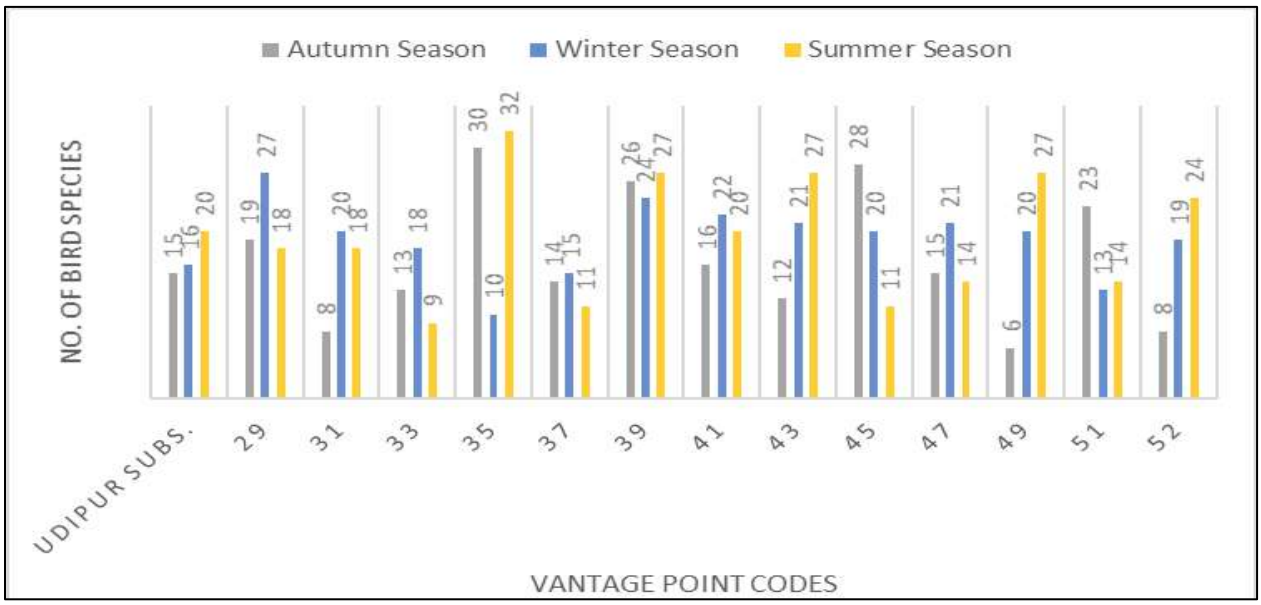


Figure 12: No. of bird species recorded from each vantage points (Udipur - Markichowk Substation section)

3.2.1.4 Markichowk Substation – Bharatpur Substation

A total of 110 species of birds were recorded in summer season from 20 vantage points present in between Markichowk substation and Bharatpur substation section. Globally threatened bird species: Egyptian Vulture (Endangered), Red-headed Vulture (Critically Endangered) and White-rumped Vulture (Critically Endangered) were recorded from 5 vantage points.

Additionally, 7 other raptor species were recorded in this section: Shikra (from vantage points 53,59 and 70), Crested Serpent-eagle (from vantage point 55 and 58), Himalayan Griffon (from vantage point 64), Black Kite (from 8 different vantage points), Common Kestrel (from vantage point 55, 57, 58, 59 and 60), Oriental Honey-buzzard (from vantage point 57 and 58) and Mountain Hawk-eagle (from vantage point 55).

Mostly, raptors were found soaring up in the sky from the vantage point 58 and 59. There is also a place located at the top of the hill with open area that has vantage points 64 and 65 that shows potential for raptor soaring. Just south to it is the plain lowland. This area is found to be good to the raptors for soaring high up because of thermals. There is also a ridge which act as passage for

migratory birds. However, during the survey, because of the bad weather (drizzle and rain), soaring of the raptors was not observed.

In the summer season, diversity of bird species was recorded high from the vantage points 'Bharatpur SS' followed by the vantage points 'Markhichowk SS' and 59. (30 bird species in an average). Because of the diverse habitat type, number of bird species were found high in these areas. Below figure shows the bird diversity of 3 seasons.

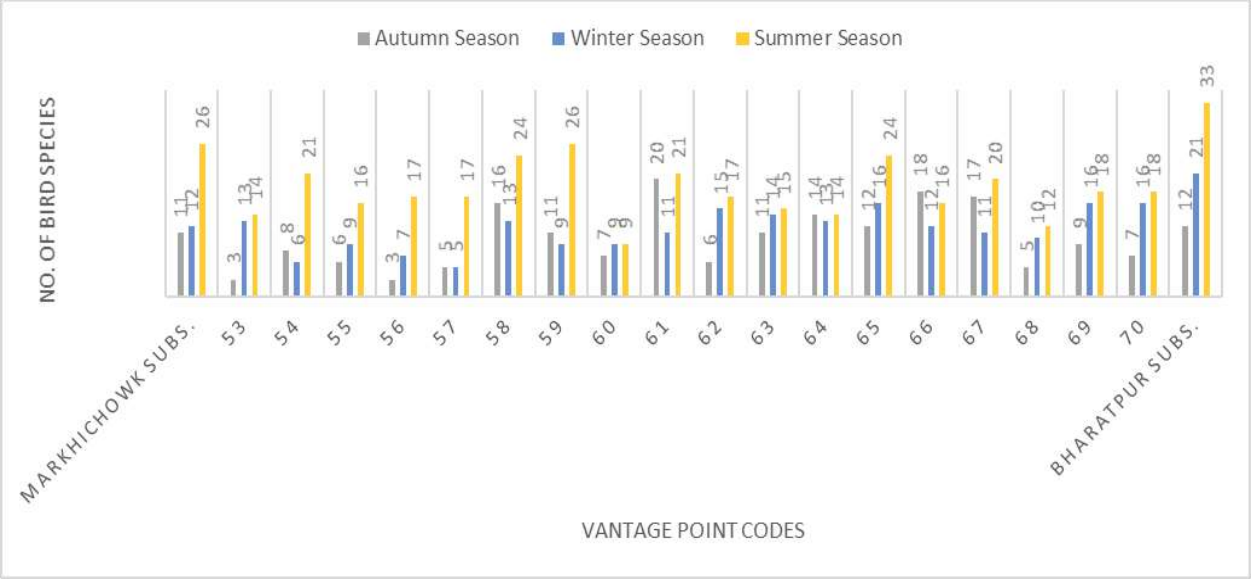


Figure 13: Number of bird species recorded from each vantage points (Markichowk - Bharatpur Substation section)

3.3 Flora/Vegetation

3.3.1 Floral Biodiversity in Khudi-Manang Section

There were not any differences in biodiversity at tree, pole and sapling staged tree species. The second time observation showed that, seedling sategd tree species were regenerated in the plot. In addition, noticeable difference was observed in herbs and shrubs species.

3.3.1.1 Tree Species diversity

The floral diversity can be divided into three subsections of Khudi-Manang Section of the project. These are Upper section, mid -section and lower section.

Upper section: Only two species are recorded at upper part of this section. These species were *Pinus wallichiana* (Gobre Salla) and *Anlus nepalensis* (Uttish).

Middle section: There was not any tree species in the mid part of Khudi Manang transmission line section. The mid part of this section was covered with *Himalayacalamus asper* (Stapleton). The average diameter of this 5.5 cm and height of this species is 3.5m. This species was common in south east aspect; altitudinal variation was 1500-1600m. Ghumre nigalo and Malinge nigalo are very common in this area. This species is very rare in Nepal particularly in hilly area. This species

is socially and economically very important because, local people use this species to weave the basket. The basket is source of income of the local people.

Lower section: Importance value index of tree species was estimated to show the species density, frequency and dominance of different staged plants in lower part of Khudi Manang section. The estimated importance value index of *Pinus wallichiana* was the highest of tree staged plant of lower part of this section with 90.77 while this value was the lowest of other species with 15.12. Other species includes *Acer* sp., *Abies* sp., *Rhododendron* sp.

Table 13: Tree species in upper part of Khudi Manang Section

Species	Scientific name	Relative Density	Relative frequency	Relative Dominance	IVI
Gobre salla	*Pinus wallichiana*	50	50	61.9048	60
Uttish	*Anlus nepalensis*	50	50	38.0952	60

Note: There is no any pole and regeneration in this part

Table 14: Tree species in lower part of Khudi-Manang Section

Local name	Scientific name	Tree staged plants				Pole staged plants				Sapling staged plants			
		RD	**RF**	**RA**	**IVI**	**RD**	**RF**	**RA**	**IVI**	**RD**	**RF**	**RA**	**IVI**
Gobre Sallo	*Pinus wallichiana*	38.10	14.29	38.39	90.77	6.98	4.76	32.04	43.78	-	-	-	-
Uttish	*Alnus nepalensis*	14.29	21.43	10.84	46.56	30.23	9.52	25.89	65.64	-	-	-	-
Mahuwa	*Madhuca longifolia*	4.76	7.14	5.48	17.38	2.33	4.76	0.47	7.56	7.69	14.29	2.70	24.68
Khirro	*Sapium insigne*	4.76	7.14	3.60	15.50	2.33	4.76	2.95	10.04	-	-	-	-
Chilaune	*Schima wallichii*	9.52	7.14	7.52	24.18	6.98	14.29	7.75	29.01	7.69	14.29	6.07	28.05
Simal	*Bombax ceiba*	14.29	21.43	17.66	53.37	4.65	9.52	3.75	17.92	-	-	-	-
Kaphal	*Myrica* sp.	4.76	7.14	6.08	17.98	4.65	4.76	4.92	14.33	15.38	14.29	16.65	46.32
Siris	*Albiliz* sp.	4.76	7.14	7.23	19.14	4.65	4.76	2.85	12.26	-	-	-	-
Faledo	*Erythrina* sp.	-	-	-	-	13.95	9.52	5.98	29.46	38.46	14.29	54.46	107.21
Guyalo	*Callicarpa macrophylla*	-	-	-	-	9.30	4.76	5.23	19.30	-	-	-	-
Makaranga	*Macaranga pustulata*	-	-	-	-	2.33	4.76	1.10	8.19	-	-	-	-
Bayar	*Zizypus maurititiana*	-	-	-	-	2.33	4.76	1.87	8.96	15.38	14.29	11.34	41.01
Kyamun	*Cleistocalyx operculata*	-	-	-	-	2.33	4.76	0.79	7.88	-	-	-	-
Khanayu	*Ficus semicordata*	-	-	-	-	2.33	4.76	0.97	8.06	-	-	-	-
Sindhure	*Mallotus philipinensis*	-	-	-	-	2.33	4.76	0.91	8.00	7.69	14.29	6.07	28.05
Khagreto	*Phyllanthus parvifolius*	-	-	-	-	-	-	-	-	7.69	14.29	2.70	24.68
Others		4.76	7.14	3.21	15.12	2.33	4.76	2.51	9.60	-	-	-	-
Total		**100**	**100**	**100**	**300**	**100**	**100**	**100**	**300**	**100**	**100**	**100**	**300**

Note: RD = relative dominance, RF= Relative Frequency, RA= Relative Abundance, IVI- Importance Value Index.

3.3.1.2 Biodiversity index of Tree species (Lower part)

The biodiversity index value was calculated of different stage of the plant of lower part of this section. The highest Shannon - wiener diversity index was recorded of pole staged plant with 0.94 while it was the lowest of tree staged plants. Similarly, the Simpson index of diversity was the highest of pole staged with 0.55 and lowest of tree staged plants with 0.44.

Table 15: Tree species biodiversity indexes in lower part of Khudi-Manang Section

Biodiversity indexes	Tree species	Pole species	Sapling
Shannon - wiener diversity index	0.77	0.94	0.84
Simpson index of diversity	0.44	0.55	0.53
Evenness Index	0.89	0.86	0.93

B. Comparison of tree species biodiversity in Khudi-Manang Section in summer season

There was no any change in tree, pole and sapling staged plant species in summer season. However, the early rain favours seedling to grow in this section. Seedling of some tree species was recorded in some plots. These species were *Schima wallichi, Sauraria nepaulense, Macaranga patulata* and *Alnus Nepalensis*.

3.3.1.3 Herbs, Shrubs and Grass species in winter season

The relative density, relative frequency and relative coverage of herbs, shrubs and grasses were varied according to species and their IVI was also varied. The highest IVI was recorded of *Ageratum conyzoides* L. with 24.68 and the lowest value of IVI was 5.56 of some species like *Ocimum gratissimum, Urtica dioica, Maesa indica, Daphne papyracea* etc.

Table 16: Herbs, Shrubs and Grass species in Khudi Manang Section in winter season

SN	Local Name	Botanical Name	Relative Density	Relative Frequency	Relative Coverage	IVI
1	Titepati	*Artemisis indica*	3.85	1.79	2.78	8.41
2	**Kalo kuro**	***Bidens pilosa***	3.85	5.36	4.63	13.83
3	Kanike Kuro	*Cynoglossum zeylanicum*	9.62	1.79	5.56	16.96
4	**Ban Tulashi**	***Ocimum gratissimum***	**1.92**	**1.79**	**1.85**	**5.56**
5	Kan Sinko	*Adiantum edgeworthii*	1.92	5.36	3.70	10.98
6	Phapar jhar	*Polygonum barbatum*	1.92	10.71	6.48	19.12
7	Kans	*Commelina nudiflora*	3.85	10.71	7.41	21.97
8	**Gande Jhar**	***Ageratum conyzoides L.***	**3.85**	**12.50**	**8.33**	**24.68**
9	Kalo Banmara	*Ageratina adenophora*	7.69	3.57	5.56	16.82
10	Pani Amala	*Nephrolepis cordifolia*	5.77	3.57	4.63	13.97
11	**Sisno**	***Urtica dioica***	**1.92**	**1.79**	**1.85**	**5.56**
12	**Bilaune**	***Maesa indica***	**1.92**	**1.79**	**1.85**	**5.56**
13	Sikhano	*Thysanolaena*	3.85	3.57	3.70	11.12
14	Dhursil	*Colebrookea oppositifolia*	7.69	3.57	5.56	16.82
15	Banse ghash	*Panicum* sp.	1.92	3.57	2.78	8.27

SN	Local Name	Botanical Name	Relative Density	Relative Frequency	Relative Coverage	IVI
17	Datiun	*Achyranthes aspera*	1.92	5.36	3.70	10.98
18	Unyu	*Arthromeris wallichiana*	9.62	1.79	5.56	16.96
19	Fren plant	*Dryopteris* sp.	1.92	1.79	1.85	5.56
20	Mothe	*Tridax procumbens*	1.92	1.79	1.85	5.56
21	Sano jai(wild)	*Avena* sp.	5.77	3.57	4.63	13.97
22	Fern	*Tracheophyta* sp.	1.92	3.57	2.78	8.27
23	Tree fern	*Cyatheales* sp	7.69	1.79	4.63	14.11
24	Pipla	*Ficus religiosa*	1.92	1.79	1.85	5.56
25	Dudhe jhar	*Euphorbia hirta L*	1.92	1.79	1.85	5.56
26	Climber	*Smilex* sp.	1.92	3.57	2.78	8.27
27	Lokta	*Daphne papyracea*	1.92	1.79	1.85	5.56
28	Amriso	*Thysanolaena maxima*	3.85	1.79	2.78	8.41
29	Aiselu	*Rubus ellipticus*	3.85	5.36	4.63	13.83
30	Jaluka	*Remusatia vivipara*	9.62	1.79	5.56	16.96
31	Gurjo	*Tinospora cordifolia*	1.92	1.79	1.85	5.56
32	Kaulo	*Machilus odoratissima*	1.92	5.36	3.70	10.98
33	Ban Haldi	*Curcuma aromatica*	1.92	10.71	6.48	19.12
34	Apamarga	*Achyranthes aspera*	3.85	10.71	7.41	21.97

3.3.1.4 Status of Herbs, Shrubs and Grass Species in Summer Season

There was total 42 species of small plants (herbs, shrubs and grasses) in Khudi Manag Section. The importance value of some species was very high in this section. The estimated highest IVI was 41.42 of *Oplismenus* sp., it was followed by *Artemisia vulgaris* with 32.9 and *Oxalis corniculata* with 23.2 while the lowest IVI was recorded of *Solanum* sp. with 1.43 (Table 16). There was no any change in tree species at tree, pole and sapling stage.

Table 17: Relative frequency, density, coverage and IVI of small plants in summer seasons

S. N.	Scientific name	Relative Frequency	Relative Density	Relative coverage	IVI
1	***Oplismenus* sp.**	**8.33**	**17.53**	**15.55**	**41.42**
2	*Artemisia vulgaris*	7.29	7.04	18.56	32.9
3	*Oxalis corniculata*	7.29	10.89	5.02	23.2
4	*Gonostegia* sp.	5.21	7.97	5.52	18.7
5	*Biden pilosa*	4.17	5.98	2.51	12.65
6	*Ageratina adenophora*	4.17	2.92	5.02	12.11
7	*Cynodon dactylon*	3.13	5.58	2.51	11.21
8	*Equisetum* sp.	1.04	3.98	5.02	10.04
9	*Stellaria* sp.	2.08	4.25	3.01	9.34
10	*Persicaria* sp.	3.13	2.12	3.01	8.26
11	*cyperus rotundus*	3.13	3.32	1.25	7.7
12	*Helichrysum* sp.	3.13	2.92	1.51	7.55
13	*Urnea lobata*	3.13	1.33	3.01	7.46

S. N.	Scientific name	Relative Frequency	Relative Density	Relative coverage	IVI
14	*Viola* sp.	2.08	1.99	3.26	7.34
15	*Desmodium* sp.	3.13	1.33	1.76	6.21
16	*persicaria chinensis*	3.13	1.46	1.61	6.19
17	*Fragaria* sp.	2.08	2.52	1.51	6.11
18	*Persicaria capitata*	2.08	0.93	2.11	5.12
19	*Rumex Nepalensis*	2.08	1.46	1.51	5.05
20	*Scutellaria* sp.	1.04	1.33	2.01	4.38
21	*Imperata cylindrica*	1.04	1.99	1	4.04
22	*Rubus* sp.	2.08	0.4	1.51	3.99
23	*Asteraceae*	2.08	0.93	0.8	3.82
24	*Vitis* sp.	2.08	0.53	1	3.62
25	*Dioscorea* sp.	2.08	0.53	1	3.62
26	*Canabis* sp.	2.08	1.06	0.35	3.5
27	*Casia tora*	2.08	0.4	1	3.49
28	*Hypoxis* sp.	1.04	0.93	1	2.97
29	*Ranunculus* sp	1.04	0.66	1	2.71
30	*Sida rhambifolia*	1.04	0.53	1	2.58
31	*Saccharum spontaneum*	1.04	0.93	0.5	2.47
32	*Lygodium* sp.	1.04	0.4	1	2.44
33	*Acanthaceae*	1.04	0.66	0.25	1.96
34	*Oplismenus* sp.	1.04	0.66	0.25	1.96
35	*Mumosa pudica*	1.04	0.4	0.5	1.94
36	*Melostoma* sp.	1.04	0.27	0.5	1.81
37	*Kyllinga* sp.	1.04	0.66	0.1	1.81
38	*Maesia chiesia*	1.04	0.27	0.5	1.81
39	*Plantago major*	1.04	0.53	0.2	1.77
40	*Coolebrokia oppositifolia*	1.04	0.13	0.5	1.68
41	*Urtica dioica*	1.04	0.13	0.5	1.68
42	*Solanum* sp.	1.04	0.13	0.25	1.43

E. Comparison of Herbs, Shrubs and Grass species between winter and summer season: Some plants species were differed in winter and summer seasons. Total plant species was 35 in winter season while 42 species were observed in summer season. The IVI was of *Ageratum conyzoides* in winter season while this was highest IVI of ***Oplismenus* sp.** This indicates that the relative density, relative frequency and relative coverage and IVI of herbs, shrubs and grass species were differed according to seasons

3.3.1.5 Biodiversity hot spot in Khudi-Manang section

The mid-section of Khudi-Manang section is biodiversity hotspot. This lies in Chaymche in Marsyangdi Rural Municipality. The areas are rocky and covered some very valuable species like *Trachycarpus sp., Berginia ciliate* and *Himalayacalamus asper* **(**Nigalo forest) (Table 17).

Table 18 : Hot spot in Khudi Manang Section

SN	Location	Location detail	Speciality of hot spots
1	Mid-section of Khudi Manang section	Marsyangdi RM, Chaymche	Species Diversity includes
			1 *Trachycarpus* sp.
			2 Berginia ciliate
			3. Nigalo forest
			Rocky slope and more vulnerable

3.3.1.6 Ethnobotany use of Medicinal plants

There are several uses of plants to treat the disease. Local people have been using the plants and their parts for different purposes particularly to treat several types of disease. Total 53 plant species were used by the local people for different purposes. For example, they use *Berginia ciliata* to treat piles and abdominal mass, *Biden pilosa* to treat ear infections and kidney (Table 18).

Table 19: Ethnobotanical use of plants (Manang Khudi Section)

SN	Local name	Scientific name	Family	Use
1	Pakhanbed	*Berginia ciliate*	Saxifragaceae	Piles, abdominal mass
2	Kuro	*Biden pilosa*	Asteraceae	Ear infections, kidney problems
3	Chari Amilo	*Oxalis corniculata*	Oxalidaceae	Abdominal Disorder
4	Buki	*Blumea*	Asteraceae	Fodder
5		*Plantago major*	Plantaginaceae	eye irritation and inflammation of mouth and throat
6	Bhui kafal	*Fragaria* sp.	Rosaeae	Food
7	Ganja	*Canabis* sp.	Canabaceae	constipation, some types of pain, epilepsy, anxiety
8		*persicaria chinensis*	Polygonaceae	Fodder
9	Phapare ghas	*Persicaria capitate*	Polygonaceae	Fodder
10	Kalo Banmara	*Ageratina adenophora*	Asteraceae	Wound treatment
11		*Vitis* sp.	Vitaceae	Skin disease
12		*Lygodium* sp.	Lygodiaceae	Fodder
13	Base ghas	*Oplismenus* sp.	Poaceae	Fodder
14	Sim jhar	*Ranunculus* sp.	Rananculaceae	Rubefacient, and to treat intermittent fever
15	Aiselu	*Rubus* sp	Rosaeae	Food
16		*Hypoxis* sp	Hypoxidaceae	Diabetes
17	Halhale	*Rumex Nepalensis*	Polygonaceae	Vegetables
18		*Pteris vitata*	Pteridaceae	Fodder

SN	Local name	Scientific name	Family	Use
19	Ljawati	*Mumosa pudica*	Fabaceae	piles, dysentery, sinus, and also applied on wounds
20	Motthe	*Cyperus rotundus*	Cperaceae	Fodder
21	Kanthakari	*Solanum virginianum*	Solanaceae	cough, chest pain, against vomiting, hair fall, leprosy, itching scabies
22		*Desmodium* sp.	Fabaceae	Fodder
23		*Urnea lobate*	Malvaceae	Treating fractures, wounds, mastitis and snake bites.
24	Kali Angeri	*Melostoma* sp.	Melostomataceae	Decorative
25	Dubo	*Cynodon dactylon*	Poaceae	Fodder, expectorant, carminative and as a brain and heart tonic.
26	Dhusure	*Coolebrokia oppositifolia*	Lamiaceae	peptic ulcers, Fodder
27	Patpate	*Casia tora*	Fabaceae	liver tonic, cardiotonic and expectorant
28	Tarul	*Dioscorea* sp.	Dioscoreaceae	Food
29		*Barleria* sp.	Acanthaceae	Fodder
30	Balu	*Sida rhombifolia*	Malvaceae	Skin disease
31	Muse khari	*Pogonatherum paniceum*	Poaceae	Fodder
32	Khar	*Saccharum spontaneum*	Poaceae	Fodder, fiber
33	Batulpate	*Stephania* sp.	Menispermiaceae	Skin disease
34		*Tridax procumbens*	Asteraceae	Fodder
35	Tite pati	*Artemisia vulgaris*	Asteraceae	Skin disease
36		*Kyllinga nemoralis*	Cperaceae	Fodder
37		*Stellaria* sp.	Caryophyllaceae	Cosmetic
38		*Persicaria* sp.	Polygonaceae	Fodder
39		*Equisetum* sp.	Equisetaceae	Fodder
40	Tulasi jhar	*Scutellaria* sp.	Lamiaceae	Perfumery
41	Bilaune	*Maesa chisia*	Primulaceae	Fodder
42	Siru	*Imperata cylindrical*	Dioscoreaceae	Fodder
43	Sisnoo	*Urtica diocea*	Urticaceae	Food, antidiabetic
44		*Pyrrosia* sp.	polypodiaceae	Bronchitis
45	Sunakhari	*Bulbophyllum* sp.	Orchidaceae	Decorative
46		*Selaginella* sp.	Sellaginaceae	Fodder

SN	Local name	Scientific name	Family	Use
47	Kurilo	*Asparagus racemosus*	Asparagaceae	Upset stomach (dyspepsia), constipation, stomach spasms, and stomach ulcers.
48	Pani amala	*Nephrolepsis* sp.	polypodiaceae	Food, Fodder
49	Pipla	*Piper* sp.	Piperaceae	flavoring of soups, meat, fish, eggs, salads, and sauces
50	Koiralo	*Bahunia variegata*	Fabaceae	Food
51	Gurjo	*Tinospora sp.*	Menispermiaceae	cough, fever
52	Rudilo	*Pogostemon Benghalensis*	Lamiaceae	cough, fever
53	Ban besar	*Curcuma* sp.	Zingiberaceae	Flavouring, antibacterial

Moreover, *Cyathea spinulosa* tree fern was also found in the sample plot taken nearby Marsyangdi river.

3.3.2 Floral Biodiversity in Khudi-Udipur Section

There was not any difference in tree stage, pole staged and sapling staged tree species according to seasons. However, more seedlings were observed in summer season. Herbs, shrubs and grass species were more in summer season in comparison to winter season.

3.3.2.1 Tree Species diversity

Importance value index was varying according to different stage of the plant species. It was the highest of *Albizia procera* with 82.06 of tree staged plant; it was followed by *Bombax ceiba* with 52.68. The lowest importance value index was *Ficus benghalensis* with 7.62. Similarly, the highest importance value index was of *Schima wallichii* with 60.76 of pole staged plant and lowest value was 5.27 of *Cedrella toona* (Tooni). The highest importance value index of sapling staged plant was 50.26 of *Mallotus philippinensis* (Table 19).

