Biodiversity Impact Assessment Report for Proposed 400kV D/C Jaunpur Obra Transmission Line passing through Kaimur Wildlife Sanctuary





Submitted by

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"For us, protection of environment is an article of faith. We have natural resources because our previous generations protected these resources. We must do the same for our future generations"

Sh. Narendra Modi
Prime Minister of India

Acknowledgement

With the grace and guidance of the spirit, it is a pleasure to have the opportunity to gratefully thank the peoplewho made this report possible with their invaluable support.

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Team Everain

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Glossary

Abbreviation	Expansion or Full Form
BZ	Buffer Zone
CPUE	Catch Per Unit Effort
CWLW	Chief Wildlife Warden
DIZ	Direct Impact Zone
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FSI	Forest Survey of India
GIS	Geographic Information System
ISFR	India State of Forest Report
IUCN	International Union for Conservation of Nature
LC	Least Concern
LR	Lower Risk
MoEF&CC	Ministry of Environment Forest, and Climate change
NT	Near Threatened
PS	Primary Source
RET	Rare, Endangered, and Threatened
ROW	Right of Way
SMP	Sanctuary Management Plan
SS	Secondary Source
TL	Transmission Line
UPPTCL	Uttar Pradesh Power Transmission Corporation Ltd.
VU	Vulnerable
WLS	Wildlife Sanctuary
WPA	Wildlife Protection Act
WWF	World Wide Fund for nature

1. INTRODUCTION

1.1 Proposed 400kV D/C Jaunpur-Obra Transmission Line

The government of India has identified the power sector as a key sector of focus to promote sustained industrial growth. It has embarked on an ambitious mission - “Power for all” backed by extensive reforms to make the power sector more attractive for private sector investment and participation. In this regard Uttar Pradesh Power Transmission Corporation Ltd. (UPPTCL) identified development of transmission system for “Evacuation of power from Obra-C (2x660 MW) Thermal Power Project & Construction of 400 kV GIS Substation Badaun with associated Transmission Lines” consisting of establishment of transmission lines as below:

1. LILO of 765 kV Anpara ‘D’ Unnao SC line at Obra-C TPS
2. **400 kV Double Circuit Jaunpur - Obra line (upto LILO point of Obra ‘B’ – Obra ‘C’ Line)**
3. 400/220/132 kV Badaun (GIS) substation (Capacity 2x315 + 2x160 MVA)
4. 400 kV DC Roza – Badaun line
5. LILO of 220 kV C.B.Ganj (220kV) – Badaun (220kV) SC line at 400 kV Badaun substation
6. LILO of 220 kV Chandausi (220kV) – Badaun (220kV) SC line at 400 kV Badaun substation.
7. 132kV BadaunUjhani – Badaun (400 kV) SC line and 132 kV Bilsi – Badaun (400 kV) SC line.

The Uttar Pradesh Government (Power Ministry) vide UPPTCH has entrusted PFC consulting with the task of selecting an Independent Private Transmission Company (IPTC) on 100% Private investment for the above scheme vide its letter no. 278/PS/DIR(W&P)/PTCL/Obra‘C’ dated June 01 2018. As per bidding procedure, PFC has invited bids for selection of bidders as prospective IPTC for establishment of transmission line on 28th June 2018 as per guidelines under section 68 of Electricity Act, 2003.

Subsequentlythe process of competitive bidding took place in accordance to the guidelines wherein M/s Adani Transmission Limited was evaluated as successful bidder for implementation of the above project through its subsidiary company Obra C Badaun Transmission Limited as the IPTC on Build, Own and Operate (BOO) basis. Consequently the Letter of Intent (LoI) was issued as letter No. 04-05/ITP-29/18-19/OCBTL/LOI on 29 November 2018. The Principal Secretary, Power Department, Uttar Pradesh, also accorded approval under section 68(1) of Electricity Act 2003, to commission these transmission lines through letter no. 2794/24-1-2018-2422/2008 dated 2 November 2018.

Transmission line projects are environmentally friendly and do not involve any disposal of solid effluents or hazardous substances in land, air or water. The spans between the transmission line towers have been designed 400 meters in length so as to avoid fragmentation of forested areas through which it will pass. The height of the towers have been designed to be 47 meters in height so as to allow free movement of birds. The layout of the towers on the transmission line have been so designed as to cause minimum tree felling. The ground clearance for the

lowermost conductors have been designed to be 8.84 meters. The spacing between the phase conductors has been designed to be 8 meters in length by following industry best guidelines to allow for free movement of birds. The foundations of the towers have been designed to have a space of only 15 meters by 15 meters. And the foundations of the towers have been designed only to go 3.5 meters under the ground.