Table 20: Importance Value Index of Tree species in Khudi Udipur Section

Local Name	Scientific name	Tree				Pole				Sapling			
		RD	RF	RA	IVI	RD	RF	RA	IVI	RD	RF	RA	IVI
Khanyu	*Ficus semecordata*	2.33	3.57	1.86	7.76	3.39	5.88	3.78	13.05	8.70	11.76	10.23	30.69
Siris	*Albizia* sp.	23.26	25.00	33.81	82.06	1.69	2.94	2.34	6.98	4.35	5.88	5.12	15.35
Mauwa	*Engelhardtia spicata*	6.98	10.71	8.39	26.08	8.47	8.82	12.42	29.71	8.70	5.88	7.29	21.87
Simal	*Bombex ceiba*	18.60	14.29	19.79	52.68	3.39	2.94	2.29	8.62			0.00	0.00
Tooni	*Cedrella toona*	4.65	7.14	4.91	16.70							0.00	0.00
Khirro	*Sapium insigne*	6.98	7.14	5.64	19.76	1.69	2.94	2.54	7.17	4.35	5.88	5.12	15.35
Khote Salla	*Pinus roxburghii*	13.95	7.14	8.49	29.59	15.25	5.88	17.77	38.91	4.35	5.88	5.12	15.35
Chilaune	*Schima wallichii*	11.63	14.29	9.04	34.95	22.03	14.71	24.02	60.76	4.35	5.88	5.12	15.35
Sal	*Shorea robusta*	6.98	3.57	3.68	14.23	3.39	2.94	3.85	10.18	13.04	5.88	9.46	28.39
Amaro	*Spondias pinnata*	2.33	3.57	2.67	8.57							0.00	0.00
Bar	*Ficus benghalensis*	2.33	3.57	1.72	7.62							0.00	0.00
Faledo	*Erythrina* sp.					3.39	2.94	0.74	7.07			0.00	0.00
Sindhure	*Mallotus philippinensis*					8.47	8.82	4.30	21.60	21.74	11.76	16.75	50.26
Maledo	*Macaranga indica*					1.69	2.94	0.63	5.27			0.00	0.00
Kalikath	*Miliusa velutina*					5.08	8.82	4.80	18.71	4.35	5.88	5.12	15.35
Tooni	*Cedrella toona*					1.69	2.94	0.63	5.27			0.00	0.00
Tiju	*Choerospondias axillaris,*					1.69	2.94	0.74	5.37			0.00	0.00
Bayar	*Ziziphus mauritiana*					1.69	2.94	1.00	5.63	4.35	5.88	5.12	15.35
Kattush	*Castonopsis indica*					5.08	5.88	3.28	14.25	4.35	5.88	5.12	15.35
Lakuri	*Fraxinus floribunda*					1.69	2.94	2.07	6.71			0.00	0.00
Jamun	*Syzygium cumini*					1.69	2.94	2.94	7.58	4.35	5.88	5.12	15.35
Badahar	*Artocarpus lakoocha*					3.39	2.94	2.30	8.63			0.00	0.00
Sissoo	*Dalbergia sissoo*					3.39	2.94	5.03	11.37			0.00	0.00
Saj	*Teminalia alata*					1.69	2.94	2.54	7.17			0.00	0.00
Dhunge										4.35	5.88	5.12	15.35
Katikath	*Miliusa velutina*									4.35	5.88	5.12	15.35
Amala	*Phyllanthus emblica*									4.35	5.88	5.12	15.35

3.3.2.2 Biodiversity index of Tree species: Tree, Pole & Regeneration

The biodiversity indexes of plants were varying according to stage of the plant. Shannon- Weinner index was the highest of regeneration staged plants with 1.75 and it was the least of pole staged plan with 0.77. The Simpson index was the highest of regeneration staged plants with 1.16 and it was the least of tree staged plants with 0.55 (Table 20).

Table 21: Tree species diversity in Khudi-Udipur Section

Biodiversity Index	Tree	Pole	Regeneration
Shannon- Weinner	0.93	0.77	1.75
Simpson	0.55	0.60	1.16
Species richness	0.90	0.76	1.83

C. Comparison of seedling staged tree biodiversity in Khudi Udipur Secion according to season: Some regeneration of seedling of tree species were recorded in second time observation. The seedlings of the species were *Macaranga patulata, Schima wallichi, Dalbergia sissoo* and *Mallotus philippensis*.

3.3.2.3 Importance Value Index of Herbs Shrubs and Grass species in Winter Season

The relative density, relative frequency and relative coverage were varying according to herbs, shrubs and grass and the importance value index accordingly. The highest importance value index was recorded 22.5 of two species name *Arthromeris wallichiana* and *Ageratina adenophora* while the lowest importance value was recorded (Table 21).

Table 22: Herbs, Shrubs and Grass species in Khudi-Udipur Section in Winter Season

SN	Species	Scientific name	Relative density	Relative Frequency	Relative Coverage	IVI
1	**Unyu**	***Arthromeris wallichiana***	**4**	**11**	**7.5**	**22.5**
2	Arari Kanda	*Mimosa himalayana*	1	4	2.5	7.5
3	Asuro	*Justicia adhatoda*	4	4	4	12
4	Banse Ghas	*Panicum* sp.	3	4	3.5	10.5
5	Khar	*Saccharum spontaneum*	3	2	2.5	7.5
6	Dubo	*Cynodon dactylon*	7	4	5.5	16.5
7	Bhimsen pati	*Buddleja asiatica*	1	2	1.5	4.5
8	Ghod Tapre	*Centella asiatica*	3	1	2	6
9	Dhursilo	*Colebrookea oppositifolia*	2	13	7.5	22.5
10	Titepati	*Artemisa carvifolia*	1	2	1.5	4.5
11	Kanthakari	*Solanum xanthocarpum*	1	2	1.5	4.5
12	Banmara	*Ageratina adenophora*	6	9	7.5	22.5
13	Lalupate	*Euphorbia pulcherrima*	1	2	1.5	4.5
14	Bamboo	*Bambusa vulgaris*	1	2	1.5	4.5
15	Raju Kanda	*Xeromphis* sp.	1	2	1.5	4.5
16	Mothe	*Cyperus* sp.	4	2	3	9

SN	Species	Scientific name	Relative density	Relative Frequency	Relative Coverage	IVI
17	Chari Amilo	*Oxalis corniculata*	9	5	7	21
18	Sarpaghandha	*Rauvolfia serpentina*	1	2	1.5	4.5
19	Batul Pate	*Stephania sp.*	1	2	1.5	4.5
20	Mothe	*Cyperus rotundus*	1	2	1.5	4.5
21	Kewara	*Pandunus* sp.	1	2	1.5	4.5
22	Dhagero	*Woodfordia fructicosa*	1	2	1.5	4.5
23	Farke Ghas		17	5	11	33
24	Seto Banmara	*Chromolaena odorata*	9	4	6.5	19.5
25	Dudhe Jhar	*Euphorbia hirta*	3	2	2.5	7.5
26	Gai Tihare	*Inula cappa*	5	2	3.5	10.5
27	Kanike Kuro	*Cynoglossum zeylanicum*	1	2	1.5	4.5
28	Gandhe Jhar	*Ageratum haustonianum*	7	2	4.5	13.5
29	Aishelu	*Rubus ellipticus*	1	2	1.5	4.5

E. Importance Value Index of Herbs Shrubs and Grass species in Summer Season

The varying relative frequency, density and coverage of plan species have cumulative effects on importance value index. Total there were 41 species of herbs, shrubs and grass species in the forest of Khudi – Udipur section. The highest importance value index (IVI) was of *Oplismenus* sp. With 45.59 while the very low importance value index was found of some species namely *Smileax sp.*, *Thysolaena americana* and *Inula sp.* with same value that was 1.52 (Table 22).

Table 23: IVI of herbs, shrubs and grass in Khudi-Udipur Section in Summer Season

S. N.	Scientific Name	Relative frequency	Relative Density	Relative coverage	IVI
1	*Artemissia vulgaris*	4.35	4.48	7.24	16.06
2	***Oplismenus* sp.**	**8.70**	**23.02**	**13.87**	**45.59**
3	*Desmodium* sp.	4.35	3.32	2.71	10.39
4	*Saccharum* sp.	1.09	1.92	1.81	4.81
5	*Cyperus* sp.	3.26	1.28	1.81	6.35
6	*Sida rhombifolia*	2.17	0.51	1.21	3.89
7	*Cyperus brevifolius*	1.09	1.92	0.60	3.61
8	*Gonostegia* sp.	4.35	2.94	4.52	11.81
9	*Sida* sp.	2.17	0.64	1.21	4.02
10	Lamiaceae	4.35	2.56	3.32	10.22
11	*Urnea lobata*	2.17	0.77	1.21	4.15
12	*Biden Pilosa*	4.35	4.60	5.73	14.68
13	*Oxalis corniculate*	3.26	4.09	1.81	9.16
14	*Alternanthera* sp.	2.17	3.45	1.21	6.83
15	*Dioscorea* sp.	1.09	0.38	0.60	2.07
16	***Smilax sp.***	**1.09**	**0.13**	**0.30**	**1.52**

S. N.	Scientific Name	Relative frequency	Relative Density	Relative coverage	IVI
17	*Mumosa* sp.	3.26	1.79	1.51	6.56
18	*Pyrrosia* sp.	1.09	0.64	1.21	2.93
19	***Thysolaena Americana***	**1.09**	**0.13**	**0.30**	**1.52**
20	*Casia* sp.	3.26	0.90	1.51	5.66
21	*Clerodendron* sp.	2.17	1.53	7.24	10.95
22	*Cynodon Dactylon*	4.35	7.67	3.32	15.34
23	*Saccharum spontaneum*	2.17	2.17	4.22	8.57
24	*Ageratum haustonianum*	4.35	6.65	8.44	19.44
25	*Persicaria* sp.	1.09	0.90	1.21	3.19
26	*Stephania Japonica*	3.26	0.64	1.09	4.99
27	*Persicaria chinensis*	1.09	0.64	0.60	2.33
28	*Acyranthus aspera*	2.17	1.53	1.21	4.91
29	*Blumea* sp.	1.09	0.26	0.30	1.64
30	*Imperata cylindrica*	2.17	8.31	7.84	18.33
31	*Nephrolepsis* sp.	1.09	2.56	1.21	4.85
32	*Acanthaceaee*	4.35	2.94	4.22	11.51
33	*Cromolaena odorata*	2.17	0.51	1.21	3.89
34	*Inula* sp.	1.09	0.13	0.30	1.52
35	*Dryopteris* sp	1.09	0.90	0.60	2.59
36	*Euphorbia hirta*	1.09	0.90	0.60	2.59
37	*Evolvulus* sp.	1.09	0.38	0.60	2.07
38	*Centella* asiatica	1.09	0.26	0.30	1.64
39	*Vitis* sp.	2.17	0.26	0.60	3.03
40	*Lygodium* sp.	1.09	0.13	0.60	1.82
41	*Justicia* sp.	1.09	1.28	0.60	2.97

F. Comparison of herbs, shrubs and grasses species in Khudi Udipur Section: Only total 29 plants species of herbs, shrubs and grass in this section in the winter season. However, total 41 species were recorded of herbs, shrubs and grass in summer season (second observation).

3.3.2.4 Ethnobotanical use of plants

Many species of herbs, shrubs and grasses are used for medicinal and aromatic purposes. Some of the important species are *Milletia extensa, Artemissia vulgaris, Oplismenus* sp., *Desmodium* sp., *Saccharum* sp., *Cyperus* sp., *Sida rhambifolia, Cyperus brevifolius, Gonostegia* sp., *Sida* sp., *Scutellaria sp., Urnea lobate, Biden pilosa, Oxalis corniculata, Pogonatherum paniceum, Dioscorea* sp., *Smilax* sp., *Mumosa* sp., *Pyrrosia* sp., *Thysanolaena maxima, Casia* sp., *Clerodendrum* sp., *Cynodon dactylon, Saccharum spontaneum, Ageratum haustonianum, Persicaria* sp., *Stephania Japonica, Persicaria chinensis* etc. Artemissia vulgaris is used to treat against the skin disease. Similarly, *Sida rhambifolia* is used to control the cough disease. *Biden pilosa* is used for treating the infection in ear (Table 23).

Table 24: Ethno botanical use of plant species (Khudi-Udipur Section)

S. N	Local / Nepali name	Scientific Name	Family	Use Value
1	Gaujo	*Milletia extensa*	Fabaceae	Fodder
2	Tite pati	*Artemissia vulgaris*	Asteraceae	Skin disease use as external problem
3	Base ghas	*Oplismenus* sp.	Poaceae	Fodder
4		*Desmodium* sp.	Fabaceae	Fodder
5		*Saccharum* sp.	Poaceae	Fodder
6		*Cyperus* sp.	Cyperaceae	Fodder
7	Balu jhar	*Sida rhambifolia*	Malvaceae	cough and wheezing, urinary tract infections
8		*Cyperus brevifolius*	Cyperaceae	Fodder
9		*Gonostegia* sp.	Urticaceae	Fodder
10		*Sida* sp.	Malvaceae	cough
11		*Scutellaria* sp.	Lamiaceae	Skin problem
12		*Urnea lobate*	Malvaceae	treating fractures, wounds, mastitis and snake bites
13	Kalo kuro	*Biden pilosa*	Asteraceae	Ear infections, kidney problems
14	Chari amilo	*Oxalis corniculata*	Oxalidaceae	traumatic injuries, sprains and poisonous snake bites
15	Musekhari	*Pogonatherum paniceum*	Poaceae	Fodder
16	Tarul	*Dioscorea* sp.	Dioscoreaceae	Food value
17	Kukurdaino	*Smilax* sp.	Smilacaceae	skin diseases
18	Lajawati	*Mumosa* sp.	Fabaceae	piles, dysentery, sinus, and also applied on wounds
19		*Pyrrosia* sp.	Polypodaceae	bronchitis
20	Amriso	*Thysanolaena maxima*	Poaceae	treatment of eye infection
21		*casia* sp.	Fabaceae	Fodder
22	Bhati	*Clerodendrum* sp.	Lamiaceae	skin disease treatment
23	Dubo	*Cynodon Dactylon*	Poaceae	Fodder, expectorant, carminative and as a brain and heart tonic.
24	Kash	*Saccharum spontaneum*	Poaceae	Fodder, fiber
25	Nilo gandhe	*Ageratum haustonianum*	Asteraceae	Use is to cure wounds and burns
26		*Persicaria* sp.	Polygonaceae	Fodder
27	Batulpate	*Stephania Japonica*	Menispermiaceae	Abdominal relief
28		*Persicaria chinensis*	Polygonaceae	Fodder
29	Datiwan	*Achyranthus aspera*	Acanthaceae	used in the treatment of boils, asthma, in facilitating delivery, bleeding
30	Buki	*Blumea* sp.	Asteraceae	Fodder

S. N	Local / Nepali name	Scientific Name	Family	Use Value
31	siru	*Imperata cylindrical*	Poaceae	Fodder
32	Pani amala	*Nephrolepsis* sp.	Polypodaceae	Food, Fodder
33		*Barleria* sp.	Acanthaceaee	Fodder
34	Gandhe	*Cromolaena odorata*	Asteraceae	used to treat wounds, burns, and skin infections
35		*Inula* sp.	Asteraceae	Treatment of wound
36	Uniu	*Dryopteris* sp.	Pteridaceae	Food
37	Dudhe jhar	*Euphorbia hirta*	Euphorbiaceae	worm infestations in children, dysentery, jaundice, pimples, gonorrhoea, digestive problems, and tumours
38		*Evolvulus* sp.	Convulvulaceae	Fodder
39	Ghod tapre	*Centella asiatica*	Apiaceae	heal wounds, improve mental clarity, and treat skin conditions
40		*Vitis* sp.	Vitaceae	cure of Skin problem
41	Uniu	*Lygodium* sp.	Lygodiaceae	Fodder
42		*Justicia* sp.	Acanthaceae	Fodder
43	Marauthi	*Acmella* sp.	Asteraceae	food and medicine, and as an insecticide
44	Sissoo	*Dalbergia sissoo*	Fabaceae	Timber, wound healing
45	Kurilo	*Asparagus racemosus*	Asparagaceae	Upset stomach (dyspepsia), constipation, stomach spasms, and stomach ulcers.
46	Sindhure, raini	*Mallotus philippensis*	Euphorbiaceae	relieve excessive irritation, scabies
47	Bayar	*Ziziphus mauritianus*	Rhamnaceae	Food, Fodder
48	Bilauni	*Maesia chisia*	Primulaceae	Fodder
49	Kali angeri	*Melostoma* sp.	Melostomataceae	Decorative
50	Simal	*Bombax ceiba*	Malvaceae	timber, Fibre and
51	Bhimsen pati	*Buddleja asiatica*	Buddlejaceae	Skin cure
52	Bharla	*Bahunia vali*	Fabaceae	Fodder
53	Barro	*Terminalia belerica*	Combretaceae	Protect the liver and to treat respiratory conditions
54	Harro	*Terminalia chebula*	Combretaceae	Ingestive disorders, including both diarrhoea and constipation, and indigestion
55	Amala	*Phyllanthus emblica*	Phyllanthaceae	Tonic to build up lost vitality and vigor.
56	Niguro	*Tectaria* sp.	Polypodaceae	Food
57	Simali	*Vitex negundo*	Verbenaceae	Skin problem treatment
58	Asuro	*Justicia adhtoda*	Acanthaceae	treatments of cough, colds, asthma
59		*Ficus* sp.	Moraceae	Skin problem

S. N	Local / Nepali name	Scientific Name	Family	Use Value
60	Khaneu, Nimaro	*Ficus semecordata*	Moraceae	food, Fodder
61	Pehuli	*Reinwardtia indica*	Linaceae	Decorative, fodder
62	Koiralo	*Bauhinia variegate*	Fabaceae	Food, fodder
63		*Fimbristylis* sp.	Cyperaceae	Fodder
64		*Huperzia* sp.	Lycopodiaceae	treatment of contusions, strains, swellings
65	Dumri	*Ficus racemose*	Moraceae	Fodder
66	Bihi	*Solanum* sp.	Solanaceae	Fodder
67		*Kyllinga nemoralis*	Cyperaceae	Fodder
68	Utis	*Alnus Nepalensis*	Betulaceae	Timber
69	Dhusure	*Coolebrookia oppositifolia*	Lamiaceae	peptic ulcers, Fodder

3.3.3 Floral Biodiversity in Udipur Markichowk Section

There were differences in the tree species biodiversity of tree, pole and sapling staged plant species. However, there was some changes in seedlings and herbs, shrubs and grass species.

3.3.3.1 A. Importance Value Index of Tree Species

The importance value index of different plant species was varying according to tree, pole and sapling staged plants. The highest importance value index was recorded 102.4 of *Schima wallichii* and it was followed by *Albizia odoratissima* (L. f.) Benth with 76.27 of tree staged plant. Similarly, the highest importance value index was *Shorea robusta* of pole staged plant with 65.1 and it was followed by *Schima wallichii* with 64.07. The highest importance index was 91.35 of *Shorea robusta* of regeneration staged plants and it was followed *Schima wallichii* with 69.53 (Table 24).

Table 25: Importance Value Index of Tree Species in Udipur-Markichowk Section

Local Name	Scientific Name	Tree				Pole				Sapling			
		RD	RF	RA	IVI	RD	RF	RA	IVI	RD	RF	RA	IVI
Sal	*Shorea robusta*	14	5.88	22.0	41.93	23.44	13.79	27.86	65.1	24	15.00	52.35	91.35
Chilaune	*Schima walichii*	42	23.53	36.8	102.4	20.31	20.69	23.07	64.07	24	25.00	20.53	69.53
Sissoo	*Dalbergia sissoo*	2	5.88	1.02	8.91	-	-	-	-	-	-	-	-
Bakaino	*Melia azedarach*	2	5.88	3.72	11.61	-	-	-	-	-	-	-	-
Botdhagero	*Lagerstroemia parviflora*	4	5.88	2.26	12.15	21.88	20.69	19.9	62.54	8.00	10.00	2.39	20.39
Tiju	*Pierasma javanica*	2	5.88	3.98	11.87	-	3.448	0.95	5.968	4.00	5.00	0.29	9.29
Padke	*Albizia odoratissima*	24	29.41	22.8	76.27	10.9	13.79	13.34	38.07	8.00	5.00	2.77	15.77
Bel	*Aegle marmelos*	2	5.88	1.60	9.48	3.12	3.448	1.93	8.50	4.00	5.00	0.36	9.36
Siris	*ALbizia sps*	2	5.88	1.47	9.35	-	-	-	-	4.00	5.00	0.87	9.87
Khair	*Acacia catechu*	6	5.88	4.16	16.04	4.68	3.448	3.38	11.52	-	-	-	-
Ankhitare	*Trichilia connaroides*	-	-	-	-	1.56	3.448	1.90	6.91	-	-	-	-
Tiju	*Choerospondias axillaris,*	-	-	-	-	1.56	-	-	-	-	-	-	-
Simal	*Bombex ceiba*	-	-	-	-	1.56	3.448	0.33	5.34	-	-	-	-
Lakuri	*Fraxinus floribunda*	-	-	-	-	3.12	3.448	1.92	8.49	-	-	-	-
Mahuwa	*Engelhardtia spicata*	-	-	-	-	3.12	3.448	0.87	7.45	4.00	5.00	0.07	9.07
Kattush	*Castonopsis indica*	-	-	-	-	1.56	3.448	2.63	7.64				
Khirro	*Sapium insigne*	-	-	-	-	3.12	3.448	1.80	8.38	4.00	5.00	1.58	10.58
Rajbrikshya	*Cassia fistula*	-	-	-	-	-	-	-	-	4.00	5.00	17.15	26.15
Sindure	*Mallotus philippensis*	-	-	-	-	-	-	-	-	8.00	10.00	1.57	19.57
Kalikath	*Miliusa velutina*	-	-	-	-	-	-	-	-	4.00	5.00	0.07	9.07
Total		**100**	**100**	**100**	**300**	**100**	**100**	**100**	**300**	**100**	**100**	**100**	**300**

Note: RD = relative dominance, RF= Relative Frequency, RA= Relative Abundance, IVI- Importance Value Index.

3.3.3.2 Biodiversity index in Tree species

The Shannon - wiener diversity index was the highest of regeneration staged plant with 1.15. this was the least of tree staged plant. The Simpson index was the highest 0.63 of regeneration staged plant while it was the lowest 0.49 of tree staged plant (Table 25).

Table 26: Tree species diversity in Udipur-Markichowk Section

Biodiversity Index	Tree	Pole	Regeneration
Shannon - wiener diversity index	0.78	1.00	1.15
Simpson index of diversity	0.49	0.60	0.63
Evenness Index	0.88	0.90	0.96

3.3.3.3 Importance Value Index of Herbs, Shrubs and Grass species in winter season

The relative density, frequency and coverage of herbs, shrubs and grass species were varying in winter season and it's varying the importance value index accordingly. The highest importance value index was recorded of *Arthromeris wallichiana* with 21 while the least value of IVI was recorded of species like *Buddleja asiatica, Lyonia ovalifolia, Bambusa vulgaris, Justicia adhatoda, Jatropa curcus, Lyonia ovalifolia, Cyperus rotundus* and *Cyanotis cristata* (Table 26).

Table 27: Herbs, Shrubs and Grass species in Udipur-Markichowk Section

SN	Species	Scientific name	Relative density	Relative Frequency	Relative Coverage	IVI
1	Unyu	*Arthromeris wallichiana*	4	10	7	21
2	Chari Amilo	*Oxalis articulate*	10	2	6	18
3	Bhati	*Clerodendrum infortunatum*	4	8	6	18
4	Kalo Banmara	*Ageratina adenophora*	8	4	6	18
5	Dhursilo	*Colebrookea oppositifolia*	2	9	5.5	16.5
6	Gande jhar	*Ageratum conyzoides*	7	4	5.5	16.5
7	Dubo	*Cynodon dactylon*	9	2	5.5	16.5
8	Banmara	*Eupatorium cannabium*	6	4	5	15
9	Banse Ghas	*Panicum sp.*	4	5	4.5	13.5
10	Titepati	*Artemisa carvifolia*	2	7	4.5	13.5
11	Seto banmara	*Chromolaena odorata*	5	4	4.5	13.5
12	Pani amala	*Nephrolepis cordifolia*	7	2	4.5	13.5
13	Ban Tulashi	*Ocimum gratissimum*	4	4	4	12
14	Bilaune	*Maesa indica*	2	5	3.5	10.5
15	Sisnu	*Urtica dioica*	4	2	3	9
16	Apamarga	*Achyranthes aspera*	2	4	3	9
17	Raju Kandha	*Xeromphis* sp.	2	4	3	9
18	Kurilo	*Asparagus racemosus*	2	4	3	9
19	Bhimshen Pati	*Buddleja asiatica*	2	2	2	6

SN	Species	Scientific name	Relative density	Relative Frequency	Relative Coverage	IVI
20	Angeri	*Lyonia ovalifolia*	2	2	2	6
21	Bamboo	*Bambusa vulgaris*	2	2	2	6
22	Ashuro	*Justicia adhatoda*	2	2	2	6
23	Sajiwan	*Jatropa curcus*	2	2	2	6
24	Angeri	*Lyonia ovalifolia*	2	2	2	6
25	Mothe	*Cyperus rotundus*	2	2	2	6
26	Kane jhar	*Cyanotis cristata*	2	2	2	6

3.3.3.4 Importance Value Index of Herbs, Shrubs and Grass species in summer season

The relative frequency, density and coverage of herbs, shrubs and grass species were varying so the importance value index was also varying. The highest importance index was of *Oplismenus sp*. with 35.89 while this value was the least of *Onychium* sp. with 0.91 (Table 27).

Table 28: IVI of Herbs, Shrubs and Grass sp. in Udipur-Markhichowk Section in Summer Season

SN	Scientific name	Relative	Relative	Relative	IVI
1	*Pogonatherum panicum*	3.52	18.83	11.33	33.68
2	*Urnea lobata*	4.23	1.36	2.12	7.71
3	***Oplismenus* sp.**	**5.63**	**20.91**	**9.35**	**35.89**
4	*Saccharum spontaneum*	2.11	3.77	2.55	8.43
5	*Casia tora*	2.82	1.04	1.27	5.13
6	*Nephrolepsis* sp.	0.70	1.30	0.85	2.85
7	*Alocasia* sp.	0.70	0.32	0.57	1.60
8	*Imperata cylindrica*	2.11	6.49	3.12	11.72
9	*Cynodon dactylon*	6.34	6.43	2.86	15.63
10	*Desmodium* sp	4.23	4.74	3.96	12.93
11	*Sida* sp.	1.41	0.71	0.99	3.11
12	*Blumea* sp.	3.52	0.91	0.85	5.28
13	*Centella asiatica*	2.82	1.43	2.27	6.51
14	*Smilax* sp.	1.41	0.19	0.71	2.31
15	*Vitis* sp.	1.41	0.65	1.42	3.47
16	*Artemissia* vulgaris	3.52	2.08	5.66	11.26
17	*Scutellaria* sp.	0.70	0.97	0.28	1.96
18	*Gonostegia* sp.	2.11	0.39	0.71	3.21
19	*Clerodendrum* sp.	4.93	2.27	7.36	14.57
20	*Ageratina adenophora*	1.41	0.65	1.70	3.76
21	*Persicaria* sp.	2.11	1.10	0.99	4.21
22	*Cyperus rotundus*	2.11	0.84	0.57	3.52
23	*Biden pilosa*	2.11	1.56	1.13	4.80
24	*Ageratum haustonianum*	4.93	3.57	6.51	15.01
25	*Justicia* sp	1.41	0.71	1.42	3.54
26	*Cromolaena* dorata	3.52	0.39	2.27	6.18

SN	Scientific name	Relative	Relative	Relative	IVI
27	*Barleria* sp.	2.11	3.38	3.96	9.45
28	***Onychium* sp.**	**0.70**	**0.06**	**0.14**	**0.91**
29	*Dioscorea* sp.	0.70	0.13	0.14	0.98
30	*Mumosa* sp.	1.41	0.52	0.85	2.78
31	*Evolvulus* sp.	0.70	1.95	2.27	4.92
32	*Justicia adhatoda*	2.11	0.71	1.98	4.81
33	*Dryoppteris* sp.	2.11	1.69	5.10	8.90
34	*Oxalis corniculata*	2.11	2.40	1.70	6.21
35	*Solanum* sp.	2.82	0.65	1.98	5.45
36	*Parthenium hysterophorus*	1.41	1.10	1.42	3.93
37	*Tectaria* sp.	0.70	0.13	0.57	1.40
38	*Rorippa* sp.	0.70	0.19	0.28	1.18
39	*Piper* sp.	0.70	0.19	0.28	1.18
40	*Kyllinga brevifolia*	0.70	0.97	0.57	2.24
41	Phyllanthus sp.	0.70	0.13	0.14	0.98
42	*Fimbristylis* sp.	0.70	0.19	0.28	1.18
43	*Lygodium* sp.	1.41	0.45	0.85	2.71
44	*Ichnocarpus* sp.	1.41	0.32	0.85	2.58
45	*Barleria cristata*	0.70	0.06	0.28	1.05
46	*Murrya koenigi*	0.70	0.13	1.13	1.97
47	*Acyranthes aspera*	1.41	0.39	1.27	3.07
48	*Adiantum* sp.	0.70	0.45	0.28	1.44
49	*Asparagus* sp.	0.70	0.06	0.28	1.05
50	*Eleusine* sp.	0.70	0.06	0.57	1.34

3.3.3.5 Comparison of Importance value index of herbs, shrubs and grass species between winter and summer season

The number species of herbs, shrubs and grass were varying according to season. Total 26 species of herbs, shrubs and grass species were found in this section in winter season. The importance value index was also varied according to season in this section. Total 50 species of herbs, shrubs and grasses were recorded in summer season.

3.3.3.6 Ethnobotanical use of plants (Udipur-Markhichowk)

Some plants species and their ethnobotanical uses are described in the table 18. Total 75 species of plants were recorded in this section. Local people have been using these species for different purposes. For instance, *Urnea lobate* is used for treating fractures, wound and snake bites. Similarly, *Clerodendrum sp* is used for treating the skin disorder and healing the wound. *Murrya koenigi* is used for treating piles, inflammation, itching, fresh cuts, dysentery. Moreover, *Acyranthes aspera* is used for abdominal relief (Table 28).

Table 29: Ethno botanical use of plant species ((Udipur-Markichowk Section)

S.N.	Local name	Scientific name	Family	Use Value
1		*Pteris vitata*	Pteridaceae	Fodder
2	Musekhari	*Pogonatherum paniceum*	Poaceae	Fodder
3		*Urnea lobata*	Malvaceae	treating fractures, wounds, mastitis and snake bites
4	Base ghas	*Oplismenus* sp.	Poaceae	Fodder
5	kash	*Saccharum spontaneum*	Poaceae	Fodder, Fibre
6	Patpate	*Casia tora*	Fabaceae	Fodder
7	pani amala	*Nephrolepsis* sp.	Polypodaceae	Food
8	jaluka	*Alocasia* sp.	Araceae	Food
9	siru	*Imperata cylindrical*	Poaceae	Fodder
10	Dubo	*Cynodon dactylon*	Poaceae	Fodder
11		*Desmodium* sp	Fabaceae	Fodder
12	Balu jhar	*Sida* sp.	Malvaceae	To treat asthma, tuberculosis, common cold, flu, headaches
13	Buki	*Blumea* sp.	Asteraceae	Fodder
14	Ghodtapre	*Centella asiatica*	Apiaceae	used to heal wounds, improve mental clarity
15	Kukurdaino	*Smilax* sp.	Smilacaceae	Very used as a diuretic, purifying, vulnerary
16		*Vitis* sp.	Vitaceae	Fodder
17	Tite pati	*Artemissia vulgaris*	Asteraceae	Skin disease, fever
18		*Scutellaria* sp.	Lamiaceae	Perfumery
19		*Gonostegia* sp.	Urticaceae	Food
20	Bhaati	*Clerodendrum* sp.	Lamiaceae	Skin disorder, wound healing
21	Nilo ghandhe	*Ageratina adenophora*	Asteraceae	used for treatment such as wound, itching, measles, skin diseases
22		*Persicaria* sp.	polygonaceae	Fodder
23	Mothe	*Cyperus rotundus*	Cyperaceae	Fodder
24	Kalo kuro	*Biden pilosa*	Asteraceae	Fever, wound healing
25	Banmara	*Ageratum haustonianum*	Asteraceae	Use is to cure wounds and burns
26		*Justicia* sp.	Acanthaceae	Fodder
27	Seto manmara	*Cromolaena dorata*	Asteraceae	Treat wounds, burns, and skin infections
28		*Barleria* sp.	Acanthaceae	Fodder
29	Sindhure	*Onychium* sp.	Pteridaceae	Fodder
30	Tarul	*Dioscorea* sp.	Dioscoreaceae	Food
31		*Mumosa* sp.	Fabaceae	Fodder
32		*Evolvulus* sp.	convolvulaceae	used to treat fever and expel intestinal worms.

S.N.	Local name	Scientific name	Family	Use Value
33	Asuro	*Justicia adhatoda*	Acanthaceae	Use to relief from abdominal pain
34	Uniu	*Dryoppteris* sp.	Dryopteridaceae	Food
35	Chari amilo	*Oxalis corniculata*	Oxalidaceae	Used in the treatment of influenza, fever, urinary tract infections
36	Bihi	*Solanum* sp.	Solanaceae	Fodder
37	Pati jhar	*Parthenium hysterophorus*	Asteraceae	remedy for skin inflammation, rheumatic pain, diarrhoea
38	Niguro	*Tectaria* sp.	Tectariaceae	Food
39		*Rorippa* sp.	Brassicaceae	Food
40	Pipla	*Piper* sp.	Piperaceae	Spices, flavouring
41		*Kyllinga brevifolia*	Cyperaceae	Fodder
42		*Phyllanthus* sp.	Phyllanthaceae	Cough
43		*Fimbristylis* sp.	Cyperaceae	Fodder
44		*Lygodium* sp.	Lygodiaceae	Fodder
45	Dudhe	*Ichnocarpus* sp.	Apocynaceae	Fodder
46		*Barlaria cristata*	Acanthaceae	Fodder
47	Mitho nim	*Murrya koenigi*	Rutaceae	Used in treating piles, inflammation, itching, fresh cuts, dysentery
48	Datiwan	*Acyranthes aspera*	Acanthaceae	Abdominal relief
49		*Adiantum* sp.	Pteridaceae	Decorative
50	Kurilo	*Asparagus* sp.	Asparagaceae	
51		*Eleusine* sp	Poaceae	
52	Bel	*Egle marmelos*	Rutaceae	food, heat relief
53	Pehuli	*Reinwardtia indica*	linaceae	Decorative
54	Bilauni	*Maesia chisia*	Primulaceae	Fodder
55	Aiselu	*Rubus ellipticus*	Rosaceae	Food
56	Khayar	*Acacia catechu*	Fabaceae	Khatha & Cutch
57		*Pyrrosia* sp.	Polypodiaceae	treatment of nephritis and bronchitis
58	Khaneu/ Nimaro	*Ficus semecordata*	Moraceae	Fodder
59	Dhusure	*Colebrookia oppositifolia*	Lamiaceae	To treat peptic ulcers.
60		*Sida cordifolia*	Malvaceae	Fodder
61	Amala	*Phyllanthus emblica*	Phyllanthaceae	Used both as a medicine and as a tonic to build up lost vitality and vigour
62	harro	*Terminalia chebula*	Combretaceae	To treat high cholesterol and digestive disorders, including both diarrhoea and constipation, and indigestion

S.N.	Local name	Scientific name	Family	Use Value
63	Kali angeri	*Melostoma* sp.	Melostomataceae	Decorative, fodder
64	Batulpate	*Stephania japonica*	Menispermiaceae	Cancer, bone fracture and fever.
65		*Plantago major*	Plantaginaceae	To trat skin diseases, eye irritation and inflammation of mouth and throat
66	Siris	*Albizia* sp.	Fabaceae	To treat coughs, boils, lung problems, flu
67	Chilaune	*Schima wallichii*	Thiaceae	Antimicrobial, anticoagulant, and antioxidant
68	Bhorla	*Bahunia vali*	Fabaceae	Leaf plate, tonic and aphrodisiac
69	Koiralo	*Bahunia variegata*	Fabaceae	Pickle
70	Bhalayo	*Semecarpus anacardium*	Anacardiaceae	Antiatherogenic, anti-inflammatory, antioxidant
71	Sajh	*Terminalia alata*	Combretaceae	Antibacterial, antifungal, antiprotozoal, antiviral
72	Kabro	*Ficus lacor*	Moraceae	Fodder, treatment of bleeding disorders, herpes, wounds, mouth ulcers
73	Dudhe jhar	*Euphorbia hirta*	Euphorbiaceae	To treat cough, coryza, bronchitis, and asthma
74	Bayar	*Zixiphus jujuba*	Rhamnaceae	To treat asthma, cough, and laryngitis
75	Kadam	*Anthocephalus cadamba*	Rubiaceae	Religious purpose, fever, uterine complaints, skin diseases

3.3.4 Vegetation Biodiversity Markichowk Bharatpur Section

A. Importance Value Index of Tree species

The importance value index of tree species was varying according to different stage of the plants. The highest record of importance value index was 216.4 of *Shorea robusta* and it was followed by *Terminalia chebula* Retz. With 37.23 of tree staged plants. The highest importance value index was 92.29 of *Shorea robusta* of pole staged plants and it was lowest of two species *Madhuca latifolia* (Roxb.) and *Castonopsis spp* with 6.315. The highest importance value index was 44.77 of *Lagerstroemia parviflora* and it was followed by *Mallotus philippensis* with 42.82 (Table 29).

Table 30: Importance Value Index of Tree Species in Markichowk-Bharatpur Section

Local Name	Scientific Name	Tree				Pole				Sapling			
		RD	RF	RA	IVI	RD	RF	RA	IVI	RD	RF	RA	IVI
Sal	*Shorea robusta*	79.1	79.1	54.55	216.4	37.68	13.04	41.57	92.29	20	14	1	35
Bel	*Aegle marmelos*	4.16	4.16	9.091	14.29	-	-	-	-	-	-	-	-
Harro	*Terminalia chebula*	8.33	8.33	18.18	37.23	-	-	-	-	-	-	-	
Mauwa	*Engelhardtia spicata*	4.67	4.16	9.091	14.97	1.449	4.348	0.518	6.315	-	-	-	-
Saj	*Terminalia alata*	4.16	4.16	9.091	17.15	-	-	-	-	2.857	5	2.82	10.68
Chilaune	*Schima walichii*	-	-	-	-	24.64	17.39	25.96	67.99	11.43	5	20.92	37.34
Kaphal	*Myreca esculenta*	-	-	-	-	4.348	4.348	2.167	10.86	5.714	5	1.833	12.55
Kattush	*Castonopsis indica*	-	-	-	-	1.449	4.348	0.518	6.315	-	-	-	-
Guhelo	*Callicarpa macrophylla*	-	-	-	-	7.246	4.348	8.576	20.17	-	-	-	-
Padeli	*Stereospermum sp*	-	-	-	-	1.449	4.348	1.123	6.921	-	-	-	-
Rajbrikshya	*Cassia fistula*	-	-	-	-	1.449	4.348	2.894	8.691	5.714	10	5.668	21.38
Tiju	*Pierasma javanica*	-	-	-	-	2.899	4.348	1.712	8.959	-	-	-	-
Bhalayo	*Semecarpus anacardium*	-	-	-	-	2.899	4.348	4.394	11.64	-	-	-	-
Botdhagero	*Lagerstroemia parviflora*	-	-	-	-	5.797	17.39	2.958	26.15	11.43	15	18.34	44.77
Khirro	*Sapium insigne*	-	-	-	-	2.899	4.348	3.209	10.46	2.857	5	10.18	18.04
Sindhure	*Mallotus philippensis*	-	-	-	-	4.348	8.696	2.08	15.12	17.14	10	15.68	42.82
Kyamun	*Cleistocalyx operculata*	-	-	-	-	1.449	4.348	2.324	8.121				
Jhigane	*Kydia calycina*	-	-	-	-	-	-	-	-	8.571	10	3.638	22.21
Tatari	*Acer tataricum,*	-	-	-	-	-	-	-	-	2.857	5	10.18	18.04
Jamun	*Syzygium cumini*	-	-	-	-	-	-	-	-	5.714	10	1.72	17.43
Kattush	*Castonopsis indica*	-	-	-	-	-	-	-	-	5.714	5	9.025	19.74

Note: RD = relative dominance, RF= Relative Frequency, RA= Relative Abundance, IVI- Importance Value Index.

3.3.4.1 Biodiversity Index of Tress species

The biodiversity index was varying according to stage of the plants. The highest Shannon - wiener diversity index was 0.87 of regeneration staged plants. The Simpson index of diversity was the highest of regeneration staged plants with 0.53 and lowest was of pole staged plants with 0.33 (Table 30).

Table 31: Tree biodiversity in Markichowk Bharatpur Section

Biodiversity Index	Tree	Pole	Regeneration
Shannon - wiener diversity index	0.60	0.60	0.87
Simpson index of diversity	0.36	0.33	0.53
Evenness Index	0.67	0.49	0.90

3.3.4.2 IVI of Herbs, Shrub and Grass species found in Winter season

The species-wise value of relative density, frequency and coverage were varying and importance value index was differed accordingly in winter season. The highest value of importance of was recorded 27.00 of *Clerodendrum infortunatum* while the lowest value was 6.00 of some species like *Xeromphis* sp., *Achyranthes aspera, Mikania micrantha, Argemone Mexicana, Thysanolaena maxima* and *Cyperus rotundus* (Table 31).

Table 32: Herbs, Shrub and Grass species in Markichowk-Bharatpur section in Winter

SN	Species	Scientific name	Relative density	Relative Frequency	Relative coverage	IVI
1	Bhanti	*Clerodendrum infortunatum*	4	14	9	27.00
2	Seto Banmara	*Chromolaena odorata*	7	10	8.5	25.5
3	Kadi Patta	*Murraya koenigii*	7	8	7.5	22.5
4	Gande Jhar	*Ageratum conyzoides*	7	8	7.5	22.5
5	Unyu	*Dryopteris* sp.	8	6	7	21
6	Kalo Banmara	*Ageratina adenophora*	8	6	7	21
7	Ban Tulashi	*Ocimum gratissimum*	5	6	5.5	16.5
8	Titepati	*Artemisa carvifolia*	5	6	5.5	16.5
9	Dubo	*Cynodon dactylon*	7	2	4.5	13.5
10	Aishelu	*Rubus ellipticus*	5	4	4.5	13.5
11	Angeri	*Lyonia ovalifolia*	5	4	4.5	13.5
12	Banse Ghas	*Cyperous* sp.	6	3	4.5	13.5
13	Kande ful	*Lantana camera*	5	2	3.5	10.5
14	Dharselo	*Colebrookea oppositifolia*	5	2	3.5	10.5
15	Paileti	*Cipadessa baccifera*	2	4	3	9
16	Bansh	*Bambusa vulgaris*	3	2	2.5	7.5
17	Apamarga	*Achyranthes aspera*	2	2	2	6

SN	Species	Scientific name	Relative density	Relative Frequency	Relative coverage	IVI
18	Mikania	*Mikania micrantha*	2	2	2	6
19	Thakal	*Argemone mexicana*	2	2	2	6
20	Amriso	*Thysanolaena maxima*	2	2	2	6
21	Mothe	*Cyperus rotundus*	2	2	2	6
22	Raju kanda	*Xeromphis* sp.	2	2	2	6

D. Importance Value Index of Herbs, Shrub and Grass species in summer season

The importance value index was varying according species as relative frequency, density and coverage was varying according to plant species. The highest importance value index was 31.75 of *Imperata cylindrica* while this value was the lowest 1.32 of two plant species namely *Parthenium hysterophorus* and *Vitis* sp. (Table 32).

Table 33: IVI of herbs, shrub and Grass in Markichowk Baharatpur section in Summer

S.N.	Scientific name	Relative frequency	Relative Density	Relative coverage	IVI
1	***Imperata cylindrica***	**4.12**	**18.18**	**9.45**	**31.75**
2	*Urnea lobata*	4.12	4.41	3.74	12.27
3	*Melostoma* sp.	0.00	0.81	3.15	3.96
4	*Evolvulus* sp.	2.06	1.89	0.79	4.74
5	*Desmodium* sp.	4.12	1.80	3.74	9.66
6	*Blumea* sp.	3.09	0.54	1.18	4.81
7	*Clerodendrum* sp.	2.06	0.63	2.36	5.05
8	*Cynodon dactylon*	4.12	6.30	2.76	13.18
9	*Ageratum haustonianum*	4.12	8.55	3.94	16.61
10	*Sida* sp.	4.12	0.90	1.38	6.40
11	*Pogonantherum paniceum*	4.12	9.45	4.92	18.50
12	*Oxalis corniculata*	3.09	4.05	1.57	8.72
13	*Oplismenus* sp.	4.12	16.38	7.48	27.99
14	*Hypoxis* sp.	1.03	1.35	0.79	3.17
15	*Barleria cristata*	1.03	0.18	1.97	3.18
16	*Artemissia vulgaris*	3.09	1.80	2.76	7.65
17	*Biden pilosa*	2.06	2.97	1.77	6.80
18	*Phyllanthus* sp.	5.15	1.98	4.72	11.86
19	*Persicaria* sp.	1.03	0.72	1.57	3.33
20	*Ageratina adinophora*	1.03	2.25	5.51	8.79
21	*Cyperus rotundus*	2.06	0.18	0.39	2.64
22	*Cromolaena odorata*	2.06	0.54	1.57	4.18
23	*Stephania japonica*	2.06	0.36	1.18	3.60
24	***Parthenium hysterophorus***	**1.03**	**0.09**	**0.20**	**1.32**
25	*Polypodium* sp.	3.09	0.72	5.51	9.32

S.N.	Scientific name	Relative frequency	Relative Density	Relative coverage	IVI
26	*Saccharum* sp.	1.03	0.27	1.18	2.48
27	*Commelina* sp	1.03	0.27	0.39	1.69
28	*Lygodium* sp.	2.06	0.54	3.54	6.15
29	*Ichnocarpus* sp.	1.03	0.54	1.18	2.75
30	*Dryopteris* sp.	1.03	0.63	1.57	3.24
31	Lamiaceae	3.09	1.80	2.36	7.26
32	*Reinwardtia indica*	1.03	0.18	0.39	1.60
33	*Centella asiatica*	1.03	1.08	0.39	2.50
34	*Cyperus* sp.	3.09	0.99	0.98	5.07
35	*Saccharum spontaneum*	2.06	2.70	0.79	5.55
36	*Dioscorea* sp	2.06	0.27	0.79	3.12
37	*Rubus ellipticus*	1.03	0.27	1.57	2.88
38	*Micania micrantha*	1.03	1.26	4.33	6.62
39	*Cajanus* sp.	1.03	0.90	1.97	3.90
40	*Calotropis gigantea*	1.03	0.09	0.79	1.91
41	*Woodfordia fructicosa*	1.03	0.18	0.79	2.00
42	*Acaranthes aspera*	1.03	0.27	0.39	1.69
43	*Mallotus philippenensis*	1.03	0.27	0.39	1.69
44	***Vitis* sp.**	**1.03**	**0.09**	**0.20**	**1.32**
45	*Cruculigo* sp.	1.03	0.27	0.39	1.69
46	*Pogostemon benghalensis*	1.03	0.09	1.18	2.30

Comparison of herbs, shrubs and grass species in Markichowk Chitwan Section in winter and summer season: There were only 22 species of herbs, shrubs and grass in this section in winter season but it was 46 species in summer season.

3.3.4.3 Ethnobotany of important species

Some important plant species and their ethnobotanical uses are presented in table. *Clerodendrum sp.* is used for treating the skin disease. Similarly, *Oxalis corniculata* is used to treat traumatic injuries, sprains and poisonous snake bites. *Stephania japonica* is used for treating cancer, bone fracture and fever. *Hypoxis* sp. is used for treating Tuberculosis, arthritis, and a skin disease (Table 33).

Table 34: Ethnobotnical value of vegetation in Bharatpur Section

SN	Local name	Scientific name	Family	Use Value
1	Sal	*Shorea robusta*	Dipterocarpaceae	Timber
2	Siru	*Imperata cylindrica*	poaceae	Fodder
3		*Urnea lobata*	Malvaceae	Treating fractures, wounds, mastitis and snake bites.
4	Kali angeri	*Melostoma* sp.	Melostomataceae	Decorative
5		*Evolvulus* sp.	Convulvulaceae	

SN	Local name	Scientific name	Family	Use Value
6		*Desmodium* sp.	Fabaceae	Fodder
7	Buki	*Blumea* sp.	Asteraceae	Fodder
8	Bhati	*Clerodendrum* sp.	Lamiaceae	Skin disease treatment
9	Dubo	*Cynodon dactylon*	poaceae	Fodder
10	Nilo ghandhe	*Ageratum haustonianum*	Asteraceae	Use is to cure wounds and burns
11	Balu jhar	*Sida* sp.	Malvaceae	To treat cough
12	Musekhari	*Pogonatherum paniceum*	poaceae	Fodder
13	Chari amilo	*Oxalis corniculata*	Oxalidaceae	To treat traumatic injuries, sprains and poisonous snake bites
14	Base ghas	*Oplismenus* sp.	poaceae	Fodder
15		*Hypoxis* sp.	Hypoidaceae	Tuberculosis, arthritis, and a skin condition
16		*Barleria cristata*	Acanthaceae	Fodder
17	Tite pati	*Artemissia vulgaris*	Asteraceae	Skin disorder
18	Kalo kuro	*Biden pilosa*	Asteraceae	Ear infections, kidney problems
19		*Phyllanthus* sp.	Phyllanthaceae	stomach pain relief and cough
20		*Persicaria* sp.	Polygonaceae	Fodder
21	Banmara	*Ageratina adinophora*	Asteraceae	blood coagulation
22	Mothe	*Cyperus rotundus*	Cyperaceae	Fodder
23	Seto banmara	*Cromolaena odorata*	Asteraceae	Treat wounds, burns, and skin infections
24	Batulpate	*Stephania japonica*	Menispermiaceae	cancer, bone fracture and fever
25	pati jhar	*Parthenium Hysterophorus*	Asteraceae	Rheumatic pain, diarrhoea, urinary tract infections
26		*Polypodium* sp.	Polypodiaceae	Fodder
27	Kash	*Saccharum* sp.	poaceae	Fodder
28	Kane jhar	*Commelina* sp	Commelinaceae	Fodder
29		*Lygodium* sp.	Lygodiaceae	Fodder
30	Dudhe	*Ichnocarpus* sp.	Apocynaceae	Fodder
31	uniu	*Dryopteris* sp.	Dryopteridaceae	food, fodder
32	tulasi jhar	Lamiaceae	Lamiaceae	Aromatic
33	Pehuli	*Reinwardtia indica*	linaceae	Ornamental
34	Ghod tapre	*Centella asiatica*	Apiaceae	Heal wounds, improve mental clarity, and treat skin conditions such as leprosy
35	mothe	*Cyperus* sp.	Cyperaceae	Fodder

SN	Local name	Scientific name	Family	Use Value
36	khar	*Saccharum spontaneum*	poaceae	Fodder, Fiber
37	Tarul	*Dioscorea* sp	Dioscoreaceae	food, fodder
38	Aiselu	*Rubus ellipticus*	Rosaceae	Food
39	Manmara	*Micania micrantha*	Asteraceae	Briquettes fuel, fodder
40	Rahar ghas	*Cajanus* sp.	Fabaceae	Fodder
41	Ank	*Calotropis gigantea*	Apocynaceae	Treating skin, digestive, respiratory, circulatory and neurological disorders
42	Dhairo	*Woodfordia fructicosa*	Lythraceae	Dysentery, diarrhea, ulcer, and infections
43	Datiwan	*Achyranthes aspera*	Acanthaceae	Abdominal disorder, wound treatment
44	Sindhure, raini	*Mallotus philippenensis*	Euphorbiaceae	kill intestinal worms
45		*Vitis* sp.	Vitaceae	To treat skin wound treatment
46	Rudilo	*Pogostemon benghalensis*	Lamiaceae	To treat cough
47		*Cruculigo* sp.	Amaryllidaceae	Treatment of impotence, limb limpness, arthritis of the lumbar and knee joints, and watery diarrhea

3.3.5 Hotspot of floral diversity

3.3.5.1 Hot-Spot of floral diversity in Khudi Manang Section

Khudi-Manang section was started from Dharapani Manang to Khudi. Altitude of Dharapani is 2400m while elevation of Khudi is 1200m. The vegetation was diversified in this section. The upper section comprises temperate and sub temperate vegetation. The local people shared that *Morchella conica* (Guchi Chyau), *Valerina Jatamansi* (Sugandhwal), *Nardostachyas Jatamansi* (Jamanshi), *Neopicrorhiza scrophulariiflora* (Kutki), *Aconitum spicatum* (Atish Jara) are the major medicinal and aromatic plan species generally found in the forest of this section. The upper section contains blue pine (Gobre Salla) and *Alnus* (Uttish) forest. *Himalayacalamus asper* (Nigalo) is dominnat species in the midsection. The lower section comprises subtropical forest. *Cyatheales* spp (Tree fern), *Machilus odoratissima* (Kaulo**)** and *Piper longum* (Pipala) were the important species in the lower part of this section.