400kV D/C JaunpurObra Transmission Line will start at from LILO point of Obra-B Obra-C line in Chopan area of DistrictSonbhadra and will terminate at 400/220/132kV substation of UPPTCL in Machlisahar of DistrictJaunpur. The length of the transmission line will be166 kilometersand will pass through 5 districts Uttar Pradesh, namely, Jaunpur, Bhadhoi, Varanasi, Mirzapur and Sonbhadra. Construction, erection and commissioning of the transmission line will create employment opportunities for the predominantly rural population of the area for a period of around24 months. Later on, after commissioning too, the maintenance of the transmission line will create employment opportunities for the locals. Needless to say, the transmission line bringing power to the region will bring in its wake industry and commerce along with improved productivity for the existing industry.

1.2 Salient Features of 400kV D/C Jaunpur-Obra Transmission Line

Particular	**Remarks, if any**
Total Line Length of 400kV D/C JaunpurObra Transmission Line	Total Line Length:165Km
District details and forest division details through which line is passing	**District**: Jaunpur, Bhadhoi, Varanasi, Mirzapur and Sonbhadra. **Forest Division:** Jaunpur, Bhadhoi, Varanasi, Mirzapur, Kaimur Wildlife Division Mirzapur and Obra
Area Passing through Kaimur Wildlife Sanctuary	55.447Ha, 12.054Km
Total No. of Tower to be erected in wildlife area	Proposednumber of towers in WLS -29 Nos.
Height of Tower	Minimum 47 Mtrs
Maximum width of Right of Way for 400KV D/C Transmission Line	46 Meters
Minimum Ground Clearance	8.84mtr.
Minimum Clearance allowed between conductors of transmission lines and Trees	For 400KV, 5.5 Meters
Average distance between two consecutive towers	400m

1.3 Methodology used for determining the routing of the transmission line

Transmission lines are sets of wires, called conductors that carry high voltage electric power from station to station. They run over long distances across a province. Conductors are connected to large metal towers that are placed on public and private properties along a transmission line route.

OCBTL uses a transmission line routing process that's based on an internationally recognized methodology. The processincorporates routing preferences from human, environmental and engineering perspectives uses these perspectives to help minimize overall impact of the project.

5 steps in selecting a transmission line route:

1. **Determine a route planning area:**Determination of start and end points and development of a broad route-planning area based on opportunities and constraints on the landscape.

2. **Plan alternative routes:** Drawingof segments connecting the start and end points within the route-planning area. These segments form alternative route options whichare presented to the stakeholder groups, to a team of specialist's engineers for feedback.
   Collection and incorporation of public and Indigenous feedback throughout the transmission line route selection process:
   During the decision-making process, documentation of site-specific issues and feedback from persons potentially affected by a possible route. Compiled information is passed to specialists to help them enhance their assessments of a preferred route.
   Local feedback and knowledge of the environment help to design the route and plan tower placement.
   Consideration of feedback received for development of mitigative segments, if any by the project team.
   Information collected helps to determine ways to mitigate potential impact on people, wildlife and the environment, if any.

3. **Develop mitigative segments:** A mitigative segment is a part of the route which has been added to the transmission line routing process based on feedback from the public or from project specialists. These segments are added to mitigate concerns or a potential effect on the landscape.
   Evaluation of these segments for technical feasibility and cost is carried out. It is also considered whether the segment results in a "net-minimization of effect", which means evaluating whether or not the segment will shift effect from one landowner to another. If evaluations deem the new segments are reasonable, they are then incorporated in the comparative evaluation of routes to determine a preferred route.

4. **Determine a preferred route:** A comparative evaluation of alternative routes determines the preferred routes that are presented to the public and Indigenous communities and organizations. Specialists focus their evaluations on this area to better understand potential effects of the preferred route on people and the environment.
   After determination of subset of routes, following parameter are compared to select a preferred route:
   - Costs;
   - Community considerations;
   - Reliability;
   - Risk to schedule;
   - Built environment and the natural environment.