The mid-section of Khudi Manang section can be considered as the biodiversity hotspot areas because of presence of important vegetation species and species diversity. This lies in Chaymche in Marsyangdi Rural Muncipality. The areas is rocky and covered some very valuable species like *Trachycarpus sp., Berginia ciliate* and *Himalayacalamus asper* **(**Nigalo forest) (Table 34).

Table 35: Biodiversity hot-spot in Khudi Manang Section

Location	Location detail	Speciality of hot spots	Remarks
Mid-section of Khudi Manang section	Marsyangdi Rural Muncipality, Chaymche	Species Diversity includes	*Cyatheales s*pp (Tree fern), *Machilus odoratissima* (Kaulo**)** and *Piper longum* (Pipala) were the important species in moist area.
		1 *Trachycarpus* sp.	
		2 Berginia ciliate	
		3. Nigalo forest	
		Rocky slope that remarks to more vulnerable	

3.3.5.2 Hot Spot of floral diversity in Khudi Udipur Section

Khudi Udipur section starts from Khudi close to Bhulbhule Danda and ended at Udipur near to Beshi Shahar. The lower altitude of this section is 722 m. So, dominant forest was sub-tropical. *Pinus roxburghii* (Khote Salla), *Schima wallichii* (Chilaune), *Castonopsis spp*. (Katus), *Albizzia spp* (Siris), *Madhuca longifolia* (Mahuwa), *Phyllanthus emblica* (Amala) were major tree species in this section. Shorea robusta was also found in the lower part of the section. *Acacia catechu* (Khair), *Dalbergia sissoo* and *Bombax ceiba* (Semal) were found in the riverside. *Pandanus odorifer* (Kewara) was found near to the Mid Marshymagdi hydropower station dam). Some important medicinal and aromatic plant species were *Cynodon dactylon* (Dubo), Buddleja tibetica (Bhimsen pati), Centella asiatica (Ghod Tapre) found close to riverside. *Arthromeris wallichiana* (Unyu), *Justicia adhatoda* (Asuro), *Solanum xanthocarpum* (Kantkari), *Bambusa vulgaris* (Bamboo) were importantly found in this section.

A site close to AP 4 in Khudi – Udipur section is very important for biodiversity conservation. This site is located close to Besisahar. The important plant species were *Pandanus sp*., *Schima wallichi, Clerodendrum sp, Dominant Smilax sp.* and *Asparagus racemosus*. So, this site needs to conserve as biodiversity hot spot (Table 35).

Table 36: Biodiversity Hot spot in Khudi Udipur section

Location	Location detail	Speciality of hit spots	Remarks
Khudi - Udipur section, near to AP 4	Besisahar muncipality, Lamjung	Species Richness:	Moist area (*Smilax sp. is the* dominant plants in this area)
		1. *Pandanus* sp.	
		2.*Schima wallichi*	
		3. *Clerodendrum* sp	
		4. *Smilax* sp.	
		5. *Asparagus racemosus*	

3.3.5.3 Hot spot of floral diversity in Udipur Markichowk Section

This section is started from Udipur and ended at Markichowk. The endpoint elevation is 372 m which possesses subtropical and tropical climate. The species were generally varying according to the altitudinal and climatic variation of the section. Riverain species like *Acacia catechu* (Khair) and *Bombax ceiba* (Semal) were found in this section. In addition, this section was dominated by *Schima wallichii* (Chilauene) and *Castonopsis spp* (Katush) Forest.The altitude of Dhuwakot village is 463 m

and aspect is South East. The tree species composition in the forest was very unique. The species were *Myrica esculanta* (Kafal), *Schima wallichii* (Chilauene), *Castonopsis* sp.), *Shorea robusta* (Sal), *Aegle marmelos* (Bael) and *Albizzia* sp. (Siris). *Anaphalis contorta* (Bukiphool), *Cyperus rotundus* (Mothe), *Curcuma* sp. (Kalo Haledo), *Asparagus* sp. (Kurilo), *Dioscorea bulbifera* (Githa), *Oxalis corniculata* (Chari Amilo), *Phyllanthus niruri* (Bhuin Amala), *Trapa bispinosa* (Semal Kande) are some important mediciabal and aromatic plant species in the forest.

The location between AP 38 and 39 at Rainas muncipality-8, Harrabot Lamjung is very rich in biodiversity. This site was covered by *Albizia* sp., *Lagerstomia parviflora, Phyllanthus emblica* and *Rauvolfia serpentina*. Local people shared that, this site is famous habitat for *Rauvolfia serpentina* but these days, it is at high risk and hence this site needs to conserve as biodiversity hot spot (Table 36).

Table 37: Biodiversity hot spot in Udipur Markichowk Section

Location	Location detail	Speciality of hit spots	Remarks
Between AP38-AP39	Rainash muncipality-8, Harrabot Lamjung	Species 1. *Albizia* sp., 2. *Lagerstomia parviflora*, 3. *Phyllanthus emblica* and 4. *Rauvolfia serpentine*	at high risk of locally extinction of Sarpagandha

3.3.5.4 Hot spot of floral diversity in Markichowk Bharatpur Section

This section lies in the lower part having altitude from 221 to 372 m (Narayangadh). Generally subtropical forest species were found in this section. *Shorea robusta* (Sal) in Teria Sal Forest, Hill Sal Forest in Chure area and Riverain *Bombax ceiba* (Simal) in Terai and Chure area were found in this section. *Abrus precatorius* (Ratigedi), *Abelmoschus moschatus* (Ban Kapas), *Achyranthes aspera* (Datiwan), *Allium sativum* (Ban Lasun), *Acorus calamus* (Bojho), *Aegle marmelos* (Bael), *Alstonia scholaris* (Chhatiwan), *Alternanthera sessilis* are important medicinal and aromatic plant species in the forest of this section.

Importantly, the location near to AP 14 of **Markichowk** -Bharatpur Section is very important for biodiversity hotspot. The location situated at Abukhaireni-4, Chimkesari Dada is hotspot for biodiversity The major plant species were 1. *Myrica esculenta*, 2.*Shorea robusta*, 3.*Schima wallichi* and 4. *Macaranga patulata*. This site is highly prone to erosion. Therefore, this area needs to conserve because of high biodiversity (Table 37).

Table 38: Biodiversity hot spot in Markichowk Bharatpur Section

SN	Location	Location detail	Speciality of hot spots	Remarks
1	Near to AP 14 point of Markichowk -Bharatpur Section	Abukhaireni-4, Chimkesari Dada	Ecotone area for:	Highly prone to erosion area
			1. *Myrica esculenta*	
			2.*Shorea robusta*	
			3.*Schima wallichi*	
			4. *Macaranga patulata*	

3.3.6 Conservation status of plant species

Some species are very important in these sections of Marshyangdi river hydro electricity transmission line project. Government of Nepal, Convention" means the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and International Union for Conservation of Nature (IUCN) have listed as the protected species in Nepal according to their current status.

3.3.6.1 List of species and its protection status at Khudi Manang Section

Some plant species found in the forest and its vicinity of Khudi-Manang transmission line project is listed under different protection status. Though *Juglans regia* was not samples in this section, this species was found nearby forest. *Juglans regia* is protected by the government of Nepal. *Dactylorhiza hatagirea* (Panchaunle) was not found in the sample plot but local people shared that this species is very common in nearby forest; this species is also protected under government of Nepal (Table 38).

Table 39: Protection Status of Species Khudi Manang

Local name	Scientific name	Protection status (GoN)	CITES Appendixes	IUCN Red list
Okhar	*Juglans regia*	Protected		
Panchaunle	*Dactylorhiza hatagirea*			
Kutki	*Neopycrorhiza scrophulariiflora*		II	
Jatamanshi	*Valeriana jatamansii*		II	
Orchid	*Calanthe alpina Hook. f. ex Lindl.*		II	
Ban Aduwa	*Calanthe plantaginea Lindl.*		II	
HarJor	*Cymbidium aloifolium*			
Bhote Lahara	*Gnetum montanum Markgr.*			Endangered

3.3.6.2 List of species and its protection status at Khudi-Udipur Section

Some plant species found in this section are listed under the protected categories. *Dendrobium ensiflorum* Lindl, *Cyathea brunoniana*, *Vanda cristata* Wall. ex Lindl and *Gnetum montanum* were found in this section was protected under Appendix II of CITES (Table 39).

Table 40: Protection Status of Species at Khudi Udipur

Local name	Scientific name	Protection status (GoN)	CITES Appendixes	IUCN Red list
Sungava	*Dendrobium densiflorum Lindl.*		II	
Tree Fern	*Cyathea brunoniana*		II	
Bhyagute phul.	*Vanda cristata Wall. ex Lindl.*		II	
Bhote Lahara	*Gnetum montanum Markgr.*		II	

3.3.6.3 List of species and its protection status at Udipur Markichuar Section

Euphorbia royleana, Euphorbia prostrata, Rauvolfia serpentine and *Dioscorea deltoidea* are major faunal species which are protected under CITES Appendixes. *Rauvolfia serpentine* and *Dioscorea deltoidea* are protected under Endangered and Threatened respectively under IUCN Red list (Table 40).

Table 41: Protection Status of Species at Udipur Markichowk

Local name	Scientific name	Protection status (GoN)	CITES Appendixes	IUCN Red list
Siundee	*Euphorbia royleana*		II	
Kanike Ghans	*Euphorbia prostrata*		II	
Sarp Gandha	*Rauvolfia serpentina*		II	Endangered
Kukur Tarul	*Dioscorea deltoidea*		II	Threatened

3.3.6.4 List of species and its protection status at Markichowk Baratpur Section

Some floral species found in this section are protected under government of Nepal, CITES and IUCN Red list. Some examples of this were *Alstonia scholaris* is protected under IUCN Red list as rare species. *Acacia catechu* is protected under the government of Nepal and CITES IInd appendix. *Rauvolfia serpentine* and *Cycas pectinate* both species are protected under CITES IInd appendix and Endangered species in IUCN red list (Table 41).

Table 42: Protection Status of Species at Markichowk Bharatpur

Local name	Scientific name	Protection status (GoN)	CITES Appendixes	IUCN Red list
Chatiwan	*Alstonia scholaris*			Rare
Khair	*Acacia catechu*	Protected		Threatened
Sal	*Shorea robusta*	Protected		
Sissoo	*Dalbergia sissoo Roxb. ex DC.*	Protected	II	
Satisal	*Dalbergia latifolia*	Protected	II	Vulnerable
Kanike Ghans	*Euphorbia prostrata*		II	
Sarp Gandha	*Rauvolfia serpentina*		II	Endangered
Thakal	*Cycas pectinata*		II	Endangered
Kukur Tarul	*Dioscorea deltoidea*		II	Threatened
Tate Bari	*Dalbergia stipulacea*		II	
Orchid	*Ascocentrum ampullaceum*		II	

4 OUTCOMES OF THE FOCUS GROUP DISCUSSION

Focus Group Discussion (FGD) and Key Informant Interviews (KII) conducted with local communities and key stakeholders in the project area brought forth an interesting conservation regarding the perspective of the local people regarding the project impact on wildlife. The key points from the six discussions have been listed below followed by the summaries of each FGD.

Key points expressed during FGDs regarding project impact on wildlife:

i. There will be significant habitat loss for the wildlife as a result of clear cutting from the project.
ii. There should be afforestation programs to compensate for the loss of trees to restore habitats.
iii. Awareness programs should be given and periodic interaction should be conducted between the locals and project managers to discuss the impact of the project.
iv. Compliance to the mitigation measures should be monitored with local participation.
v. Key wildlife habitats should be left undisturbed.

The following summaries are direct feedback from the perspective of the participants without our interpretation:

4.1 FGD at Tal village, Manang district

Summary of discussion: *Number of participants: 10, Date: 2078-12-02*

The tree clearing for the electrical transmission lines will result in habitat loss of wildlife in addition to other impacts. Direct loss of forest area, increase in cases of electrocution of vultures in transmission wires, and increase in the population of monkeys and leopards are some expected impacts. Bear conflicts need addressing in the region. The local people should be properly informed before starting the project. For every tree felled, 10 trees should be planted and authorities should put in more effort to combat cases of forest fires. Public awareness programs should be conducted, and compliance to rules and laws should be monitored. The TL wires should be kept away from settlement areas. The project managers should conduct periodic discussion, at least twice a year with the public to give updates on progress as well as receive public feedback. Using the local manpower should be prioritized wherever possible.

4.2 FGD at Dharapani, Manang district

Summary of discussion: *Number of Participants: 4, Date: 2078-12-03*

The wildlife in the area will be displaced due to the construction of transmission line tower structures. There have been past incidents where construction work was done without proper agreement with the public. In recent years there has been an increase in conflict related to Ghorals, bears, monkeys, and leopards. There are some cases of wildlife hunting by visitors and people who come from other areas for different work. They have heard that the high temperature in the TL structure can result in forest fires. Proper mitigation measures must be taken to minimize the impact of the project on wildlife and environment. There should be some measures in place for compensation for loss or harm caused as a result of the project. Local people should be prioritized for employment and should be consulted before implementing construction activities.

4.3 FGD at Tachai village, Manang district

Summary of discussion: *Number of Participants: 10, Date: 2078-12-03*

Road construction, electrical transmission lines, and hydropower dams have large direct impacts on wildlife habitats. The river flow will be interrupted and will dry the upstream areas. During

construction, the noise from activities will also stress out and disturb the wildlife. Measures to minimize these impacts should be implemented with consultation from experts. Alternate habitats should be built for the displaced wildlife and some important habitats should be left undisturbed. Plantation activities should be implemented, noise and air pollution should be minimized. Roads should be maintained to reduce pollution. The project managers should work closely with locals to implement these mitigation measures, and prioritize local people for job opportunities. While implementing the project, local culture should be respected and biodiversity should be protected.

4.4 FGD at Tallo Chipla village, Lamjung district

Summary of discussion: *Number of Participants: 5, Date: 2078-12-13*

The project will make the rivers dry and affect the local climate making it hotter and displacing wildlife to other areas. There will be risk of electrocution cases from the transmission lines. Even smaller wildlife such as frogs will be impacted. Three mules had died in the past due to electrocution at Shreechaur. Landowners should be compensated properly in areas where the transmission line passes over their land. Plantation programs should be implemented to compensate for the loss of trees from clearcutting. Locals should be encouraged to use induction stoves instead of firewood to save trees. 25 trees should be planted in place of every tree felled. The locals should be provided with conservation awareness and capacity building training. Mitigation measures should be strictly implemented by the government in the affected regions within 2-5 years of project completion, through a joint collaboration of all affected parties.

4.5 FGD at Syange, Lamjung district

Summary of discussion: *Number of Participants: 5, Date: 2078-12-13*

The main areas important for wildlife in the locality are - Sildhunga bhitta area, the Northern Mipra area, region around Syange river, Western Tagrin, and the Upper region of Rambazar and Jagat area around the border of Manang-Lamjung district. Noise and disturbance during project construction activities will scare the wildlife from the area, and workers might be involved in hunting activities. The fish population will decline due to dams, and cases of electrocution of domestic (mention of mules dying in past due to electrocution) and wild animals will increase. Locals should be assigned to monitor compliance, and proper rules/regulations should be enforced to minimise impacts of the project. Work should be done in agreement with local stakeholders.

4.6 FGD at Jaldevi Community Forest, Bharatpur, Chitwan district

Summary of discussion: *Number of Participants: 2, Date: 2078-12-20*

The Barandabar corridor is very rich in biodiversity and is an important region for conservation. However, the area has been affected by a lot of activities with the major being the expansion of the highway, construction of landfill site resulting in chemical pollution, and military training which includes firing practice. Clearing forest and adding transmission lines will have a great adverse impact on the existing wildlife corridor. The large enclosed area of the substation in the forest will also affect the wildlife habitat. There is a need to make an underpass on the highway for animal crossing. The landfill should be moved to another area. Where possible the transmission lines should be made underground. The company should inform workers of the importance of biodiversity and enforce compliance with conservation rules. Small mitigation programs should be jointly implemented with the community forest and larger mitigation measures should be implemented by the government.

5 IMPACTS ON BIODIVERSITY

This chapter addresses the likely adverse impacts of the project on the biological environment of the area. In this report, impacts are identified based on the field study information. In order to minimize the predicted impacts, mitigation measures have also been proposed in this section. Predicted impacts and the mitigation measures on the different aspect of the biological environment in discussed below.

5.1 Wildlife

5.1.1 Wildlife habitat loss

This is going to be one of the major impacts on the local wildlife due to the project. 30m of clear cutting under the corridor is going to impact wildlife, especially small mammals and change their habitats drastically. The clearing can affect wildlife in both ways: positively for disturbance loving species such as Golden Jackal, and negatively for core species such as Himalayan Black Bears. This might also result in habitat fragmentation but we don't have enough data on movement of wildlife to verify this. There is also a high probability that the clearing will have barrier effects[1] for insects, reptiles, amphibians, small mammals and even some large mammals that avoid edges.

5.1.2 Illegal hunting of wildlife

Illegal hunting is going to be one of the most prominent threats to the local wildlife during the construction phase. Since a lot of workers come from other parts of the country and the work provides them with some purchasing power, the workers might entice locals to sell them bushmeat. In some cases, they might even hunt the animals themselves. A similar incident with Red Panda was reported from the Manang area. Coupled with the forest clearings and road extensions, this can result in increased bushmeat and wildlife trade in the project site[2].

Photo 1. Snare found in Khudi, Lamjung (left). Probable hunters in Bagarchhap camera trap (right).

[1] William F. Laurance, Miriam Goosem, Susan G.W. Laurance, Impacts of roads and linear clearings on tropical forests, Trends in Ecology & Evolution,Volume 24, Issue 12, 2009, Pages 659-669, ISSN 0169-5347, https://doi.org/10.1016/j.tree.2009.06.009.

[2] William F. Laurance, Miriam Goosem, Susan G.W. Laurance, Impacts of roads and linear clearings on tropical forests, Trends in Ecology & Evolution,Volume 24, Issue 12, 2009, Pages 659-669, ISSN 0169-5347, https://doi.org/10.1016/j.tree.2009.06.009.

5.1.3 Accidental death of wildlife

Clear cutting as well as activities like transporting goods and setting infrastructures for the transmission lines is a massive undertaking which will drastically modify the land use of the area which could be sheltering wildlife, especially the small mammals and birds that take shelter in borrows and trees. Construction activities might inadvertently destroy wildlife shelters and also trigger landslides and rockslides that can cause unintentional death of wildlife.

5.1.4 Increased human-wildlife conflict

The construction of infrastructures in some scale disturbs the wildlife. In one particular hydropower station, there was a reported killing of a civet due to its presence in the hydropower building. The clearing under the transmission line can also act as a trail for conflict species such as Leopard, Himalayan Black Bear and Barking deer. Since this trail intersects with farmlands and villages, the incidents of encounter and crop depredation might increase which in turn increases conflict.

5.1.5 Inorganic waste in wildlife habitat

We observed improper disposal of inorganic waste throughout the project area and this was more severe in a particular hydropower station. Construction workers can leave inorganic waste such as plastics and metals in their working area without proper management. Leftover construction materials such as wires can act as unintentional snares.

5.1.6 Disturbances during fawning season of ungulates

Ungulates have been known to avoid areas where construction of transmission lines have been ongoing but the existence of power lines itself might not have much disturbance[3]. During the calving season, females avoid disturbances as much as possible for the sake of their calves. Hence, the construction phase of the TL can have a high impact on the breeding females.

5.1.7 Disruption in the natural activity pattern of wildlife

The activity-overlap graphs (Figure 8) show that Masked Palm Civet, Leopard, Leopard Cat and Large Indian Civet are more active when there is less human activity. On the other hand, Yellow-throated Marten, Langur and Barking Deer overlap temporally with humans. Since these three are usually tolerant to human presence, we don't think there will be much disturbance for these species. However, if the constructions are conducted during night time as well, Civets, Leopard and Leopard Cat can suffer disturbances and can abruptly change their natural activity pattern.

5.1.8 Loss of access to water holes

During dry seasons, water holes will be the limiting resources for the wildlife. Work and infrastructure development near water holes can make the water holes inaccessible for the wildlife.

[3] Colman, J.E., Tsegaye, D., Flydal, K. *et al.* High-voltage power lines near wild reindeer calving areas. *Eur J Wildl Res* **61,** 881–893 (2015). https://doi.org/10.1007/s10344-015-0965-x

5.1.9 Positive impacts on wildlife

While there are several short and long term that can cause potential harm to the wildlife in the area, some edge loving species will benefit in the long term as a result of the change. Species that are adapted to living in forest edges and disturbed areas, will thrive in the post project completion period. Sites that will recover secondary vegetation over time will provide new habitat for small mammals and act as a corridor for some larger mammals.

5.1.10 Local Community Involvement:

1. Locals can be hired for construction and other jobs in the field site. This will have two positive impacts.
    a. Locals don't/won't increase the demand for bushmeat and won't set traps.
    b. This will also change the perspective of locals into a positive outlook towards the project.

5.2 Avi-fauna (Birds)

1. Landfill sites close to transmission line are sometimes problematic. Similar site was observed near Beshisahar, at the bank of Marsyangdi river., crows, kites and vultures are found in high number in the garbage site for food. These bird species attract bigger predatory and scavenging birds like eagles. There may be the chances of bird collisions in such area.
2. Some migratory bird species take the path of river and gorge area during the migration period. Existing as well as proposed electric transmission lines are found crossing the Marsyangdi river that flows from north to south. There may be the chances of bird collisions in such area.
3. During the surveys, habitats potential for raptors were found at Simalchaur area of Lamjung (vantage point 20 and 21), about 2 km north of Palungtar airport (vantage point 39), Chaukidanda of Chitwan (vantage point 64). These areas were found important for soaring of raptors. As the raptors take the height or cross the hill ridge, there could be chance of collision or electrocution.
4. The project site also contains good wetland habitat for migratory bird species. Migratory wetland birds were recorded in the wide Marsyangdi river area and dam-side area close to Markichowk substation and Udipur substation. There may be the chances of bird collisions in such area.
5. In the settlement areas raptors are attracted where people farm chicken and duck in an open space. There is chance of collision of the raptors with the transmission line passing close by the settlement area, as they dive to hunt the domesticated animals. There may be the chances of bird collisions in such area.
6. Existing transmission lines passing parallel to the proposed transmission line forms a wide barrier for the flying birds.
7. It was found that there is also a practice of hunting birds by Chepang community (place on the way to Chhimkeswori, vantage point 59). It is not directly related to transmission line but threats to birds might change their behavior.

5.3 Flora/Vegetation

5.3.1 Impact of project on Forest and Vegetation

5.3.1.1 Impact of project on forest and vegetation in Khudi Manang and Khudi Udipur Section

The impact of Marsyangdi Corridor Transmission Line Project can be categorized into two main categories. These are: i. Augmented impact & ii. Adverse Impacts

A. Augmented impact: More than 27.0385 ha forest area will be afforested as ex-situ conservation and same species will be planted in open areas of the forest. Total 315050 seedlings will be planted in the ratio of 1:25. So, the biodiversity will be maintained in the nearby forest. The forest user will be aware about the merit of the project. In addition, felled trees will be handed over to the authority and users. They can use forest products for their own purpose. Thus, government of Nepal can generate the royalty from selling the timber and so as the forest users can. Local forest professionals will have opportunity to work in the forest and biodiversity conservation activities like, they will have employment to work in nursery, afforestation and protection. In addition, the afforested areas will be additional habitat for wildlife.

B. Adverse Impacts

The possible adverse impacts can be categorized into three main parts. These are area loss, tree loss and biodiversity and habitat loss.

Affected forest area and management types: The project permanently requires 27.0385 ha forest area. So, some parts of different types of forest management types will be affected due to this project in Manang (Khudi Manang section) and Lamjung (Khudi Udipur section) districts. Some parts of Annpurna Conservation Area and government managed forest will be affected. Similarly, 8 community forests (7 community forests in Lamjung district and one community forest in Manag district) will be affected. Moreover, 3 leasehold forests will be affected in Lamjung district.

Affected Forest Tree species in Khudi Manang and Khudi Udipur section: Total 12602 trees of different species will be felled during the construction phase of high tensions line. These affected species are *Schima wallichii* (Chilaune), *Pinus Wallichiana* (Gobre salla), *Pinus oxburghii* (Khote Salla), *Shorea robusta* (Sal), *Alnus nepalensis* (Utis), *Dalbergia sissoo* (Sissoo), *Juglans regia* (Okhar), *Madhuca Longifolia* (Mahuwa), *Michelia champaca* (Chanp), *Fraxinus floribunda* (Lankuri), Semecarpus anacardium (Bhalayo), Myrica esculenta (Kafal), Albizia sp. (Siris), *Catonopsis indica* (Katus) and *Litsea monopelata* (Kutmiro),

Moreover, there may be the probability of illegal extraction of forest products like fuel wood collection for workers working in the project. They may burn the forest and illegally hunt the wildlife. The extraction of forest product may affect the Non-timber Forest Products (NTFPs) in specific site. Loss of trees in Private Forest: Total 985 number of trees and pole will be cut. Out of these 364 stems were tree staged and 621 stems were pole staged. In addition, 75 bamboo clumps and 400 clumps of Nigalo will be cut. Major affected species were *Pinus Wallichiana*

(Gobre salla), *Malus pumila* (Apple), *Jugland regia* (Okhar), Prunus persica (Peach), *Pinus roxburghii* (Khote salla), *Michelia champaca* (Chanp), *Albizzia* sp. (Siris), *Bombax cieba* (Semal), *Schima wallichii* (Chilauene), *Cedrela toona* (Tooni), *Syzygium cumini* (Jamun), *Terminalia chebula* (Harro), *Bauhinia purpurea* (Tanki) etc. (Table 42).
The envisaged impacts will be medium in magnitude, local in extent and long-term duration.

Table 43: Forest management type and affected area (Khudi Manang and Khudi Udipur section)

Forest Management Types	District	Number	Affected Area ha	No. of trees to be felled
ACA	Manang	Some parts	2.7625 (10.22%)	8051
	Lamjung	Some parts	14.5145 (53.68%)	
Gov. Managed Forest	Manang	Some parts	0	
	Lamjung	Some parts	0.4135 (1.53%)	194
Community forest	Manang	1	0.480 (1.78%)	3110
	Lamjung	7	6.192 (22.9%)	
Leasehold forest	Manang	-	0	0
	Lamjung	3	2.676 (9.9%)	1247
Total			27.0385	12602

Source: NEA-ESSD, 2018

Note: ACA: Annapurna Conservation Area, CF: Community Forest, LF: Leasehold Forest

5.3.1.2 Impact of project on Biodiversity in Udipur Markichowk and Markichowk Bharatpur Section

A. Augmented impact: Approximately, 90.65 ha forest area will be afforested as ex-situ conservation in these sections. Moreover, maintaining the ratio of 1:25, total 315200 seedlings and saplings shall be planted as a compensatory plantation. This will be ex-situ conservation nearby the project area. Moreover, the government authority (division forest office) will have positive support to Nepal Electricity Authority. In addition, community forest and leasehold forest users will have more planted forest. Furthermore, felling of trees in government managed forest, community and leasehold forest will create the opportunity to generate the royalty selling the products. The users can use the timber and firewood after harvesting of these trees including poles. Local people can engage in harvesting, nursery techniques, plantation and protection activities so this will be employment opportunity for them. Ultimately, the afforested areas will provide the better habitat for wildlife.

B. Adverse Impact: There are three major forest management types in these sections namely Udipur Markichowk and Markichowk Bharatpur. These forest management types are government management, community forest and lease hold forest. Total 43.5 ha government managed forest will be affected because of this high tension in four districts namely Lamjung, Gorkha, Tanahu and Chitwan. Total 2492 trees will be felled during construction phase of this project. Similarly, total 20 community forests will be affected because of this high-tension line project. So, total 43.8325 ha community forest area will be affected and hence 2985 trees including pole will be

harvested during construction phase of this project. Moreover, 3 leasehold forests (1 in Chitwan and 2 in Gorkha district) will be affected because of this high-tension line project. Thus, 3.31 ha leasehold forest will be affected and hence 42 trees (24 pole and 18 trees) will be cut for this project. In addition, some sapling sized plants also will be harvested during construction phase of this project. Therefore, total 90.6425 ha forest area will be affected because of this project and 5519 trees will be harvested (Table 43).

Table 44: Forest management type and affected area (Udipur Markichowk and Markichowk Bharatpur section)

Forest Management Types	**District**	**No.**	**Affected Area ha**	**Number of trees to be felled (Tree+ pole)**
Government Managed Forest	Lamjung	1	4.17 (4.6%)	47
	Gorkha	6	2.30 (2.54%)	147
	Tanahu	5	12.76 (14.08)	281
	Chitwan	4	24.27 (26.78%)	2017
	Sub total	16	43.5 (47.99%)	2492
Community Forest	Lamjung	9	18.93 (20.88%)	768
	Gorkha	7	13.41(14.79%)	1261
	Tanahu	2	4.93 (5.44%)	74
	Chitwan	2	6.5625 (7.24%)	882
	Sub total	20	43.8325 (48.36%)	2985
Leasehold forest	Lamjung	-	-	-
	Gorkha	2	2.62 (2.89%)	31
	Tanahu	-	-	-
	Chitwan	1	0.69 (0.76%)	11
	Sub total	3	3.31 (3.65%)	42
Total		**39**	**90.6425**	**5519**

The impacts will be medium in magnitude, local in extent and long-term duration.

Source: NEA, 2017

6 MITIGATION MEASURES

6.1 Wildlife

We recommend the following mitigation measures for the identified project impacts on wildlife:

6.1.1 Mitigation for wildlife habitat loss

There will be a significant habitat loss. Our camera trap study has verified the presence of a diverse variety of small and large mammals in the region. As clear cutting along the transmission line area will decrease habitable area for wildlife some measures have to be taken to minimise the impact of habitat loss.

i. Where possible it is recommended that clearcutting should avoid fragmentation of contiguous forest, and instead narrow stretches of corridor should be left behind so mammals can use these to travel safely between adjacent habitats.
ii. Trees and other wild vegetation plantation programs should be implemented through reforestation and forest restoration where feasible, in the surrounding areas.
iii. It is recommended that the species selected for restoration should be selected based on expert recommendation to ensure that they are non-invasive and can adapt well to the local environmental conditions. The selected species should be diverse so that they can fulfil different ecological roles to help support wildlife and restore/reform the ecological balance in the area.

6.1.2 Mitigation for Illegal hunting of wildlife

Hunting/Poaching incidents might increase during project activities. The clear cutting will create clearings which will reduce cover for wildlife, thus leaving them more vulnerable and easier to spot for hunters.

i. Awareness campaigns/training should be conducted for locals as well as workers and visitors involved in the construction project not to hunt them.
ii. In addition, information and warning signs/boards to discourage hunting and for creating conservation awareness, should be placed along the construction sites.
iii. Compliance to the no hunting/harming wildlife should be monitored by onsite supervisor during the project.
iv. Road extension should be kept to a minimum. Roads should be extended only when absolutely necessary. For roads that won't be used in the long term, care should be taken that they can go back to their natural state.

6.1.3 Mitigation for human-wildlife conflict

There might be both a short and long-term increase in human-wildlife conflict cases. As a result of habitat loss, the carrying capacity of the local ecosystem will decrease which might cause some species to venture closer to human settlements and farm areas in search of food, resulting in an increase in human-wildlife conflict cases.

Also land use change and modification of existing habitat might chase away some species while attracting others depending on their habitat preferences. For some species this will disrupt their habituated trails and hunting/foraging spaces.

i. We recommended that follow up study should be conducted to monitor conflict cases during construction and after project completion to identify the proper mitigation strategy for possible conflict scenarios.
ii. Awareness campaigns/training should be conducted for locals as well as workers and visitors involved in the construction project on how to deal with animal encounters and how to avoid them.

6.1.4 Reducing accidental death of wildlife

Cases of accidental death of wildlife might increase. During clearing of vegetation and construction of the transmission line infrastructures, there is a high likelihood of accidental death of wildlife especially those that live on trees and borrows.

i. Proper inspection of the area is recommended before clear cutting for nests and burrows so the wildlife will have time to escape to a safer location.
ii. Making structures or leaving small patches of shrubs and bushes for small mammals to take cover in the open is recommended.
iii. Some animals and birds might use the transmission infrastructure, for eg - Flying squirrels can climb the poles and use them as gliding platforms. It is recommended to use non harmful physical deterrent structures where possible like spikes and fences in high risk sites so chances of wildlife approaching these areas decreases.

6.1.5 Control of Inorganic waste in wildlife habitat

Unmanaged waste in the project site can be hazardous to wildlife. In the post project completion period, some of these areas will retain vegetation and be habitable for species that live on forest edges.

i. All inorganic waste produced as a result of construction activities should be properly collected and removed from the environment.
ii. Any chemical wastes should be segregated and disposed properly so the local environment is not polluted.

6.1.6 Local Community Involvement

Locals can be hired for construction and other jobs in the field site. This will have several positive impacts.

i. Locals don’t/won’t increase the demand for bushmeat and won’t set traps and control hunting cases to some extent.
ii. This will also change the perspective of locals into a positive outlook towards the project.
iii. Seeing conservation steps implemented as a part of the project will help spread awareness among the local people on the value of biodiversity and need for assessment and mitigation measures for any future projects in the region.

6.1.7 Reducing activities at night time and avoiding unnecessary noise/gatherings

Loud noises and operation of heavy machinery coupled with the all time presence of large numbers of humans in their habitat can have a negative impact on the activity pattern of some wildlife.

i. Although heavy machineries will be required for the completion of the project, the use of heavy machinery should be kept to a minimum. We recommend that in forested areas, the use of heavy machinery should be done only during day time to reduce impact on wildlife.

6.1.8 Waterholes and streams consideration

Prior plans should be made while working at sites with all year-round waterholes and streams. This can be easily done. We also recommend making sure that these waterholes and streams are left in as natural a state as possible for future after construction is completed.

6.1.9 Enhancing the habitat restoration process

After the project completion, most of the areas will recover secondary vegetation with an increase in grassland and shrublands. This might create new living spaces for some smaller mammals and corridors for others to move across habitats. The project managers can help make plans and take steps to help in restoration of such areas.

i. Clearcutting areas should be conducted in a way that minimizes disturbance to the physical topography of the site.
ii. After project completion, these sites should be planted with vegetation that does not pose risk to the constructed infrastructures and at the same time help bring more biodiversity and ecological balance to the region.
iii. Newly formed habitats can add more diversity to both flora and fauna in the long run.
iv. Awareness campaigns should encourage participation from the local community so that it will enhance community knowledge on the wildlife in their area and the value of biodiversity thus contributing to long term wildlife conservation.

6.1.10 Potential positive impacts on the community

i. Job opportunities from the project, increased income, and improved roads can help faster transition from fuelwood to alternative energy resources, thus making habitats sustainable in the long term.
ii. Presence of government bodies and monitoring can reduce poaching and hunting.

Below is the summary table:

Identified impacts	**Mitigation of impacts**
Habitat Loss	1. Implement plantation programs and forest restoration where possible 2. Scientific selection of species for restoration purpose
Illegal Hunting/Poaching	1. Awareness programs for workers 2. Information and warning signs/boards should be placed to discourage such acts 3. Monitoring compliance
Human-Wildlife Conflict	1. Awareness program for the workers and local people 2. Follow up study to observe change in conflict patterns to determine optimum conflict resolution measures
Accidental Deaths	1. Inspect areas for nest and borrows before clearcutting or constructing infrastructures 2. Make non harmful physical deterrent structures in high risk structures/areas to

	reduce chances of animals approaching the site.
Hazardous Waste	1. All inorganic project waste should be collected and removed. 2. Chemical waste should be disposed of following proper regulations.
New Habitat Formation	1. Project activities should be conducted in a way that cause least impact to the physical terrain 2. Encourage plantation of non-invasive native vegetation in low-risk project sites after project completion.

6.2 Birds

- Three surveys of birds were carried out that covered Autumn, Winter and Summer seasons of a year. The survey has shown the present status of the bird. The status of the birds needs to be assessed even after the transmission line installation is completed, to monitor any unforeseen impacts to the birds by the transmission line.
- Either shifting of landfill sites or transmission line or placing of deflector devices in the electric transmission line is recommended.
- Use of deflector devices in river-crossed transmission line is recommended. Also recommended to minimize the multiple rivers crossing of transmission line.
- During the surveys, habitats potential for raptors were found at Simalchaur area of Lamjung (vantage point 20 and 21), about 2 km north of Palungtar airport (vantage point 39), Chaukidanda of Chitwan (vantage point 64). These areas were found important for soaring of raptors. As the raptors take the height or cross the hill ridge, there could be chance of collision or electrocution. So, use of deflector devices in the transmission lines of these area is recommended.
- The project site also contains good wetland habitat for migratory bird species. Migratory wetland birds were recorded in the wide Marsyangdi river area and dam-side area close to Markichowk substation and Udipur substation. Necessary techniques have to be applied in order to avoid collision and electrocution to arriving wetland birds including passage migrants in the winter season.
- Minimum clearance of the trees has to be done in the places rich in bird diversity as shown in above Figure 10,11,12 and 13.
- In the settlement areas raptors are attracted where people farm chicken and duck in an open space. There is chance of collision of the raptors with the transmission line passing close by the settlement area, as they dive to hunt the domesticated animals. It is recommended to train and aware local people to farm such animals within a closed space.
- Existing transmission lines passing parallel to the proposed transmission line forms a wide barrier for the flying birds. Necessary methods need to be adopted to avoid such barrier for the birds.
- It was found that there is also a practice of hunting birds by Chepang community (place on the way to Chhimkeswori, vantage point 59). It is not directly related to transmission line but threats to birds might change their behavior. So, awareness program is necessary for such community people.
- Disposal of animal flesh or carcasses need to be done far away from the transmission line passing area.

Below is a photo from Kaski district showing Vultures and Kites using power transmission tower to roost. So, it is very important to ensure bird safety on such transmission towers

6.3 Flora/Vegetation

6.3.1 Mitigation Measures against impact of TL on forest and vegetation in Khudi Manang and Khudi Udipur Section

The mitigation measures against the impact of high-tension line will be categorized into 6 parts. These are clearance of the site, acquisition of land, plantation and protection, coordination with the forest authority, private forest owner and forest users, aware the workers about the illegal activities in the forest, hot spot management for protected species.

A. Site clearance in the forest: Total 12608 trees including poles will be felled from different management types of national forest and 985 (tree and poles) from private forest. So, the site clearance of felled trees and poles is very important. The site clearance includes the felling of affected trees including poles, logging and hand over process. The trees including pole shall be felled in such a way that neighbouring trees, pole and regeneration will not have affected and damaged or minimally affected and damaged. The care shall be taken whether the valuable (protected spp) are damaged due during felling process of the tree including poles. Second step of site clearance is logging. After felling operation of affected trees, logging shall be proceeded which

include the sectioning and transportation of logs at safe site. Next step of site clearance is hand over process of the logs which was felled during the construction phase of high-tension line. Same process shall be followed for trees and poles felling in private forest as well.

B. Acquisition of land: It is very important to consider the percentage of areas affected because of the high-tension line project. Total 27.0385 ha of forest area will be permanently affected during the construction of high-tension line. According to government policy, land shall be purchased by the project and plantation shall be done of same species. Out of total affected forest area, about 63.9% i.e. 17.277 ha of land under Annapurna Conservation Area will be affected. Considering this fact, it is very important to maintain the affected conservation area through compensatory plantation.

C. Plantation and protection: The authority is responsible to afforest the plants (seedling & sapling) as a compensatory planation in the project area. The government policy emphasizes on the compensatory plantation in the ratio of 1:25 maintaining same species. Thus, total 315200 seedling and sapling shall be planted as a compensatory plantation. The plantations species shall be *Schima wallichii* (Chilaune), *Pinus Wallichiana* (Gobre salla), *Pinus oxburghii* (Khote Salla), *Shorea robusta* (Sal), *Alnus nepalensis* (Utis), *Dalbergia sissoo* (Sissoo), *Juglans regia* (Okhar), *Madhuca Longifolia* (Mahuwa), Michelia champaca (Chanp), *Fraxinus floribunda* (Lankuri), *Semecarpus anacardium* (Bhalayo), *Myrica esculenta* (Kafal), *Albizia* sp. (Siris), *Castonopsis indica* (Katus), *Litsea monopelata* (Kutmiro) in order to assure the ex-situ conservation. The government policy emphasizes on the protection of plantation for five years. The project needs to protect the planted forest and hand over the plantation area to the forest authority. Same mitigation measures shall be applied for affected trees in the private forest as well.

D. Coordination with forest authority: The high-tension line of both sections affect Annapurna conservation area, government managed forest, community forest, lease hold forest and private forest. The project shall coordinate with the stakeholders like forest users, forest and conservation area authority as well as private forest owner. The project authority shall arrange the regular meeting, interaction and workshop with the stakeholders. Moreover, the authority shall provide the opportunity of employment in construction work as well as provide financial help to their development activities. The project needs to emphasize on the social harmony of the people in project area.

E. Aware the worker about the illegal activities in the forest: The project identified some illegal activities may be caused by workers during the construction of high-tension line. In this context, the workers shall be oriented about the illegal activities in the forest or minimize the damage in the forest. The orientation shall be focused on the illegal activities in the forest. It includes i. avoid the collection and use of firewood and small wood without permission of users and authority for cooking and heating ii. poaching (hunting and killing) of wild life iii. activities that cause soil erosion like excavation, and collection of non-timber forest product. Thus, the project authority needs to provide the alternative source of energy for cooking and heating for workers.

F. Hot spot management for protected species: There are two major hot spots in Khudi Manang and Khudi Udipur section of the high-tension line project. Hot spot management in Khudi Manang section: The upper part Khudi Manang section of possesses *Pinus wallichian* (Blue pine: Gobre Salla) and *Alnus* (Uttish) forest while *Himalayacalamus asper* (Nigalo) is dominnat species in the midsection and *Cyatheales spp* (Tree fern), *Machilus odoratissima* (Kaulo**)** and *Piper longum* (Pipala) were the important species in the lower part of this section. In addition, upper part of Khudi Manang section is rich with medicinal and aromatic plant species *Morchella conica* (Guchi Chyau), *Valerina Jatamansi* (Sugandhwal), *Nardostachyas Jatamansi* (Jamanshi), *Neopicrorhiza scrophulariiflora* (Kutki), *Aconitum spicatum* (Atish Jara). These areas shall be given the priority to protect these important species considering their conservation status. The plant species like *Juglans regia, Dactylorhiza hatagirea, Neopycrorhiza scrophulariiflora, Valeriana jatamansii, Calanthe alpina Hook. f. ex Lindl., Calanthe plantaginea Lindl., Cymbidium aloifolium* and *Gnetum montanum Markg* found in this section are protected by Government of Nepal, CITES Appendixes and IUCN Red list. Thus, these species shall be given high priority to conserve especially in hot spot area.

Hot Spot of floral diversity in Khudi Udipur Section: The dominant forest in this section was sub-tropical having important species like *Pinus roxburghii* (Khote Salla), *Schima wallichii* (Chilaune), *Castonopsis* sp. (Katus), *Albizzia* sp. (Siris), *Madhuca longifolia* (Mahuwa), *Phyllanthus emblica* (Amala). In addition, *Shorea robusta* was found in lower part and *Acacia catechu* (Khair), *Dalbergia sissoo* and *Bombax ceiba* (Semal) in riverside. More importantly, *Pandanus odorifer* (Kewara) was found near to the Mid Marsyangdi hydropower station dam). Valuable medicinal and aromatic plant species like *Cynodon dactylon* (Dubo), Buddleja tibetica (Bhimsen pati), and Centella asiatica (Ghod Tapre) found close to riverside. *Arthromeris wallichiana* (Unyu), *Justicia adhatoda* (Asuro), *Solanum xanthocarpum* (Kantkari), *Bambusa vulgaris* (Bamboo) were found in this section. These sites need to manage according to protection status of the forest species as some valuable plant species like *Dendrobium ensiflorum* Lindl, *Cyathea brunoniana*, *Vanda cristata* Wall. ex Lindl and *Gnetum montanum* found in this section is protected under CITES and hence the high priority shall be given to protect these species in hot spot area.

6.3.2 Mitigation Measures against impact of TL on forest and vegetation in Udipur Markichowk and Markichowk and Bharatpur Section

The mitigation measures against the impact of high-tension line of Udipur Markichowk and Markhichuar Bharatpur section will be grouped under six parts. These are clearance of the site, acquisition of land, plantation and protection, coordination with the forest authority, private forest owner and forest users, aware the workers about the illegal activities in the forest, hot spot management for protected species.

A. Clearance of the site: Obviously, some trees will be cut during construction phase of the high-tension line project and the site needs to clear. Thus, the site clearance can be done in four steps. The first step of the site clearance is cutting 5519 trees (Trees+ poles). Some regeneration will also be removed to construct the high-tension line. Second step shall be focused on the logging

activities like sectioning of the felled trees including poles and transporting them to safe places in log yard. So, feeling, logging and transporting activities shall be carried out in such a way that there shall be no or minimal damage to neighbouring plants (tree+ pole+ regeneration). Third step of the site clearance shall be focused on hand over of the log to the authority or users' group.

***B. Land acquisition*:**
Total 90.6425 ha forest area will be affected because of the high-tension line project. The government Nepal has policy for acquisition of same area of land to maintain the biodiversity. This principle shall be followed by the authority. The authority shall be given high priority to the percentage affected forest area and conservation status of the species. About 43.8325 (48.36%) community forest and around 43.5 ha (47.99%) government managed forests are affected due to high tension line in Lamjung, Gorkha, Tanahu and Chitwan districts, thus priority shall be given to manage this forest accordingly considering the conservation status of the species.

C. Plantation and protection: As total 5519 trees including poles will be harvested during the construction phase of high-tension line, total 137975 seedlings and sapling of same species shall be planted as a compensatory plantation. The plantations species shall be *Myrica esculenta* (Kafal), *Rhododendron arboretum* (Gurans), *Schima wallichii* (Chilaune), *Pinus oxburghii* (Khote Salla), *Alnus nepalensis* (Utis), *Dalbergia sissoo* (Sissoo), *Juglans regia* (Okhar), unknown (Pepe), *Madhuca Longifolia* (Mahuwa), *Fraxinus floribunda* (Lankuri), *Semecarpus anacardium* (Bhalayo), Tooni, *Albizia* sp. (Siris), *Castonopsis indica* (Katus), *Litsea monopelata* (Kutmiro), *Shorea robusta* (Sal), *Bombax ceiba* (Semal) in order to assure the ex-situ conservation. The project needs to protect the planted forest for five years and hand over the plantation area to the forest authority. Same mitigation measures shall be applied for affected trees in the private forest as well.

D. Coordination with forest authority:
The coordination is very important to protect the forest biodiversity. There are three types of forest management in these sections of the project. These are government managed forest, community forest and leasehold forest. Thus, it is very important to coordinate with the stakeholders like forest users, forest authority as well as private forest owner in order to get support to construct the high-tension line. The coordination can be done through organizing the regular meeting, interaction and workshop with the stakeholders. The project needs to maintain the social harmony of the people in project area. The project authority shall provide the employment opportunity in construction work as well as provide financial help to the social development activities.

E. Aware the worker about the illegal activities in the forest: It is very important to aware the workers about the illegal activities in the forest. The illegal activities may be collection and use of firewood and small wood without permission of users for cooking and heating; poaching (hunting and killing) of wild life; activities that cause soil erosion like excavation and collection of non-timber forest product. Therefore, orientation is essential to aware the workers to avoid these illegal

activities in the forest during construction phase of high-tension line. Thus, the project authority needs to provide the alternative source of energy for cooking and heating for workers.

F. Hot spot management for protected species: There are two major hot spots in Khudi Manang and Khudi Udipur section of the TL project.
Udipur and ended at Markichowk possesses some valuable types of vegetation which are valuable hotspots. These are *Acacia catechu* (Khair) and *Bombax ceiba* (Semal) in riverain area, *Schima wallichii* (Chilauene) and *Castonopsis spp* (Katush) Forest. Dhuwakot village having 463 m and with South East aspect possesses unique composition of vegetation such as *Myrica esculanta* (Kafal), *Schima wallichii* (Chilauene), *Castonopsis* sp.(Katus), *Shorea robusta* (Sal), *Aegle marmelos* (Bel) and *Albizzia* sp. (Siris). Moreover, *Anaphalis contorta* (Bukiphool), *Cyperus rotundus* (Methe), *Curcuma* sp. (Kalo Haledo), *Asparagus* sp. (Kurilo), *Dioscorea bulbifera* (Githa), *Oxalis corniculata* (Chari Amilo), *Phyllanthus niruri* (Bhuin Amala), *Trapa bispinosa* (Semal Kande) are valuable medicinal and aromatic plant species in the forest. Out of these *Euphorbia royleana, Euphorbia prostrata, Rauvolfia serpentine* and *Dioscorea deltoidea* are protected under CITES Appendixes. *Rauvolfia serpentine* and *Dioscorea deltoidea* are protected under Endangered and Threatened respectively under IUCN Red list. Considering the protection status of these species, the hotspot area needs to manage for biodiversity conservation.

Markichowk Bharatpur Section: possesses subtropical forest species like *Shorea robusta* (Sal) in Teria Sal Forest, Hill Sal Forest in Chure and Riverain *Bombax ceiba* (Simal) in Terai and Chure area. In addition, medicinal and aromatic plant species like *Abrus precatorius* (Ratigedi), *Abelmoschus moschatus* (Ban Kapas), *Achyranthes aspera* (Datiwan), *Allium sativum* (Ban Lasun), *Acorus calamus* (Bojho), *Aegle marmelos* (Bael), *Alstonia scholaris* (Chhatiwan), *Alternanthera sessilis* (Bhiringi Jhar) are valuable plant species in the forest of this section. Importantly, floral species found in this section like *Alstonia scholaris* is protected under IUCN Red list as rare species; *Acacia catechu* is protected under the government of Nepal and CITES IInd appendix. *Rauvolfia serpentine* and *Cycas pectinate* both species are protected under CITES IInd appendix and Endangered species in IUCN red list. Thus, considering the protection status of these floral species, the hotspots identified in this section, need to protect and manage accordingly.

7 CONCLUSION AND RECOMMENDATIONS

Certain section of the MCTLP line being developed lies in the Annapurna Conservation Area region. In this report, systematic assessment of wildlife, birds and vegetation was made to assess the impacts of the MCTLP on these aspects of environment. An attempt has been made in this study to gather more baseline information, predict impacts and recommend mitigation measures for wildlife birds and vegetation of the project impact area.

This assessment identified that the MCTLP project will results in impacts on forest/vegetation, wildlife and birds during the project construction and some impacts continuing during the operation phase of the project as well. The study predicted that the MCTLP will have more impacts on birds during its operation phase. Mitigation measures recommended in this study are specific and are additional to the approved IEE and EIA recommendations of the MCTLP.

This study identified and recommend the best practice measures for minimizing and managing the project related impacts arising mainly from clear felling of trees, wildlife habitat loss, human-wildlife conflict and illegal hunting, collision and electrocution, and construction disturbances. Awareness campaign and training is recommended as one of the key measures for managing human-wildlife conflict, illegal hunting and wildlife habitat restoration. Vegetation plantation program is recommended as a mitigation for habitat losses. Color balls and deflector devices are recommended in specific area based on the project impacts on birds.

The project will implement the mitigation measures proposed by this study in addition to those proposed in approved IEE and EIA of the project. This implementation will help ensure the avoidance/minimization of the impacts on the biodiversity.

REFERENCES

Baral, H. S. and Inskipp, C. (2005) Important Bird Areas in Nepal: key sites for conservation. Kathmandu, Nepal and Cambridge, UK: Bird Conservation Nepal and BirdLife International.