5. **Finalize the preferred route and submit an environmental assessment report:** Following our presentation of the preferred route, potential changes based on feedback from the public, Indigenous communities and organizations, and project specialists are considered. After incorporating feedback, final preferred route are determined and present to regulators for review.
   During the regulatory review process, details are provided regarding transmission line routing and the impact statement is available for review and comment.
   Throughout each step of the transmission line route selection process, regularly planning, gathering feedback, analysing information, and evaluating are done. Feedback from stakeholders assists in the development of criteria used to evaluate strengths and weaknesses of route options. Criteria are developed to represent the natural, the human and engineering perspectives, i.e.:
   - Natural environment: acres of natural forest, acres of wetland area, stream and river crossings;
   - Engineering: project cost, existing transmission line crossings, length;
   - Human environment: proximity to residences, land use and capability, historic
   - Resources, public use areas.
   - Timelines for route selection depend on the project. They are closely associated with public and Indigenous engagement and environmental assessment processes. Some projects, based on complexity, may require more or fewer steps to determine a final preferred route.

Who decides the final preferred route?

Project Proponent work with a range of technical specialists and invite public comments through publishing the same in local newspapers and gazette notification. They strive to balance concerns and feedback from the public, project specialists, stakeholder groups, and indigenous communities and organizations. Goal is to achieve consensus amongst a project team (with a range of specialties) on the final preferred route of a transmission project. The route is considered final once approved by the regulator.

1.4 Alternative Routes Examined and Justification of the proposed route

The Project i.e. 400kV D/C Jaunpur Obra transmission line will start at LILO point of Obra-B Obra-C line located at Chopan and will terminate at substation constructed by UPPTCL at Machlisahar in Jaunpur District. The route of the line passes through Kaimur Wildlife Sanctuary located in district Sonbhadra, having forest area involvement as well as non-forest land involvement within Kaimur WLS totaling to 55.447 Ha. The chosen route is the most optimal route in terms of minimum interference with wildlife area as well as the best alignment for efficient construction, erection as well as post commissioning maintenance operations.

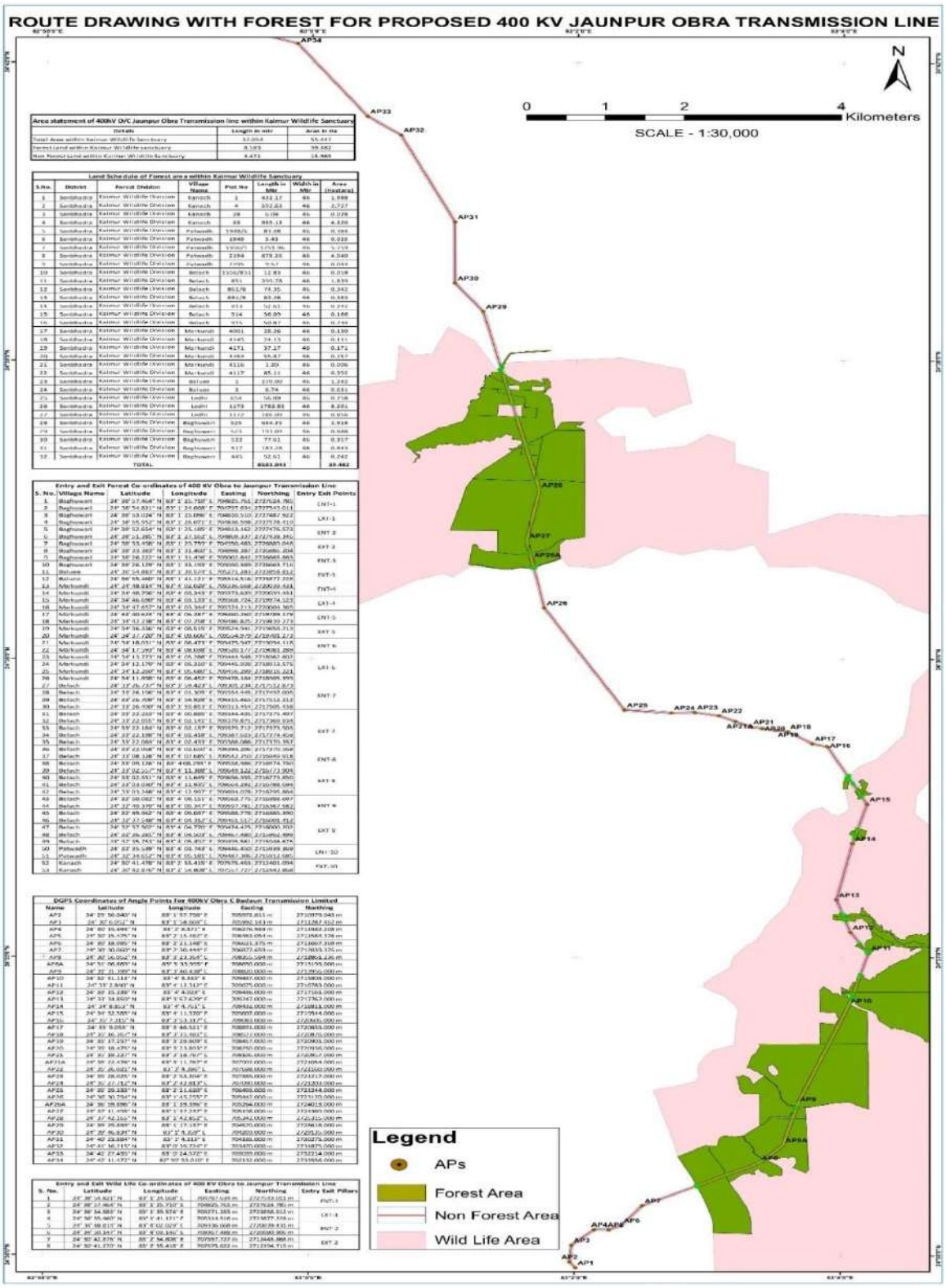
A detail comparison of all the three alternative routes examined is as provided in the below table.