Bibby, C., Burgess, N., Hill, D., Mustoe, S., 2000. Bird Census Techniques. Academic Press, London.

Bird Conservation Nepal and Department of National Parks and Wildlife Conservation. 2018. Birds of Nepal: An Official Checklist. Kathmandu, Nepal.

Grimmett, R., Inskipp, C. and Inskipp, T. (2000) Birds of Nepal. Christopher Helm, London, UK.

https://ebird.org/region/NP-3-LAM?yr=all

Inskipp C., Baral H. S., Phuyal S., Bhatt T. R., Khatiwada M., Inskipp, T, Khatiwada A., Gurung S., Singh P. B., Murray L., Poudyal L. and Amin R. (2016) The status of Nepal's Birds: The national red list series. Zoological Society of London, UK.

Al-Namazi, A. A., Al-Khulaidi, A. W. A., Algarni, S., & Al-Sagheer, N. A. (2021). Natural plant species inventory of hotspot areas in Arabian Peninsula: Southwest Al-Baha region, Saudi Arabia. Saudi Journal of Biological Sciences, 28(6), 3309-3324.

Brehm, G., Homeier, J., Fiedler, K., Kottke, I., Illig, J., Nöske, N. M., & Breckle, S. W. (2008). Mountain rain forests in southern Ecuador as a hotspot of biodiversity–limited knowledge and diverging patterns. In Gradients in a tropical mountain ecosystem of Ecuador (pp. 15-23). Springer, Berlin, Heidelberg.

Chiluwal, N., Basnyat, D. B., Kafle, M. R., & Shrestha, D. (2021). Climate Change Impact on Hydropower Projects in Marsyangdi Basin, Nepal: A Comparative Study using GCM-led Top-down and Bottom-Up Approaches.

Dadds, M. R., Whiting, C., Bunn, P., Fraser, J. A., Charlson, J. H., & Pirola-Merlo, A. (2004). Measurement of cruelty in children: The Cruelty to Animals Inventory. Journal of Abnormal Child Psychology, 32(3), 321-334.

DoF, 2003. Community Forest Inventory Guideline, Department of Forest, Babarmahal, Kathmandu Nepal

Polasky, S., Kling, C. L., Levin, S. A., Carpenter, S. R., Daily, G. C., Ehrlich, P. R., & Lubchenco, J. (2019). Role of economics in analyzing the environment and sustainable development. Proceedings of the National Academy of Sciences, 116(12), 5233-5238.

Khanna L. S. and Chaturvedi A.N., 2011. Forest Mensuration, BioGreen Publication

Kaygusuz, K. (2011). Energy services and energy poverty for sustainable rural development. Renewable and sustainable energy reviews, 15(2), 936-947.

Marshall, B. M., Strine, C., & Hughes, A. C. (2020). Thousands of reptile species threatened by under-regulated global trade. Nature communications, 11(1), 1-12.

NEA, 2017. Initial Environmental Examination Marsyangdi Corridor (Udipur- New Bharatpur) 220 kv Double Circuit Transmission Line, Nepal Electricity Authority, Kathmandu

NEA, 2018. Environmental Impact Assessment (EIA) Report of Marsyangdi Corridor (Manang – Udipur) 220 kv Transmission Line Project, Nepal Electricity Authority, Kathmandu

Panth, P. (2017). Hydroelectricity Power Potentiality and Its Development in Nepal (Doctoral dissertation, Central Department of Economics Kirtipur, Kathmandu).

Rajaure, S., Paudel, T. R., & Bhattarai, G. K. (2011). Strong motion observation at Middle Marsyangdi Hydroelectric Project dam, Lamjung, western Nepal. Journal of Nepal Geological Society, 42, 75-83.

Redding, M. (2019). Mammal species inventory using various trapping methods in Zone 4 of Billy Barquedier National Park, Belize during rainy season.

Sachs, J. D. (2012). From millennium development goals to sustainable development goals. The lancet, 379(9832), 2206-2211.

Shrestha, R. S. (2010). Electricity crisis (load shedding) in Nepal, its manifestations and ramifications. Hydro Nepal: Journal of Water, Energy and Environment, 6, 7-17.

Walsh, B. W. (2005). Convention on international trade in endangered species of wild fauna and flora: a CITES Timeline. Selbyana, 92-102.

APPENDIX A: RELATED TO WILDLIFE

Table 1: Camera trap setup date and retrieved date with the coordinates and camera trap nights (first season).

S.N	Station	Setup date	Retrieval date	Nights total	Latitude	Longitude
1	01A-ESSD10	2022-03-10	2022-03-17	7	28.5301	84.3399
2	03A-ESSD07	2022-03-10	2022-03-12	2	28.53045	84.32973
3	04A-ESSD04	2022-03-10	2022-03-17	7	28.54172	84.32973
4	05A-ESSD05	2022-03-10	2022-03-17	7	28.53383	84.36063
5	06A-ESSD17	2022-03-11	2022-03-18	7	28.53703	84.34552
6	07A-ESSD18	2022-03-09	2022-03-18	9	28.53882	84.34287
7	08A-ESSD16	2022-03-11	2022-03-18	7	28.52553	84.34713
8	09A-ESSD13	2022-03-11	2022-03-18	7	28.522	84.34908
9	11B-ESSD07	2022-03-15	2022-03-22	7	28.53523	84.37143
10	12B-ESSD08	2022-03-14	2022-03-22	8	28.46975	84.38002
11	13B-ESSD02	2022-03-15	2022-03-22	7	28.42372	84.38998
12	16B-ESSD14	2022-03-14	2022-03-22	8	28.43412	84.3907
13	16B-ESSD15	2022-03-14	2022-03-22	8	28.44173	84.3782
14	17B-ESSD01	2022-03-14	2022-03-22	8	28.47505	84.36298
15	19B-ESSD06	2022-03-14	2022-03-22	8	28.47828	84.35735
16	20B-ESSD03	2022-03-15	2022-03-22	7	28.48112	84.35255
17	24B-ESSD12	2022-03-13	2022-03-21	8	28.48612	84.34962
18	28B-ESSD19	2022-03-13	2022-03-21	8	28.49055	84.35095
19	29B-ESSD20	2022-03-13	2022-03-21	8	28.50528	84.36222
20	32C-ESSD03	2022-03-22	2022-03-27	5	28.4892	84.36187
21	33C-ESSD17	2022-03-20	2022-03-27	7	28.47675	84.37022
22	34C-ESSD16	2022-03-21	2022-03-28	7	28.38308	84.39897
23	35C-ESSD13	2022-03-20	2022-03-27	7	28.37593	84.39767
24	36C-ESSD04	2022-03-20	2022-03-27	7	28.39288	84.41352
25	38C-ESSD09	2022-03-19	2022-03-27	8	28.39877	84.41687
26	39C-ESSD10	2022-03-20	2022-03-27	7	28.39013	84.40465
27	40C-ESSD18	2022-03-19	2022-03-27	8	28.36278	84.38952
28	42C-ESSD05	2022-03-20	2022-03-26	6	28.37232	84.3874
29	43D-ESSD12	2022-03-24	2022-03-31	7	28.39023	84.38367
30	45D-ESSD08	2022-03-25	2022-04-01	7	28.40967	84.40168
31	46D-ESSD07	2022-03-24	2022-03-31	7	28.32875	84.408
32	47D-ESSD02	2022-03-23	2022-04-01	9	28.305	84.35613

33	49D-ESSD14	2022-03-24	2022-03-26	2	28.34835	84.38448
34	50D-ESSD11	2022-03-24	2022-04-01	8	28.33903	84.38573
35	51D-ESSD15	2022-03-25	2022-04-01	7	28.3103	84.38163
36	52D-ESSD06	2022-03-25	2022-04-01	7	28.347	84.40322
37	53D-ESSD20	2022-03-26	2022-04-02	7	28.30398	84.38295
38	54D-ESSD01	2022-03-26	2022-04-02	7	28.29208	84.35128
39	56D-ESSD19	2022-03-26	2022-04-02	7	28.28703	84.38692
40	A-OP-ESSD09	2022-03-09	2022-03-18	9	28.36863	84.36863
41	B-OP-ESSD11	2022-03-12	2022-03-22	10	28.27313	84.3554

Table 2: Camera trap setup date and retrieved date with the coordinates and camera trap nights (secondt season).

S.N	Camera station	Grid	Elevation	Latitude	Longitude	Installed Date	Retrieval Date	Effort Days
	ESSD-14	01A	2439.557	28.54197	84.34528	2022-05-19	2022-06-04	16
	ESSD-06	09A	2469.023	28.52198	84.3491	2022-05-20	2022-06-05	16
	ESSD-19	A-OP	2308.745	28.53015	84.33994	2022-05-20	2022-06-05	16
	ESSD-05	06A	2304.708	28.53521	84.37145	2022-05-20	2022-06-05	16
	ESSD-08	13B	2201.398	28.48977	84.36445	2022-05-20	2022-06-05	16
	ESSD-04	21B	2248.117	28.46847	84.36316	2022-05-21	2022-06-06	16
	ESSD-16	19B	2716.737	28.47766	84.36235	2022-05-21	2022-06-06	16
	ESSD-18	16B	2753.724	28.48111	84.35257	2022-05-21	2022-06-06	16
	ESSD-13	16B	2746.352	28.48607	84.34961	2022-05-21	2022-06-06	16
	ESSD-09	B-OP	2006.429	28.46967	84.37953	2022-05-22	2022-06-07	16
	ESSD-15	24B	1764.289	28.44214	84.37774	2022-05-22	2022-06-07	16
	ESSD-12	32C	1596.814	28.40964	84.40169	2022-05-22	2022-06-07	16
	ESSD-10	35C	1135.942	28.39025	84.40455	2022-05-22	2022-06-07	16
	ESSD-07	34C	1945.704	28.38945	84.3855	2022-05-23	2022-06-08	16
	ESSD-03	40C	1915.309	28.37527	84.40257	2022-05-23	2022-06-08	16
	ESSD-17	39C	1672.693	28.37343	84.38396	2022-05-23	2022-06-08	16
	ESSD-01	45D	1125.335	28.34712	84.40323	2022-05-24	2022-06-09	16
	ESSD-11	47D	1245.352	28.32885	84.40804	2022-05-24	2022-06-09	16
	ESSD-20	50D	1609.809	28.3074	84.36037	2022-05-24	2022-06-09	16

	ESSD-02	54D	1495.12	28.2871	84.38682	2022-05-25	2022-06-09	15

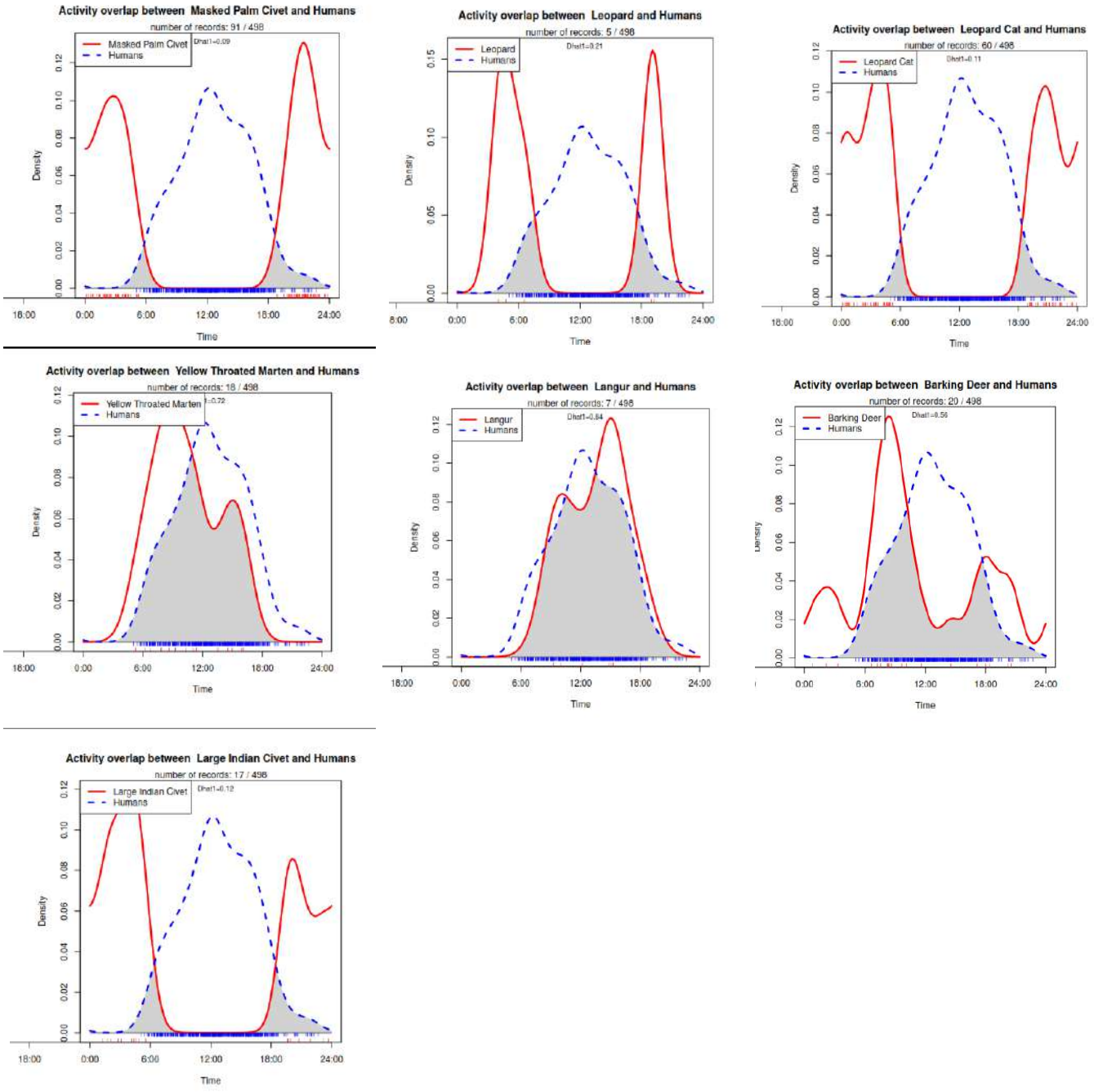


Figure 1: *Activity overlap of wildlife species with human activity in the project area from both season data. Species with low independent detections (n < 5) have been ignored for this graph.*

Table 3: III: Species captured in all stations with their independent capture numbers.

	Station	*Species*	*Independent*

			captures
3	*01A-ESSD10*	*Humans*	*2*
4	*01A-ESSD10*	*Leopard*	*1*
5	*01A-ESSD10*	*Masked Palm Civet*	*1*
9	*01A-ESSD14*	*Humans*	*3*
10	*01A-ESSD14*	*Leopard Cat*	*2*
11	*01A-ESSD14*	*Masked Palm Civet*	*2*
12	*01A-ESSD14*	*Rodents*	*1*
15	*03A-ESSD07*	*Humans*	*2*
16	*03A-ESSD07*	*Masked Palm Civet*	*1*
18	*04A-ESSD04*	*Humans*	*2*
19	*04A-ESSD04*	*Livestocks*	*12*
21	*05A-ESSD05*	*Humans*	*9*
22	*05A-ESSD05*	*Leopard Cat*	*6*
23	*05A-ESSD05*	*Livestocks*	*6*
24	*05A-ESSD05*	*Masked Palm Civet*	*4*
25	*05A-ESSD05*	*Yellow Throated Marten*	*1*
27	*06A-ESSD05*	*Goral*	*1*
28	*06A-ESSD05*	*Humans*	*42*
29	*06A-ESSD05*	*Livestocks*	*57*
30	*06A-ESSD05*	*Yellow Throated Marten*	*2*
33	*06A-ESSD17*	*Humans*	*16*
34	*06A-ESSD17*	*Leopard Cat*	*1*
35	*06A-ESSD17*	*Livestocks*	*5*
37	*07A-ESSD18*	*Humans*	*2*
38	*07A-ESSD18*	*Langur*	*2*
41	*08A-ESSD16*	*Humans*	*3*
43	*09A-ESSD06*	*Humans*	*5*
44	*09A-ESSD06*	*Masked Palm Civet*	*8*
45	*09A-ESSD06*	*Yellow Throated Marten*	*2*
47	*09A-ESSD13*	*Humans*	*3*
48	*09A-ESSD13*	*Livestocks*	*1*
49	*09A-ESSD13*	*Masked Palm Civet*	*1*
51	*11B-ESSD07*	*Humans*	*3*
52	*11B-ESSD07*	*Livestocks*	*5*
55	*12B-ESSD08*	*Humans*	*7*
56	*12B-ESSD08*	*Leopard*	*1*

57	*12B-ESSD08*	*Livestocks*	*5*
59	*13B-ESSD02*	*Humans*	*2*
60	*13B-ESSD02*	*Livestocks*	*3*
63	*13B-ESSD08*	*Humans*	*5*
64	*13B-ESSD08*	*Leopard Cat*	*1*
65	*13B-ESSD08*	*Masked Palm Civet*	*1*
66	*13B-ESSD08*	*Rodents*	*2*
70	*16B-ESSD13*	*Humans*	*2*
71	*16B-ESSD13*	*Langur*	*1*
72	*16B-ESSD13*	*Leopard Cat*	*4*
73	*16B-ESSD13*	*Livestocks*	*11*
74	*16B-ESSD13*	*Masked Palm Civet*	*3*
75	*16B-ESSD13*	*Yellow Throated Marten*	*1*
77	*16B-ESSD14*	*Humans*	*2*
78	*16B-ESSD14*	*Leopard*	*1*
79	*16B-ESSD14*	*Livestocks*	*1*
80	*16B-ESSD14*	*Yellow Throated Marten*	*1*
82	*16B-ESSD15*	*Humans*	*2*
83	*16B-ESSD15*	*Leopard*	*1*
84	*16B-ESSD15*	*Livestocks*	*7*
87	*16B-ESSD18*	*Humans*	*3*
88	*16B-ESSD18*	*Leopard Cat*	*3*
89	*16B-ESSD18*	*Masked Palm Civet*	*8*
90	*16B-ESSD18*	*Yellow Throated Marten*	*1*
93	*17B-ESSD01*	*Humans*	*2*
94	*17B-ESSD01*	*Langur*	*1*
96	*19B-ESSD06*	*Humans*	*2*
97	*19B-ESSD06*	*Masked Palm Civet*	*1*
98	*19B-ESSD06*	*Rodents*	*2*
101	*19B-ESSD16*	*Humans*	*5*
102	*19B-ESSD16*	*Leopard Cat*	*1*
103	*19B-ESSD16*	*Masked Palm Civet*	*1*
104	*19B-ESSD16*	*Rodents*	*2*
107	*20B-ESSD03*	*Humans*	*3*
110	*21B-ESSD04*	*Humans*	*38*
111	*21B-ESSD04*	*Langur*	*1*
112	*21B-ESSD04*	*Livestocks*	*26*

113	*21B-ESSD04*	*Masked Palm Civet*	*4*
115	*21B-ESSD04*	*Yellow Bellied Weasel*	*1*
116	*21B-ESSD04*	*Yellow Throated Marten*	*1*
117	*24B-ESSD12*	*Barking Deer*	*2*
120	*24B-ESSD12*	*Ferret Badger*	*2*
121	*24B-ESSD12*	*Humans*	*2*
123	*24B-ESSD15*	*Barking Deer*	*1*
126	*24B-ESSD15*	*Humans*	*2*
127	*24B-ESSD15*	*Masked Palm Civet*	*1*
128	*24B-ESSD15*	*Rodents*	*1*
131	*28B-ESSD19*	*Humans*	*5*
132	*28B-ESSD19*	*Leopard Cat*	*1*
136	*29B-ESSD20*	*Humans*	*3*
139	*32C-ESSD03*	*Humans*	*11*
140	*32C-ESSD03*	*Jungle Cat*	*2*
141	*32C-ESSD03*	*Livestocks*	*8*
142	*32C-ESSD03*	*Masked Palm Civet*	*1*
145	*32C-ESSD12*	*Humans*	*34*
146	*32C-ESSD12*	*Leopard Cat*	*3*
147	*32C-ESSD12*	*Livestocks*	*23*
148	*32C-ESSD12*	*Masked Palm Civet*	*1*
149	*32C-ESSD12*	*Rodents*	*1*
151	*32C-ESSD12*	*Yellow Throated Marten*	*2*
154	*33C-ESSD17*	*Humans*	*2*
155	*33C-ESSD17*	*Livestocks*	*1*
157	*34C-ESSD07*	*Humans*	*18*
158	*34C-ESSD07*	*Large Indian Civet*	*5*
159	*34C-ESSD07*	*Leopard Cat*	*4*
160	*34C-ESSD07*	*Masked Palm Civet*	*4*
161	*34C-ESSD07*	*Rodents*	*2*
162	*34C-ESSD16*	*Barking Deer*	*1*
164	*34C-ESSD16*	*Humans*	*18*
165	*34C-ESSD16*	*Large Indian Civet*	*1*
166	*34C-ESSD16*	*Leopard Cat*	*5*
167	*34C-ESSD16*	*Livestocks*	*1*
168	*34C-ESSD16*	*Rodents*	*3*
172	*35C-ESSD10*	*Humans*	*2*

173	*35C-ESSD10*	*Langur*	*2*
174	*35C-ESSD10*	*Leopard Cat*	*1*
175	*35C-ESSD10*	*Masked Palm Civet*	*1*
176	*35C-ESSD10*	*Rodents*	*4*
179	*35C-ESSD13*	*Ferret Badger*	*1*
180	*35C-ESSD13*	*Humans*	*4*
181	*35C-ESSD13*	*Livestocks*	*1*
182	*35C-ESSD13*	*Masked Palm Civet*	*4*
186	*36C-ESSD04*	*Humans*	*5*
187	*36C-ESSD04*	*Large Indian Civet*	*2*
188	*36C-ESSD04*	*Livestocks*	*1*
190	*38C-ESSD09*	*Humans*	*4*
191	*38C-ESSD09*	*Livestocks*	*3*
192	*38C-ESSD09*	*Rodents*	*2*
196	*39C-ESSD10*	*Humans*	*4*
197	*39C-ESSD10*	*Large Indian Civet*	*2*
198	*39C-ESSD10*	*Leopard Cat*	*1*
199	*39C-ESSD10*	*Livestocks*	*2*
200	*39C-ESSD17*	*Barking Deer*	*1*
203	*39C-ESSD17*	*Humans*	*5*
205	*39C-ESSD17*	*Large Indian Civet*	*3*
206	*39C-ESSD17*	*Masked Palm Civet*	*3*
207	*39C-ESSD17*	*Rodents*	*1*
210	*40C-ESSD03*	*Humans*	*4*
211	*40C-ESSD03*	*Rodents*	*3*
215	*40C-ESSD18*	*Humans*	*3*
216	*40C-ESSD18*	*Rodents*	*2*
217	*40C-ESSD18*	*Yellow Throated Marten*	*1*
220	*42C-ESSD05*	*Humans*	*10*
221	*42C-ESSD05*	*Large Indian Civet*	*1*
222	*42C-ESSD05*	*Leopard Cat*	*3*
223	*42C-ESSD05*	*Livestocks*	*8*
224	*42C-ESSD05*	*Masked Palm Civet*	*1*
225	*42C-ESSD05*	*Rodents*	*1*
229	*43D-ESSD12*	*Humans*	*12*
230	*43D-ESSD12*	*Large Indian Civet*	*1*
231	*43D-ESSD12*	*Livestocks*	*4*

232	*45D-ESSD01*	*Barking Deer*	*3*
235	*45D-ESSD01*	*Humans*	*8*
237	*45D-ESSD01*	*Leopard Cat*	*9*
238	*45D-ESSD01*	*Livestocks*	*6*
239	*45D-ESSD01*	*Malayan Porcupine*	*1*
240	*45D-ESSD01*	*Masked Palm Civet*	*3*
241	*45D-ESSD01*	*Rodents*	*3*
243	*45D-ESSD01*	*Yellow Throated Marten*	*1*
244	*45D-ESSD08*	*Barking Deer*	*5*
246	*45D-ESSD08*	*Humans*	*5*
247	*45D-ESSD08*	*Large Indian Civet*	*1*
248	*45D-ESSD08*	*Leopard*	*1*
249	*45D-ESSD08*	*Livestocks*	*3*
250	*45D-ESSD08*	*Malayan Porcupine*	*2*
251	*45D-ESSD08*	*Masked Palm Civet*	*4*
252	*45D-ESSD08*	*Squirrel*	*1*
255	*46D-ESSD07*	*Humans*	*2*
256	*46D-ESSD07*	*Leopard Cat*	*1*
257	*46D-ESSD07*	*Livestocks*	*1*
258	*46D-ESSD07*	*Rodents*	*1*
260	*47D-ESSD02*	*Assamese Macaque*	*3*
262	*47D-ESSD02*	*Humans*	*38*
263	*47D-ESSD02*	*Livestocks*	*21*
264	*47D-ESSD02*	*Masked Palm Civet*	*10*
265	*47D-ESSD02*	*Rhesus Macaque*	*2*
267	*47D-ESSD11*	*Barking Deer*	*1*
270	*47D-ESSD11*	*Humans*	*30*
271	*47D-ESSD11*	*Livestocks*	*13*
272	*47D-ESSD11*	*Masked Palm Civet*	*7*
273	*47D-ESSD11*	*Rodents*	*4*
274	*47D-ESSD11*	*Yellow Throated Marten*	*1*
277	*49D-ESSD14*	*Humans*	*13*
278	*49D-ESSD14*	*Masked Palm Civet*	*1*
280	*50D-ESSD11*	*Humans*	*7*
281	*50D-ESSD11*	*Leopard Cat*	*2*
282	*50D-ESSD11*	*Yellow Throated Marten*	*1*
283	*50D-ESSD20*	*Barking Deer*	*3*

285	*50D-ESSD20*	*Humans*	*7*
286	*50D-ESSD20*	*Large Indian Civet*	*1*
287	*50D-ESSD20*	*Leopard Cat*	*9*
288	*50D-ESSD20*	*Livestocks*	*2*
289	*50D-ESSD20*	*Masked Palm Civet*	*4*
290	*50D-ESSD20*	*Rodents*	*1*
292	*51D-ESSD15*	*Barking Deer*	*1*
294	*51D-ESSD15*	*Humans*	*5*
295	*51D-ESSD15*	*Masked Palm Civet*	*3*
296	*51D-ESSD15*	*Rodents*	*2*
299	*52D-ESSD06*	*Humans*	*12*
300	*52D-ESSD06*	*Livestocks*	*1*
301	*52D-ESSD06*	*Masked Palm Civet*	*2*
302	*52D-ESSD06*	*Rodents*	*1*
305	*53D-ESSD20*	*Humans*	*3*
306	*53D-ESSD20*	*Masked Palm Civet*	*1*
307	*54D-ESSD01*	*Assamese Macaque*	*1*
309	*54D-ESSD01*	*Humans*	*9*
310	*54D-ESSD01*	*Leopard Cat*	*1*
311	*54D-ESSD01*	*Livestocks*	*1*
312	*54D-ESSD01*	*Rodents*	*3*
315	*54D-ESSD02*	*Humans*	*2*
317	*54D-ESSD02*	*Rodents*	*4*
318	*56D-ESSD19*	*Barking Deer*	*2*
320	*56D-ESSD19*	*Humans*	*5*
323	*A-OP-ESSD09*	*Humans*	*13*
324	*A-OP-ESSD09*	*Leopard Cat*	*1*
325	*A-OP-ESSD09*	*Livestocks*	*2*
326	*A-OP-ESSD09*	*Masked Palm Civet*	*3*
327	*A-OP-ESSD09*	*Yellow Throated Marten*	*1*
330	*A-OP-ESSD19*	*Humans*	*10*
331	*A-OP-ESSD19*	*Leopard Cat*	*1*
332	*A-OP-ESSD19*	*Livestocks*	*2*
333	*A-OP-ESSD19*	*Masked Palm Civet*	*1*
334	*A-OP-ESSD19*	*Yellow Throated Marten*	*2*
337	*B-OP-ESSD09*	*Humans*	*14*
338	*B-OP-ESSD09*	*Livestocks*	*19*

339	*B-OP-ESSD09*	*Masked Palm Civet*	*1*
343	*B-OP-ESSD11*	*Humans*	*2*
344	*B-OP-ESSD11*	*Livestocks*	*1*

Some photographs from the Biodiversity Impact Assessment field work

Landscape around Tachai village in Manang district, Cluster A

Landscape around Khotro village in Manang district, Cluster B

Landscape around Syange region in Lamjung district, Cluster C

Landscape around Bahun danda in Lamjung district, Cluster D

A typical camera trap station setup - camera traps were placed in optimum locations within grids, and secured to trees with chains and padlocks after which they were camouflaged to blend in with the environment to minimise detection/disturbance.

Animal signs - scats and tracks, were recorded in the camera trap station grids to verify presence of mammals and determine optimum locations to place the camera traps.

Focus Group Discussion at Tal village in Manang

Focus Group Discussion at Tachai village in Manang

APPENDIX B: RELATED TO AVI-FAUNA

Table 1: Bird survey vantage points and survey days

SN	*Transmission line section*	*Total vantage points and sub-station location points*	*Number of vantage points for bird survey*	*Total survey days*
1.	Dharapani Substation – Khudi Substation	20	20	3
2.	Khudi Substation – Udipur Substation	11	11	2
3.	Udipur Substation – Markichowk Substation	25	14 (bird survey was carried out from each alternate vantage points)	2
4.	Markichowk Substation – Bharatpur Substation	20	20	3
	Total	***76***	***65***	***10***

Table 2 2: Itinerary

Survey Days	*Vantage Points Covered*	*No of Vantage Points*	*Stayed Place*
15 May 2022	9,10,11,12,13	5	Chamje
16 May 2022	Dharapani SS,0,1,2,3,4,5,6,7,8	10	Chamje
17 May 2022	14,15,16,17,18, Khudi SS	6	Shirchaur
18 May 2022	19,20,21,22,23,24	6	Kapurkot
19 May 2022	25,26,27,28, Udipur SS, 29,31	7	Besisahar
20 May 2022	33,35,37,39,41,43,45	7	Palungtaar
21 May 2022	47,49,51,52, Markhichowk SS,53, 54	7	Chhimkeswori
22 May 2022	55,56,57,58,59,60	6	Narayangarh
23 May 2022	61,62,63,64,65, 66, 67	7	Narayangarh
24 May 2022	68,69,70, Bharatpur SS	4	Return

Table 3: Bird survey vantage points and their coordinates (locations)

Vantage Points	*Latitude(N)*	*Longitude(E)*
Dharapani Substation	28.5327	84.3444
0	28.5250	84.3561
1	28.5128	84.3611
2	28.5001	84.3633
3	28.4888	84.3698
4	28.4763	84.3749
5	28.4633	84.3740

6	28.4504	84.3784
7	28.4399	84.3877
8	28.4296	84.3974
9	28.4182	84.4055
10	28.4059	84.4114
11	28.3947	84.4087
12	28.3830	84.4027
13	28.3696	84.4030
14	28.3563	84.4018
15	28.3438	84.3963
16	28.3303	84.3969
17	28.3171	84.3998
18	28.3058	84.3928
Khudi Substation	28.2980	84.3809
19	28.2921	84.3670
20	28.2806	84.3639
21	28.2677	84.3674
22	28.2554	84.3732
23	28.2438	84.3808
24	28.2315	84.3870
25	28.2207	84.3955
26	28.2092	84.4029
27	28.1983	84.4108
28	28.1905	84.4222
Udipur Substation	28.1850	84.4269
29	28.1771	84.4393
31	28.1527	84.4476
33	28.1293	84.4375
35	28.1061	84.4431
37	28.0857	84.4631
39	28.0634	84.4794
41	28.0394	84.4719
43	28.0139	84.4678
45	27.9950	84.4468
47	27.9717	84.4492
49	27.9549	84.4664
51	27.9316	84.4805
52	27.9277	84.4944
Markhichowk Substation	27.9220	84.5048
53	27.9124	84.5128
54	27.9035	84.5232
55	27.8917	84.5303

56	27.8801	84.5337
57	27.8694	84.5247
58	27.8589	84.5154
59	27.8470	84.5108
60	27.8339	84.5074
61	27.8214	84.5033
62	27.8110	84.4935
63	27.8019	84.4825
64	27.7918	84.4752
65	27.7784	84.4772
66	27.7650	84.4793
67	27.7516	84.4792
68	27.7441	84.4678
69	27.7330	84.4593
70	27.7206	84.4532
Bharatpur Substation	27.7073	84.4464

Annex 5: List of bird species recorded along the Marsyangdi Corridor Transmission Line (Dharapani Substation to Bharatpur Substation)

(Notes: NTS=Nationally Threatened Species, GTS=Globally Threatened Species, RR=Restricted Range Species, BR=Biome Restricted Species, CR=Critically Endangered, EN=Endangered, VU=Vulnerable, NT=Near Threatened, B05=Eurasian High Montane (Alpine and Tibetan), B07=Sino-Himalayan Temperate Forest, B08=Sino-Himalayan Subtropical Forest, B09=Indochinese Tropical Moist Forests, B11=Indo-Malayan Tropical Dry Zone, R=Residential, PM=Passage Migrant, WV=Winter Visitor, SV=Summer Visitor)

SN	English name	Scientific name	Nepali	GTS	RR	BR	CITES	NTS	Migration	Autumn Survey	Winter Survey	Summer Survey
	GALLIFORMES											
	Phasianidae											
1	Hill Partridge	*Arborophilatorqueola*	पिउरा			B07			R			2
2	Black Francolin	*Francolinusfrancolinus*	कालो तित्रा						R		8	29
3	Indian Peafowl	*Pavocristatus*	मुजुर			B11	III	NT	R	2	2	2
4	Red Junglefowl	*Gallus gallus*	लुईचे						R	2	8	3
5	Satyr Tragopan	*Tragopan satyra*	मुनाल			B07	III	VU	R			1
6	Kalij Pheasant	*Lophuraleucomelanos*	कालिज				III		R		10	5
	ANSERIFORMES											
	Anatidae											
7	Goosander	*Mergus merganser*	मणितुण्डक						WV		1	
8	Ruddy Shelduck	*Tadornaferruginea*	चखेवाचखेवी					NT	WV		8	
9	Common Pochard	*Aythya ferina*	कैलोटाउके हाँस	VU				NT	PM/WV		1	
10	Tufted Duck	*Aythya fuligula*	कालीजुरे हाँस						PM/WV	2		1
11	Gadwall	*Mareca strepera*	खडखडे हाँस						PM/WV	8	4	
12	Eurasian Wigeon	*Marecapenelope*	सिन्दुरे हाँस						PM/WV	1		
	COLUMBIFORMES											
	Columbidae											
13	Rock Dove	*Columba livia*	मलेवा						R	37	102	125
14	Hill Pigeon	*Columba rupestris*	लेकालीमलेवा						R			2
15	Ashy Woodpigeon	*Columba pulchricollis*	फुस्रो वनपरेवा						R			1
16	Oriental Turtle-dove	*Streptopeliaorientalis*	तामे ढुकुर						R	6	14	38
17	Western Spotted Dove	*Spilopeliasuratensis*	कुर्ले ढुकुर						R	34	21	45
18	Barred Cuckoo-dove	*Macropygiaunchall*	धर्के ढुकुर					VU	R			1
19	Yellow-footed Green-pigeon	*Treronphoenicopterus*	हलेसो			B11			R	8		5
	CAPRIMULGIFORMES											

	Apodidae											
20	White-rumpedSpinetail	*Zoonavena sylvatica*	सानो वनगौंथली					NT	R			10
21	Himalayan Swiftlet	*Aerodramusbrevirostris*	चीँचिकागौंथली						R		8	8
22	Alpine Swift	*Tachymarptis melba*	बतासीगौंथली						R			18
23	House Swift	*Apus nipalensis*	फिरफिरे घरगौंथली						R	127	213	231
24	Common Swift	*Apus apus*	खैरो गौंथली						SV			8
	CUCULIFORMES											
	Cuculidae											
25	Greater Coucal	*Centropus sinensis*	ढोडे गोकुल						R	8	21	24
26	Green-billed Malkoha	*Phaenicophaeus tristis*	हरित मालकौवा						R	2		5
27	Chestnut-winged Cuckoo	*Clamatorcoromandus*	ठूलो जुरे कोइली					NT	SV			1
28	Western Koel	*Eudynamysscolopaceus*	कोइली						R/SV		1	39
29	Banded Bay Cuckoo	*Cacomantissonneratii*	धर्के खैरो कोइली						R			2
30	Grey-bellied Cuckoo	*Cacomantispasserinus*	फुस्रो सानो कोइली						SV			6
31	Fork-tailed Drongo-cuckoo	*Surniculusdicruroides*	चिबे कोइली						SV			1
32	Large Hawk-cuckoo	*Hierococcyxsparverioides*	पहाडी बीउकुहियो						SV			8
33	Common Hawk-cuckoo	*Hierococcyxvarius*	बीउकुहियो						R			6
34	Indian Cuckoo	*Cuculusmicropterus*	काफलपाक्यो						SV			26
35	Common Cuckoo	*Cuculuscanorus*	कुक्कु कोइली						SV			10
36	Lesser Cuckoo	*Cuculuspoliocephalus*	सानो कोइली						SV			1
37	Oriental Cuckoo	*Cuculussaturatus*	पूर्वीय कोइली						SV			2
	GRUIFORMES											
	Rallidae											
38	White-breasted Waterhen	*Amaurornisphoenicurus*	सिमकुखुरा						R			2
	OTIDIFORMES											
	Ciconiidae											
39	Asian Woollyneck	*Ciconia episcopus*	लोभीपापी गरुड	NT				NT	R			2
	Threskiornithidae											
40	Red-naped Ibis	*Pseudibispapillosa*	कर्रा साँवरी			B11			R			5
	PELECANIFORMES											
	Ardeidae											
41	Indian Pond-heron	*Ardeolagrayii*	आसकोटे बकुल्ला						R	4	14	23
42	Cattle Egret	*Bubulcus ibis*	वस्तु बकुल्ला						R	29	107	190

43	Little Egret	*Egrettagarzetta*	सानो सेतोबकुल्ला						R	5	4	4
	SULIFORMES											
	Phalacrocoracidae											
44	Great Cormorant	*Phalacrocorax carbo*	जलेबा					NT	WV	2	111	
	CHARADRIIFORMES											
	Charadriidae											
45	River Lapwing	*Vanellusduvaucelii*	खोले हुटिट्याउ					NT	R			2
46	Red-wattled Lapwing	*Vanellus indicus*	हुटिट्याउँ						R			2
	Scolopacidae											
47	Common Sandpiper	*Actitishypoleucos*	चञ्चले सुडसुडिया						PM/WV	1		
48	Green Sandpiper	*Tringaochropus*	रुख सुडसुडिया						PM/WV	1		
	STRIGIFORMES											
	Strigidae											
49	Collared Owlet	*Glaucidium brodiei*	सानो डुन्डुल				II		R		3	
50	Asian Barred Owlet	*Glaucidium cuculoides*	ठूलो डुन्डुल				II		R	1	8	6
51	Jungle Owlet	*Glaucidium radiatum*	डुन्डुल				II		R		1	1
52	Spotted Owlet	*Athene brama*	कोचलगाँडे लाटोकोसेरो				II		R			2
53	Collared Scops-owl	*Otus lettia*	चित्रीउलूक				II		R			1
	ACCIPITRIFORMES											
	Accipitridae											
54	Oriental Honey-buzzard	*Pernis ptilorhynchus*	मधुहा				II		R/PM	2		2
55	Crested Serpent-eagle	*Spilornischeela*	काकाकुल				II		R		10	10
56	Bearded Vulture	*Gypaetus barbatus*	हाडफोर				II	VU	R	2	2	3
57	Egyptian Vulture	*Neophron percnopterus*	सेतो गिद्ध	EN			II	VU	R	1	3	9
58	Red-headed Vulture	*Sarcogyps calvus*	सुन गिद्ध	CR		B11	II	EN	R	3	6	5
59	Himalayan Griffon	*Gyps himalayensis*	हिमाली गिद्ध			B05	II	VU	R	4	73	23
60	White-rumped Vulture	*Gyps bengalensis*	डंगर गिद्ध	CR		B11	II	CR	R		2	1
61	Cinereous Vulture	*Aegypiusmonachus*	राजगिद्ध				II	EN	PM/WV		1	
62	Mountain Hawk-eagle	*Nisaetusnipalensis*	पहाडी शदलचील				II		R/WV	1	1	2
63	Black Eagle	*Ictinaetusmalaiensis*	द्रोणक चील				II		R	3	1	
64	Greater Spotted Eagle	*Clangaclanga*	जीवाहार महाचील	VU			II	VU	WV	1		
65	Steppe Eagle	*Aquila nipalensis*	गोमायु महाचील	EN			II	VU	PM/WV	10	14	
66	Bonelli's Eagle	*Aquila fasciata*	मोरङ्गी चील				II		R	8	3	4
67	Booted Eagle	*Hieraaetuspennatus*	काँधचन्द्र चील				II		R/PM/WV	1	1	

68	Shikra	*Accipiter badius*	शिक्रा				II		R	1		4
69	Besra	*Accipiter virgatus*	वेसरा				II		R	1		
70	Eurasian Sparrowhawk	*Accipiter nisus*	वनबाज				II		R/PM	1		2
71	Northern Goshawk	*Accipiter gentilis*	बलाकांक्षवनबाज				II		R			1
72	Black Kite	*Milvus migrans*	कालो चील				II		R/PM	42	46	47
73	Himalayan Buzzard	*Buteo refectus*	श्येनबाज				II		PM/WV	7	6	
74	Long-legged Buzzard	*Buteo rufinus*	लामखुट्टे श्येनबाज				II		PM/WV	2	1	
75	Upland Buzzard	*Buteo hemilasius*	पहाडी श्येनबाज				II	DD	R/WV	2	1	
	BUCEROTIFORMES											
	Upupidae											
76	Common Hoopoe	*Upupa epops*	फाप्रे चरा						R	2		
	CORACIIFORMES											
	Meropidae											
77	Asian Green Bee-eater	*Meropsorientalis*	मुरलीचरा						R	3	16	5
78	Chestnut-headed Bee-eater	*Meropsleschenaulti*	कटुसटाउके मुरलीचरा						SV		7	22
	Coraciidae											
79	Indian Roller	*Coracias benghalensis*	ठेउवा						R	2	2	5
80	Oriental Dollarbird	*Eurystomusorientalis*	लालचुच्चे ठेउवा						SV			1
	Alcedinidae											
81	Common Kingfisher	*Alcedoatthis*	सानो माटीकोरे						R		1	2
82	Crested Kingfisher	*Megacerylelugubris*	ठूलो छिरबिरे माटीकोरे						R		2	
83	White-breasted Kingfisher	*Halcyon smyrnensis*	सेतोकण्ठे माटीकोरे						R	11	7	23
	PICIFORMES											
	Megalaimidae											
84	Coppersmith Barbet	*Psilopogonhaemacephalus*	मिलचरा						R	1	3	4
85	Great Barbet	*Psilopogon virens*	न्याउली						R	12	60	61
86	Lineated Barbet	*Psilopogonlineatus*	छिर्के कुथुर्के			B11			R	1	5	10
87	Golden-throated Barbet	*Psilopogonfranklinii*	कुक्लुङ्ग			B08			R		1	6
88	Blue-throated Barbet	*Psilopogon asiaticus*	कुथुर्के			B08			R	8	33	67
	Indicatoridae											
89	Yellow-rumped Honeyguide	*Indicator xanthonotus*	चाकासूचक			B07		EN	R			1
90	Speckled Piculet	*Picumnusinnominatus*	थोप्ले ससिया						R	2	1	1

91	Greater Flameback	*Chrysocolaptesguttacristatus*	गर्दनथोप्ले लाहाँचे						R	2		
92	Rufous Woodpecker	*Micropternusbrachyurus*	सानो तामे लाहाँचे						R			2
93	Greater Yellownape	*Chrysophlegmaflavinucha*	ठूलो सुनजुरे काठफोर						R	3	1	2
94	Lesser Yellownape	*Picuschlorolophus*	सुनजुरे काठफोर						R			1
95	Black-naped Woodpecker	*Picusguerini*	कालोगर्दने काठफोर						R		4	2
96	Grey-capped Woodpecker	*Picoidescanicapillus*	फुस्रोटाउके काष्ठकूट						R	7		
97	Fulvous-breasted Woodpecker	*Dendrocoposmacei*	काष्ठकूट						R	5	1	2
	CARIAMIFORMES											
	Falconidae											
98	Collared Falconet	*Microhieraxcaerulescens*	पौरी बाज				II	NT	R	2		
99	Lesser Kestrel	*Falco naumanni*	सानो बौंडाइ				II	NT	PM/WV	1		
100	Common Kestrel	*Falco tinnunculus*	बौंडाइ				II		R/PM/WV	10	11	14
101	Peregrine Falcon	*Falco peregrinus*	शाहीबाज				I		R/PM/WV	2	1	2
	PSITTACIFORMES											
	Psittacidae											
102	Slaty-headed Parakeet	*Psittaculahimalayana*	कर्रा सुगा			B08	II		R		45	
103	Plum-headed Parakeet	*Psittaculacyanocephala*	टुइँसी सुगा			B11	II		R	12	10	12
104	Red-breasted Parakeet	*Psittaculaalexandri*	कागभेला सुगा				II	VU	R			11
105	Alexandrine Parakeet	*Psittaculaeupatria*	कर्रा सुगा				II	NT	R	3	1	7
106	Rose-ringed Parakeet	*Psittaculakrameri*	कण्ठे सुगा						R	24	15	13
	PASSERIFORMES											
	Eurylaimidae											
107	Long-tailed Broadbill	*Psarisomusdalhousiae*	चित्रकुट						R			3
	Oriolidae											
108	Maroon Oriole	*Oriolustraillii*	घनरक्त सुनचरी			B08			R		1	2
109	Black-hooded Oriole	*Oriolusxanthornus*	कालोटाउके सुनचरी						R	4	16	16
110	Indian Golden Oriole	*Orioluskundoo*	गाजले सुनचरी						SV	1		10
	Campephagidae											
111	Long-tailed Minivet	*Pericrocotusethologus*	लामपुछ्रे रानीचरी						R	2	15	14
112	Scarlet Minivet	*Pericrocotusflammeus*	रानीचरी						R	17	40	14
113	Indian Cuckooshrike	*0*	लटुशक विरहीचरी						R	10	8	9

114	Black-winged Cuckooshrike	*Lalage melaschistos*	कालो विरहीचरी			B08			R			1
	Artamidae											
115	Ashy Woodswallow	*Artamusfuscus*	मिथुन			B11			R	13		7
	Vangidae											
116	Bar-winged Flycatcher-shrike	*Hemipuspicatus*	आसकोटे चरी						R	3		
	Aegithinidae											
117	Common Iora	*Aegithina tiphia*	सुसेलीचरी						R	2	3	4
	Rhipiduridae											
118	White-throated Fantail	*Rhipiduraalbicollis*	नक्कले मारुनीचरी						R	1		2
	Dicruridae											
119	Black Drongo	*Dicrurusmacrocercus*	कालो चिवे						R	31	23	59
120	Ashy Drongo	*Dicrurusleucophaeus*	ध्वाँसे चिवे						R			4
121	White-bellied Drongo	*Dicruruscaerulescens*	सेतोपेटे चिवे			B11			R	1		2
122	Bronzed Drongo	*Dicrurus aeneus*	सानो चिवे						R	39	7	14
123	Hair-crested Drongo	*Dicrurushottentottus*	केशराजचिवे						R	19	30	31
124	Greater Racquet-tailed Drongo	*Dicrurusparadiseus*	भीमराजचिवे						R	3	4	
	Laniidae											
125	Long-tailed Shrike	*Laniusschach*	भद्राई						R	13	12	13
126	Grey-backed Shrike	*Laniustephronotus*	हिमालीभद्राई			B05			R	5	2	1
	Corvidae											
127	Rufous Treepie	*Dendrocittavagabunda*	कोकले						R	14	7	10
128	Grey Treepie	*Dendrocittaformosae*	पहाडी कोकले			B08			R	58	37	31
129	Red-billed Blue Magpie	*Urocissaerythroryncha*	स्यालपोथरी लामपुच्छे						R	6	13	3
130	Common Green Magpie	*Cissa chinensis*	हरियो लामपुच्छे						R		2	
131	Southern Nutcracker	*Nucifragahemispila*	वनसर्रा						R		2	
132	House Crow	*Corvus splendens*	घर काग						R	17	16	101
133	Large-billed Crow	*Corvus macrorhynchos*	कालो काग						R	32	164	182
	Stenostiridae											
134	Yellow-bellied Fairy-fantail	*Chelidorhynxhypoxanthus*	पहेंलो मारुनीचरी						R		2	
135	Grey-headed Canary-flycatcher	*Culicicapaceylonensis*	चञ्चले अर्जुनक						R	27	10	13

	Paridae											
136	Rufous-vented Tit	*Periparusrubidiventris*	सेतोगर्दने चिचिल्कोटे			B07			R	1	2	
137	Green-backed Tit	*Parus monticolus*	हरियो चिचिल्कोटे			B07			R		11	15
138	Great Tit	*Parus major*	चिचिल्कोटे						R	48	22	40
139	Black-lored Tit	*Machlolophusxanthogenys*	पाण्डु चिचिल्कोटे						R	59	18	56
	Cisticolidae											
140	Striated Prinia	*Priniacrinigera*	सुया घाँसेफिस्टो			B08			R	1	24	36
141	Grey-breasted Prinia	*Priniahodgsonii*	फुस्रोछाती घाँसेफिस्टो						R	2	2	4
142	Yellow-bellied Prinia	*Priniaflaviventris*	पीतोदर घाँसेफिस्टो					NT	R		6	
143	Ashy Prinia	*Priniasocialis*	टुणुक् घाँसेफिस्टो			B11			R			6
144	Common Tailorbird	*Orthotomussutorius*	पातसिउने फिस्टो						R	39	69	50
	Hirundinidae											
145	Asian House Martin	*Delichondasypus*	एशियालीभीरगौंथली						R			12
146	Nepal House Martin	*Delichonnipalense*	नेपालभीरगौंथली			B07			R		10	25
147	Northern House Martin	*Delichonurbicum*	भीरगौंथली						PM			5
148	Barn Swallow	*Hirundorustica*	घर गौंथली						R	30	13	21
149	Red-rumped Swallow	*Cecropisdaurica*	गेरुकटी गौंथली						R	11	23	36
150	Eurasian Crag Martin	*Ptyonoprognerupestris*	नहिकुटी गौंथली						R	28		
151	Asian Plain Martin	*Riparia chinensis*	भित्तेगौंथली					NT	R		237	108
	Pycnonotidae											
152	Ashy Bulbul	*Hemixosflavala*	फुस्रोपेटे जुरेली						R	2	9	2
153	Mountain Bulbul	*Ixosmcclellandii*	कैलोपेटे जुरेली			B08			R	13		7
154	Black Bulbul	*Hypsipetes leucocephalus*	बाखे जुरेली			B08			R	14	92	121
155	Black-crested Bulbul	*Pycnonotusflaviventris*	कालोकल्कीपहेंलोजुरेली						R	2		
156	Red-whiskered Bulbul	*Pycnonotusjocosus*	श्वेतवक्ष जुरेली						R	6	6	5
157	Himalayan Bulbul	*Pycnonotusleucogenys*	जुल्फे जुरेली			B08			R	49	91	99
158	Red-vented Bulbul	*Pycnonotuscafer*	जुरेली						R	77	109	149
	Phylloscopidae											
159	Hume's Leaf-warbler	*Phylloscopushumei*	चञ्चले फिस्टो						R	10	25	
160	Buff-barred Warbler	*Phylloscopuspulcher*	सुन्तलेरेखी फिस्टो			B07			R		4	
161	Ashy-throated Warbler	*Phylloscopusmaculipennis*	फुस्रोकण्ठे फिस्टो			B07						4
162	Tickell's Leaf-warbler	*Phylloscopusaffinis*	पीतोदर फिस्टो			B05						1
163	Grey-cheeked Warbler	*Phylloscopuspoliogenys*	सेतोचश्मे फिस्टो			B07		NT			2	
164	Whistler's Warbler	*Phylloscopuswhistleri*	सुसेली फिस्टो								1	