Table 1: Alternative Routes Examined and Justification of the proposed route

S.N	Description	Alt-I (Proposed Route)		Alt-II		Alt-III	
		Length	Area	Length	Area	Length	Area
1.	Total Forest in within Kaimur WLS	8.583Km	39.482Ha	8.329 Km	38.313Ha	9.084 Km	41.786 Ha
2.	Non-Forest area within Kaimur WLS	3.471Km	15.965Ha	5.169 Km	23.777 Ha	3.777 Km	17.374 Ha
3.	Total Area within Kaimur WLS	12.054Km	55.447Ha	13.498 Km	62.091 Ha	12.861Km	59.160 Ha

The above table shows that all three alternatives for routes are positioned on either side of BEE line. After initial inspection through Survey of India maps and satellite images, all three routes were analyzed to find the most optimum route. Special attention was given to avoiding as much wildlife sanctuary area and habitation area as possible. Accessibility to the routes through existing roads and paths was also a factor in choosing a route. Route 1 was determined to have the least interference with wildlife area hence it was chosen for the alignment of the transmission line. Also, the tree density in all three routes were the same, therefore Route 1 was all the more attractive as the most optimum alignment as it moved through the minimal area in wildlife sanctuary among the 3 alternatives.

1.5 Proposed Route Map w.r.t Kaimur Wildlife Sanctuary



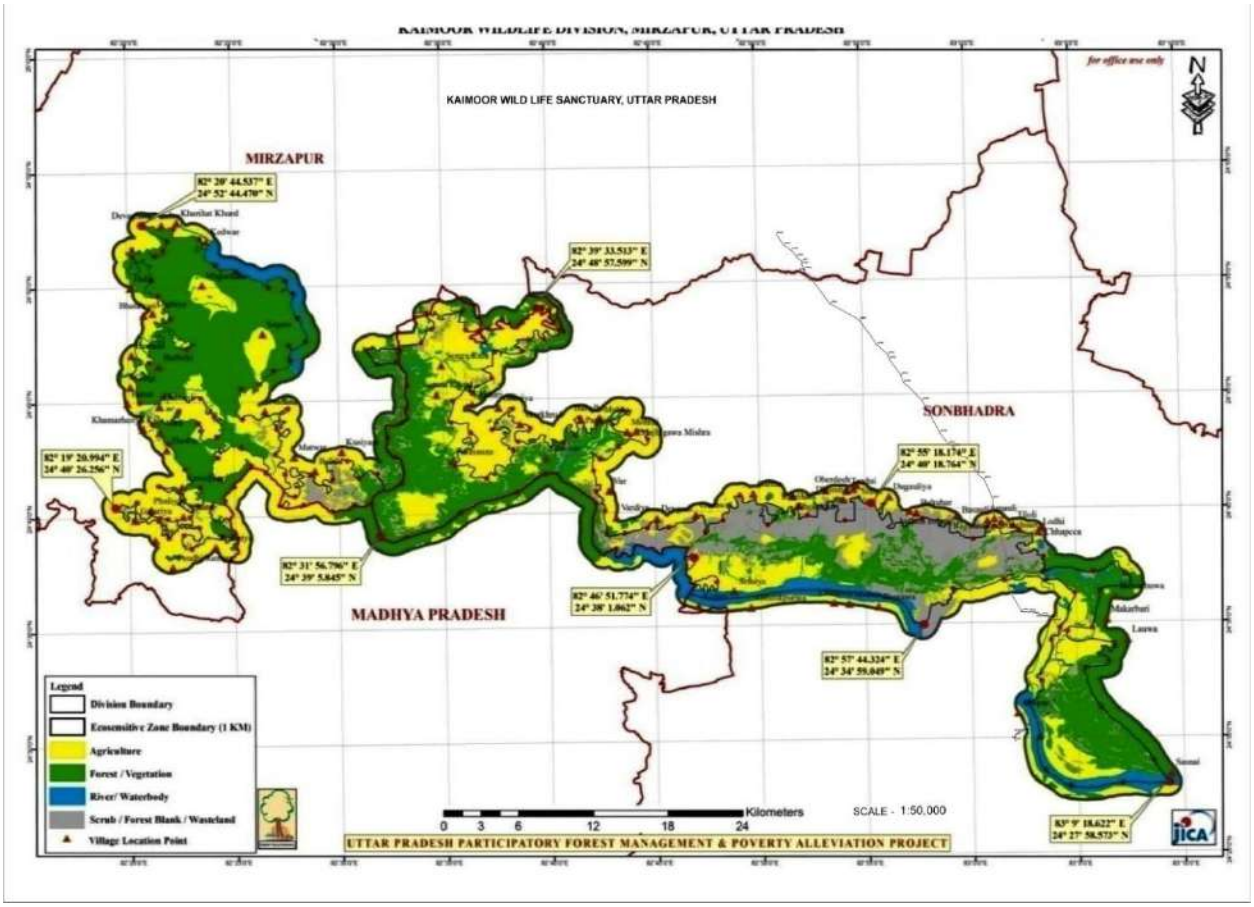


Figure 1: Route Map w.r.t Kaimur Wildlife Sanctuary

1.6 Objectives of the study

The study aims to achieve the following objectives –

i. Collection and review of relevant documents available with OCBTL related to the Obra Transmission Line and Guidelines issued by the MoEF&CC on Eco-friendly measures to mitigate of linear infrastructure on wildlife and/or guidelines CWLW, Uttar Pradesh Forest Department

ii. Mapping of the Land Use and Forest/Vegetation types along the proposed Right of Way (RoW) using suitable GIS techniques.

iii. Assess distribution and diversity of Floral (lower and higher plants) and Fauna (Mammals, Amphibians, Reptiles, Avifauna, Insects) in present season.

iv. Assess existence, status and distribution of Threatened and Near Threatened Floral and Faunal species (Schedule-I Species, IUCN REET Category)

v. Ecological evaluation of the potential impacts on biodiversity due to the construction, operation and post-construction phases of the proposed transmission line

vi. Preparation of Biodiversity Impact Assessment Report

vii. Identify/Recommend suitable measures and strategies for mitigation/management of the anticipated impacts

Figure 2: Landscape in the study area

2. BASELINE INFORMATION

2.1 Flora and Fauna Diversity in Uttar Pradesh

Uttar Pradesh covers an area of 2,40,928 sq. km which is 7.33% of the geographical area of the country. Physio graphically, the state has predominance of vast Gangatic plain having highly fertile alluvial soil and the smaller Vindhya hills and plateau. The state has a humid a humid sub-tropical with dry winter climate. The average annual rainfall varies from about 1000 mm to about 1200 mm and the average annual temperature ranges between 5^{o}C to 45^{o}C. The state is drained by a number of rivers, which include Betwa, Chambal, Gandak, Ganga, Gomti, Ghaghra and Yamuna **(FSI, 2017)**. All above characteristics make the state a unique land feature to flourish biodiversity.