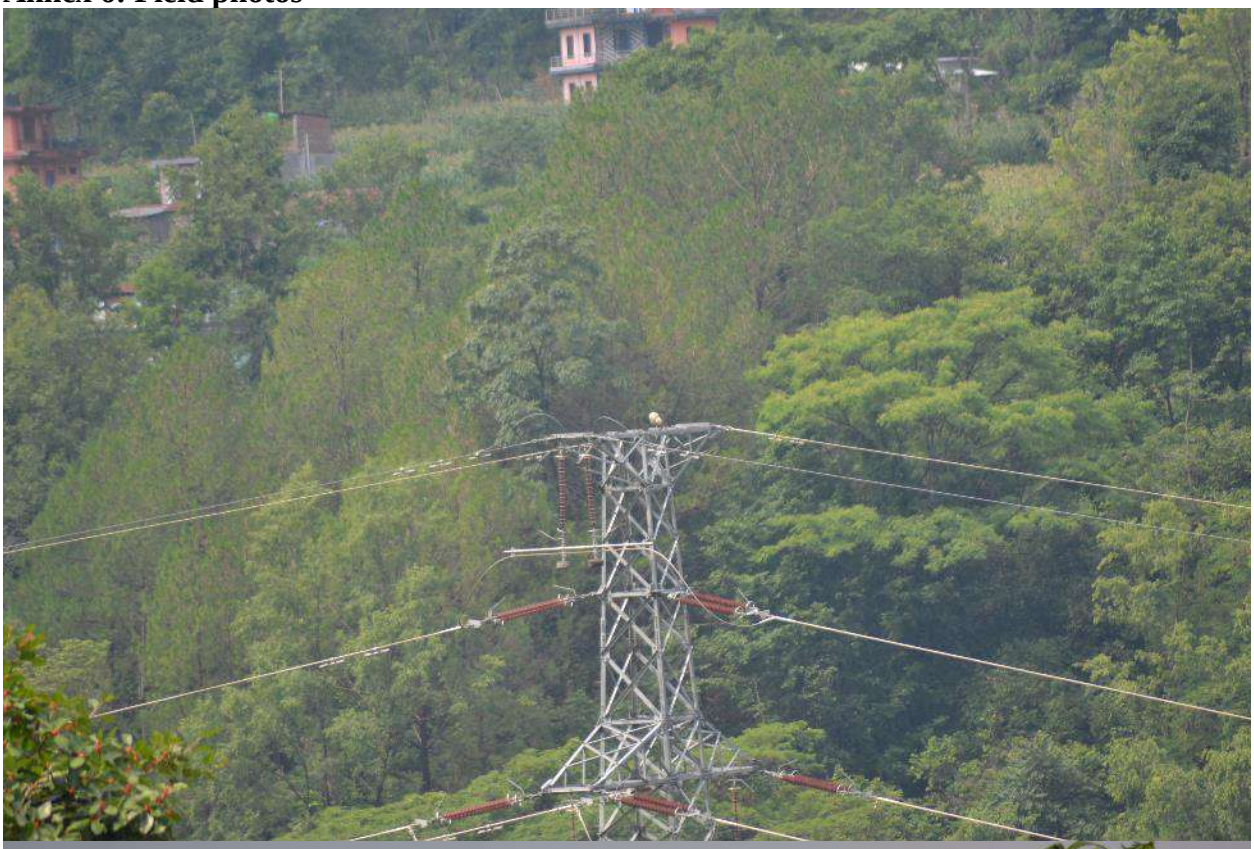
165	Chestnut-crowned Warbler	*Phylloscopuscastaniceps*	रातोटाउके फिस्टो								5	
166	Greenish Warbler	*Phylloscopustrochiloides*	जीवल फिस्टो							18	8	
167	Blyth's Leaf-warbler	*Phylloscopusreguloides*	तालुधर्के फिस्टो							6		
168	Grey-hooded Warbler	*Phylloscopusxanthoschistos*	तुमुलकारी फिस्टो			B08				34	82	45
169	Yellow-bellied Warbler	*Abroscopussuperciliaris*	पहेंलोपेटे फिस्टो					VU			2	
170	Hume's Bush-warbler	*Horornisbrunnescens*	पीतेदर झाडीफिस्टो			B07		VU	R	1	4	
	Aegithalidae											
171	Red-headed Tit	*Aegithalosiredalei*	कालीकण्ठे राजचिचिल्कोटे		RR	B08						2
	Zosteropidae											
172	Stripe-throated Yuhina	*Yuhina gularis*	थुपलकल्की जुरेचरा			B07						13
173	Whiskered Yuhina	*Yuhina flavicollis*	जुंगे जुरेचरा								17	6
174	Oriental White-eye	*Zosteropspalpebrosus*	कांकीर							37	12	27
	Timaliidae											
175	Rusty-cheeked Scimitar-babbler	*Erythrogenyserythrogenys*	पाल्कोटे			B08				6	2	4
176	Pin-striped Tit-babbler	*Mixornisgularis*	पीतोदर फिस्टेभ्याकुर							1		
177	Black-chinned Babbler	*Cyanodermapyrrhops*	कालोचिउँडे वनभ्याकुर			B08				9	8	9
	Pellorneidae											
178	Puff-throated Babbler	*Pellorneumruficeps*	थोप्ले भ्याकुर							11	3	2
	Leiotrichidae											
179	Spiny Babbler	*Acanthoptilanipalensis*	काँडे भ्याकुर		RR				R	2	6	
180	Jungle Babbler	*Turdoides striata*	बगाले भ्याकुर			B11			R	33	6	25
181	Striated Laughingthrush	*Grammatoptila striata*	कल्कीतोरीगाँडा			B07			R			3
182	White-crested Laughingthrush	*Garrulaxleucolophus*	हिउँजुरे तोरीगाँडा						R	15	38	29
183	White-throated Laughingthrush	*Garrulaxalbogularis*	सोइरने तोरीगाँडा			B07			R			2
184	Streaked Laughingthrush	*Trochalopteronlineatum*	छिर्के तोरीगाँडा			B07			R		2	
185	Variegated Laughingthrush	*Trochalopteron variegatum*	टिकीयुरी तोरीगाँडा						R		2	
186	Chestnut-crowned Laughingthrush	*Trochalopteronerythrocephalum*	कटुसटाउके तोरीगाँडा						R		7	2
187	Rufous Sibia	*Heterophasiacapistrata*	सिबिया			B07			R		5	
	Certhiidae											

188	Rusty-flanked Treecreeper	*Certhianipalensis*	कैलोकोखे छेपारेचरी			B07					1	
	Sittidae											
189	Chestnut-bellied Nuthatch	*Sittacinnamoventris*	कटुसे मट्टा							20	10	10
190	Velvet-fronted Nuthatch	*Sitta frontalis*	मखमलीमट्टा							1		5
191	Wallcreeper	*Tichodromamuraria*	मुरारी पुतलीचरा			B05					3	
	Troglodytidae											
192	Northern Wren	*Troglodytes troglodytes*	चित्री								1	
	Cinclidae											
193	Brown Dipper	*Cincluspallasii*	खैरो वञ्जूल								2	1
	Sturnidae											
194	Asian Pied Starling	*Gracupica contra*	डाइग्रे सारौं							1	1	7
195	Chestnut-tailed Starling	*Sturniamalabarica*	फुस्रोटाउके सारौं			B11				14	3	26
196	Common Myna	*Acridotheres tristis*	डाइग्रे रुपी							51	86	171
197	Jungle Myna	*Acridotheresfuscus*	वन रुपी							6	13	25
198	Common Hill Myna	*Gracula religiosa*	मदनसारिका मैना				II					6
	Turdidae											
199	Orange-headed Thrush	*Geokichlacitrina*	सुन्तले चाँचर									2
200	White-collared Blackbird	*Turdus albocinctus*	कण्ठे चाँचर			B07					1	
201	Black-throated Thrush	*Turdus atrogularis*	कालोकण्ठे चाँचर								6	
	Muscicapidae											
202	Oriental Magpie-robin	*Copsychussaularis*	धोबिनी चरा							24	27	36
203	Dark-sided Flycatcher	*Muscicapasibirica*	ध्वाँसे अर्जुनक							20	5	
204	Small Niltava	*Niltavamacgrigoriae*	सानो नीलतभा			B08						1
205	Large Niltava	*Niltava grandis*	ठूलो नीलतभा					NT			1	1
206	Verditer Flycatcher	*Eumyiasthalassinus*	नीलतुथो अर्जुनक							2	4	4
207	Pale Blue-flycatcher	*Cyornis unicolor*	नीलगगनअर्जुनक								1	
208	Indian Blue Robin	*Larvivorabrunnea*	नीलो रबिन			B07						3
209	Himalayan Bush-robin	*Tarsigerrufilatus*	सुन्तलाकोखे रबिन								2	
210	Golden Bush-robin	*Tarsigerchrysaeus*	सुनौलो रबिन			B07					2	
211	Little Forktail	*Enicurusscouleri*	गंगाखोलेधोबिनी						R	5	2	3
212	Slaty-backed Forktail	*Enicurusschistaceus*	फुस्रोढाडे खोलेधोबिनी			B08			R		2	
213	Black-backed Forktail	*Enicurusimmaculatus*	कालोढाडे खोलेधोबिनी			B09			R	1		1
214	Blue Whistling-thrush	*Myophonus caeruleus*	कल्चौडे						R	12	30	39

215	Slaty-backed Flycatcher	*Ficedulaerithacus*	नीलढाडे अर्जुनक			B07		NT			2	
216	Rufous-gorgeted Flycatcher	*Ficedulastrophiata*	सेतोटिके अर्जुनक			B07					2	
217	Rusty-tailed Flycatcher	*Ficedularuficauda*	कैलोपुच्छे अर्जुनक			B07					2	
218	Red-throated Flycatcher	*Ficedula albicilla*	लालकण्ठे अर्जुनक							7	3	
219	Blue-fronted Redstart	*Phoenicurus frontalis*	नीलटाउके खञ्जरी									2
220	Blue-capped Redstart	*Phoenicuruscoeruleocephala*	धोबिनीखञ्जरी			B07					1	
221	White-capped Water-redstart	*Phoenicurus leucocephalus*	सेतोटाउके जलखञ्जरी						R	7	8	5
222	Plumbeous Water-redstart	*Phoenicurusfuliginosus*	नीलाम्बर जलखञ्जरी						R	11	13	11
223	White-winged Redstart	*Phoenicuruserythrogastrus*	सेतोपंखे खञ्जरी			B05						3
224	Hodgson's Redstart	*Phoenicurushodgsoni*	तनकम्पखञ्जरी			B05						2
225	Blue-capped Rock-thrush	*Monticolacinclorhyncha*	सानो हजारा चाँचर			B08				2		3
226	Blue Rock-thrush	*Monticola solitarius*	उमा चाँचर									1
227	Grey Bushchat	*Saxicola ferreus*	हिमालीझ्याप्सी								6	4
228	Pied Bushchat	*Saxicola caprata*	काले झ्याप्सी							17	24	20
229	Common Stonechat	*Saxicola torquatus*	झेकझेक झ्याप्सी							19	8	4
	Chloropseidae											
230	Golden-fronted Leafbird	*Chloropsisaurifrons*	कृष्णकण्ठे हरितचरी								1	
231	Orange-bellied Leafbird	*Chloropsishardwickii*	स्वर्णोदर हरितचरी			B08				3	4	3
	Dicaeidae											
232	Thick-billed Flowerpecker	*Dicaeum agile*	मोटोठूँडे पुष्पकोकिल						R		1	
233	Fire-breasted Flowerpecker	*Dicaeumignipectus*	अग्निवक्षपुष्पकोकिल						R	10	3	2
	Nectariniidae											
234	Purple Sunbird	*Cinnyris asiaticus*	कालोबुङ्गेचरा						R	1	5	5
235	Fire-tailed Sunbird	*Aethopygaignicauda*	लामपुच्छे बुङ्गेचरा			B07			R	6	1	
236	Black-throated Sunbird	*Aethopygasaturata*	कालीकण्ठ बुङ्गेचरा			B08			R	1	1	2
237	Gould's Sunbird	*Aethopygagouldiae*	कान्ति बुङ्गेचरा						R	4	1	
238	Crimson Sunbird	*Aethopygasiparaja*	सिपराजाबुङ्गेचरा						R	10	9	10
	Prunellidae											
239	Rufous-breasted Accentor	*Prunella strophiata*	मुसे लेकचरी			B07						2

	Ploceidae											
240	Baya Weaver	*Ploceusphilippinus*	बयातोपचरा					NT	R			28
	Estrildidae											
241	White-rumped Munia	*Lonchura striata*	सेतोढाडे मुनियाँ						R	20	2	16
	Passeridae											
242	House Sparrow	*Passer domesticus*	घर भँगेरा						R	50	91	123
243	Eurasian Tree Sparrow	*Passer montanus*	रुख भँगेरा						R	24	32	34
	Motacillidae											
244	Olive-backed Pipit	*Anthushodgsoni*	रुख चुइयाँ							44	11	6
245	Rosy Pipit	*Anthusroseatus*	गुलाफीकण्ठे चुइयाँ			B05						6
246	Upland Pipit	*Anthussylvanus*	पहाडी चुइयाँ								2	
247	Paddyfield Pipit	*Anthusrufulus*	आलीचुइयाँ							6	2	23
248	Grey Wagtail	*Motacilla cinerea*	फुस्रो टिकटिके							14	2	3
249	White-browed Wagtail	*Motacillamaderaspatensis*	खोले टिकटिके							1	6	
250	White Wagtail	*Motacilla alba*	फुस्रो टिकटिके							10	21	
	Fringillidae											
251	Common Rosefinch	*Carpodacus erythrinus*	अमोंगातितु									2
252	Beautiful Rosefinch	*Carpodacus pulcherrimus*	झिवीतितु			B05						12
253	Dark-rumpedRosefinch	*Carpodacus edwardsii*	कुमधर्के तितु			B07				2	16	
254	Plain Mountain-finch	*Leucosticte nemoricola*	तितुभँगेरा			B05					276	
255	Yellow-breasted Greenfinch	*Chloris spinoides*	गाजले पीतचरी			B07					7	
	Emberizidae											
256	Crested Bunting	*Emberizalathami*	जुरे बगेडी								5	6

Annex 6: Field photos




TOYOTA

APPENDIX C: RELATED TO FLORA/VEGETATION

Annex 1: Field Data Sheet for forest and plant diversity

General Information of the site

Sample Plot No.:		Date of survey:	
Elevation :		District :	
Plot Size :	500 m^2 (25 m x 20 m) for tree, 100 m^2 (10 m x 10 m) for pole, 25 m^2 (5 m x 5 m) for sapling, 10 m^2 (5 m x 2 m) for seedling,	GAPA/NAPA and Ward No.:	
Slope :		Forest category (National, Comm., Pvt., etc) :	
Aspect :		Forest classification (Sal forest, pine forest, etc)	……,…….,
Crown Cover (%)			

Individual tree data of the quadrat

Tree (DBH> 30cm),

SN	Local name	Bot. name	GBH (cm)	Height m	Seedling - lj?jf_N	Sapling - लाथ्र) ल	Remarks

Biodiversity within the surveyed forest

Herbs, Shrubs and Grass diversity of the forest plot (Plot size = 5 x 5 $m^{2)}$

Corresponding plot no.	Local name	Botanical name	Number	Coverage	Remarks

Annex 2: Location of sample plots

Khudi Manang Section				
Sample plot No	**X coordinate**	**Y coordinate**	**Altitude m**	**Remarks**
MK1	84.3461050	28.532053	2065	
MK2	84.3481250	28.531926	2037	
MK3	84.3587590	28.505989	1817	
MK4	84.3582470	28.504883	1829	
MK6	84.3705380	28.463093	1725	
MK7	84.4078850	28.401882	1147	
Mk8	84.4061210	28.392437	1166	
MK10	84.4004600	28.381838	1093	
MK11	84.4002890	28.381873	1097	
MK12	84.3962180	28.321172	1125	
MK13	84.3972760	28.315529	1123	
Khudi Udipur Section				
Sample plot No	**X coordinate**	**Y coordinate**	**Altitude m**	**Remarks**
KU1	84.3643100	28.292224	907	
KU2	84.3648040	28.293031	907	
KU3	84.3627610	28.290935	888	
KU4	84.3742450	28.295772	985	
KU5	84.3630060	28.282024	801	
KU6	84.3643660	28.273623	812	
KU7	84.3673060	28.264077	828	
KU8	84.3794140	28.242174	752	
KU9	84.3826400	28.236200	720	
KU10	84.3846620	28.231638	719	
KU11	84.3902880	28.227759	764	
KU12	84.4001700	28.209282	770	
Udipur Markichowk Section				

Sample plot No	X coordinate	Y coordinate	Altitude m	Remarks
UM1	84.4466420	28.158224	633	
UM2	84.4445620	28.147194	600	
UM3	84.4401350	28.135781	537	
UM4	84.4509220	28.097376	506	
UM5	84.4686520	28.078302	544	
UM6	84.4697480	28.075630	507	
UM7	84.4771680	28.064265	473	
UM8	84.4812320	28.064107	558	
UM9	84.4947370	28.050584	604	
UM10	84.4393179	27.984930	473	
UM11	84.4765806	27.936330	396	
Markichowk Bharatpur Section				
Sample plot No	**X coordinate**	**Y coordinate**	**Altitude m**	**Remarks**
MB1	84.5093170	27.918343	434	
MB2	84.5216990	27.901616	628	
MB3	84.5203400	27.865595	1219	
MB4	84.4994380	27.817977	335	
MB6	84.4804040	27.802534	1002	
MB7	84.4769950	27.760989	220	
MB8	84.4762750	27.750306	284	
MB9	84.4660360	27.744431	271	

Annex 3: ***Details of Key informants***

List of informants in Khudi Manang Section				
SN	Person consulted	Address	Mobile	Remark
1	Bijaya Gupta	Marsyangdi Corridor Project Head Manang-Udipur Section	9841569876	
2	Dhan Bahadur Gurung	Marshyangdi GAPA -4, Tangring	9846738372	
3	Bal Bahadur Gurung	Marshyangdi GAPA -4, Tangring	9846273817	
4	Jit Bahadur Gurung	Marshyangdi GAPA -4, Tangring	9846409772	
5	Kanchaman Gurung	Marshyangdi GAPA -4, Mipra	9846632958	
6	Khum Bahdur Gurung	Marshyangdi GAPA -4, Mipra		
7	Dipak Gurung	Marshyangdi GAPA -4, Mipra		
List of informants in Khudi Udipur Section				
1	Bir Bal Tamang	Tarkhu Gau	9846824855	
2	Budhi Bahadur Tamang	Tarkhu Gau	9846753215	
3	Bhabar Jung Gurung	Besi Sahar 10, Pasachuar	9840412149	
4	Dhan Bahadur Dawadi	Besi Sahar 10, Pasachuar	9851026735	
5	Uttam Gurung	Besi Sahar 10, Pasachuar	9815111019	
6	Achyut Babu Tiwari	Besi Sahar 11, Tharchaur	9827117741	

7	San Kaji Mijar	Besi Sahar 11, Tharchaur	9806500862	
8	Hark Nidhi Tiwari	Besi Sahar 11, Tharchaur	9862219084	
9	Gopal Kumar Shrestha	Besi Sahar 11, Tharchaur	9823177012	
10	Sunil Tiwai	Besi Sahar 11, Tharchaur	9842776930	
11	Pawan Tiwari	Besi Sahar 11, Tharchaur	9819181822	
Udipur Markichowk Section				
1	Narayan Regmi	Marsyangdi Corridor Project Asst. Manager Udipur-Bharatpur Section	9851147454	
2	Narayan Babu Tiwari	Besi Sahar 11,	9866021042	
3	Achyut Regmi	Dordi GAPA 2, Arhalbot	9846128158	
4	Satya Devi Dhakal	Dordi GAPA 2, Arhalbot	9846458232	
5	Ram Prasad Poudel	Dordi GAPA 2, Arhalbot	9864172821	
6	Sobita Kunwar	Dordi GAPA 2, Arhalbot	9866041115	
7	Biswa Kant Sadaula	Rainas NAPA 8, Harrabot	9841315072	
8	Tika Prasad Shrestha	Rainas NAPA 8, Harrabot		
9	Prem Bahadur Kandel	Rainas NAPA 8, Godetari	9745685590	
10	Daran Ranabhat	Rainas NAPA 8, Harrabot	9846416641	
11	Binod Thapa	Rainas NAPA 8, Harrabot	9808924114	
12	Kuber Ranabhat	Rainas NAPA 8, Harrabot	9846644436	
13	Ram Bahadur Gurung	Rainas NAPA 8, Bagar	9814134865	
14	Dev Bahadur Gurung	Rainas NAPA 8, Harrabot		
15	Prem Nepali	Palungtar NAPA 6,	9819186790	
16	Nir Bahadur Nepal	Palungtar 6,	9812294487	
17	Devka Regmi	Palungtar 6	9806580646	
18	Thakur Adhikari	Palungtar 6		
19	Ujeli Maya Kumal	Palungtar 7, Pareghhat	9814168495	
20	Sandesh Nepali	Palungtar 7, Pareghhat		
21	Bishnu Maya Kumal	Palungtar 7, Pareghhat	9817164722	
Markichowk Chitwan				
3	Nahesh Poudel	Gorkha	9846146805	DFO
4	Purneshwar Subedi	Lamjung	9856046630	DFO
5	Ashok Kumar Shreatha	Gorkha	9856040136	DFO
6	Lok Raj Nepal	Chitwan	9855057215	DFO
1	Gobardhan Thapa	Abukhaireni-3, Tanahu,jyabisara	9814119624	
2	Kesh Bahadur Ale	Abukhaaireni-4 Chimkesai, Tanahu		
3	Shyam Thapa	Abukhaaireni-4 Chimkesai, Tanahu	9846968220	
4	Tilak Bahadur Thapa	Abukhaaireni-4 Chimkesai, Tanahu	9840643319	
5	Aaitaram Bhujel	Abukhaaireni-4 Chimkesai, Tanahu	9849955240	
6	Gore Gurung	Bhatratpur Ghamne chauki		
7	Santa Bahadur Gurung	Bhatratpur Ghamne chauki	9807172085	

Annex 4: Photographs
A. Photographs of vegetation taken in Khudi Manang section

Photo plate 1 : *Rumex* sp.

Photo plate 2: *Biden pilosa*

Photo plate 3: *Persicaria chinensis*

Photo plate 4: *Rubus elipticus*

Photo plate 5: *Coelogyne* sp.

Photo plate 6: *Artemissia vulgaris*

Photo plate 7: *Berberis* sp.

Photo plate 8: *Pyrrosia* sp

Photo plate 9: *Trachycarpus* sp.

Photo plate 10: *Plantago major*

Photo plate 11: *Selaginella* sp.

Photo plate 12: *Maesa chisia*

Photo plate 13: Hotspot Area

Photo plate 14: *Gentiana* sp.

Photo plate 16: Marchantia sp.

. *Photo plate 17: Oplismenus* sp.

Photo plate 18: Cythea sp.

Photo plate 19: Plot Design for Herb

B. Photographs of vegetation taken in Khudi Udipur section

Photo plate 20: Kyllinga nemoralis

Photo plate 21: Smilax sp.

Photo plate 22: Pyrrosia sp.

Photo plate 23: Solanum sp.

Photo plate 24: Stephania sp.

Photo plate 25:Euphorbia hirta

Photo plate 26: Pandanus sp.

Photo plate 27: Pteris vitata

Photo plate 28: Clerodendrum sp.

Photo plate 291: Cyperus sp.

Photo plate 30: Hupergia sp.

Photo plate 31: Commelina sp.

Photo plate 32: Ageratina adenophora

Photo plate 33: Persicaria sp.

Photo plate 34: Acmella sp.

Photo plate 35: Imperata cylindrica

Photo plate 36: Hotspot Area near AP4

Photo plate 37: With informants

C. Photographs of vegetation taken in Udipur Markichowk section

Photo plate 38: Tridax procumbens

Photo plate 39: Cromolaena odorata

Photo plate 40: Casia tora

Photo plate 41: Ariesema sp.

Photo plate 42: Urnea lobata

Photo plate 43: Cyperus rotundus

Photo plate 44: Adiantum sp.

Photo plate 45: Achyranthus aspera

Photo plate 46: Tectaria sp.

Photo plate 47: Fragaria sp.

Photo plate 48: Kyllimga brevifolius

Photo plate 49: Lygodium sp.

Photo plate 49: Mumosa pudica

Photo plate 51: Cajanus sp.

Photo plate 52: Barleria sp.

Photo plate 53: Rauvolfia serpentine

Photo plate 54: Hotspot area

Photo plate 55: Ecological plot

D. Photographs of vegetation taken in Markichowk Chitwan section

Photo plate 56: Melostoma sp.

Photo plate 57: Lycopodium Japonicum

Photo plate 58: Cyperus sp.

 *Photo plate 59: Phyllanthus* sp.	 *Photo plate 60: Hypoxis* sp.	 *Photo plate 61: Colebrookia oppositifolia*
 *62: Michania macrantha*	 *Photo plate 63: Spermacoce alata Photo plate*	 *Photo plate 64: Desmodium* sp.
 *Photo plate 65: Barleria cristata*	 *Photo plate 66: Triumfetta* sp.	 *Photo plate 67: Solanum* sp.

Photo plate 68: Stephania japonica

Photo plate 69: Gonostegia sp.

Photo plate 70: Blumea sp.

Photo plate 71: Calotropis gigantean

Photo plate 72: Hot spot Area

Photo plate 73: Ecological plot for Herb

E. Miscellensous photographs

Photo plate 74: Measurement of BA

Photo plate 75: Pinus forest (Upper part)

Photo plate 76: Measurement in upper part

Photo plate 77: Bushy portion in the middle part

Photo plate 78: Small busy region (middle region)

Photo plate 79: Nephrolepsis sp, (Pani amala)

Photo plate 80: Tree fren recorded in the corridor

Photo plate 81: Pandanus sp. in the lower portion

Photo plate 82: Discussion with local people (Impact analysis)

Photo plate 83: Aegle marmelos (Bel) NTFPs recorded during study

Photo plate 84: Measurement of DBH of Schima wallichii (Chilaune)

Photo plate 85: Sal forest in the lower belt

Photo plate 86: Study team recorded floral diversity

Photo plate 87: Riverine sal forest (Tropical belt)

Photo plate 88: Sal forest patches

Photo plate 89: Invasive species (Lantana camera)

Photo plate 90: Spreading of Lantana camera

Photo plate 91: Melastoma sp. recorded in sal-chilaune forest

	
Photo plate 92: Seedling of Mallotus philippensis	Photo plate 93: Pure sal forest observed in lower Belt (Bharatpur section)