Floral Diversity: As per the literature survey and studies conducted, the recorded floral diversity of Uttar Pradesh include 1017 genera and 2932 species of plants (lower and higher) with 67 genera and 301 species of algae; 46 genera and 135 species of lichens; 135 genera and 935 species of fungi; 31 genera and 72 species of bryophytes; 20 genera and 41 species of Pteridophytes; 4 genera and 6 species of gymnosperms; 714 genera and 1442 species of angiosperms **(UP State Biodiversity Board)**.

The faunal inventory of Uttar Pradesh deals with 41 species of 11 genera under 6 families comprising 2 orders of free living protozoa, 140 species of 43 genera under 15 families comprising 1 order of phytophagous nematodes, 1445 species of 735 genera under 93 families comprising 11 orders of insect, 15 species of 5 genera under 1 family comprising 1 order of ixodid ticks (Acari: Ixodidae), 47 species of 27 genera under 15 families comprising 5 orders of fresh water Mollusca and 699 species of 420 genera under 151 families comprising 45 orders of vertebrates **(UP State Biodiversity Board)**.

2.2 Flora and Fauna Diversity in Sonbhadra District

The portion of the district north of the Son River lies in the Lower Gangetic plains moist deciduous forests ecoregion. The portion south of the Son lies in the Chhota Nagpur dry deciduous forests ecoregion. The northern part of the district lies on a plateau of the Vindhya Range, and is drained by tributaries of the Ganges including the Belan and Karmanasha rivers. South of the steep escarpment of the Kaimur Range is the valley of the Son River, which flows through the district from west to east. The southern portion of the district is hilly, interspersed with fertile stream valleys. Kaimoor Wildlife Sanctuary lies mostly within the district, reaching generally east and west along the spine of the Kaimur Range, and extending to the Son River at its eastern end.

The whole of the area is covered with natural scrubby jungle and somewhere thick forests. Almost the entire plateau exhibits a uniform horizontal stratification of rocks. The top of the

plateau is unsuitable for the growth of broad-leaved plants and, is represented by uniform scrubby dry vegetation. The broad-leaved plants are generally seen on the slopes of the plateau. Overall, the entire forest is mixed dry deciduous, but evergreen trees are frequently seen in ravines. According to a revised classification of forest type in India by **Champion & Seth (1968)**, the forest type of Sonbhadra District is tropical dry deciduous. The whole area of the district has an interesting diversity of flora and vegetation due to variable plains, slopes, hills, and climate, represented by dry deciduous vegetation, natural scrub jungle, patches of grasses, and thick forest. The whole area of the district is covered with rich plant diversity with trees at the top layer, shrubs at the middle layer, and herbs, climbers, and twiners at the ground level. **Kushwaha *et al.*, (2018)** repoerted 705 species of Angiosperms under 459 genera and 110 families including 78 cultivated ones that have been planted in the area for different purposes.

2.3 Flora and Fauna Diversity in Kaimur Wildlife Sanctuary

Kaimur wildlife sanctuary (KWS) is situated in Kaimur hills of Mirzapur and Sonbhadra district of Uttar Pradesh (Fig. 1). It covers an area of 500.73 km^2 in the semi-arid zone of northern India (Rodgers et al. 2000) with geographical extent of 82°20' 15" E to 24°52' 00" N and 83°08 '23" E to 24°27' 51" N. For administrative purpose, sanctuary is divided into four ranges namely Halia, Ghorawal, Robertsganj and Gurma. Geologically, mostly part of the sanctuary is hilly and undulating terrains. Soil found in this area is red clay which is stiff and ferruginous in nature. This Sanctuary faces three seasons namely summer (March–June), Monsoon (June–September) and winter (November–February). The maximum/minimum temperature is 46.8 and 4°C respectively. According to Champions & Seth (1968) sanctuary comes under dry deciduous type forest. There are four major types of forest forms in this sanctuary namely Sal forest, Bamboo, Scrub and Dry Deciduous forest. Sal forest comes under dry peninsular and enriched by *Shorearobusta*. The Bamboo forest consists of dry Bamboo brakes. The Scrub forest is accompanied by open dry scrubby vegetation. While, dry deciduous forest consists of dry deciduous mixed woody species.

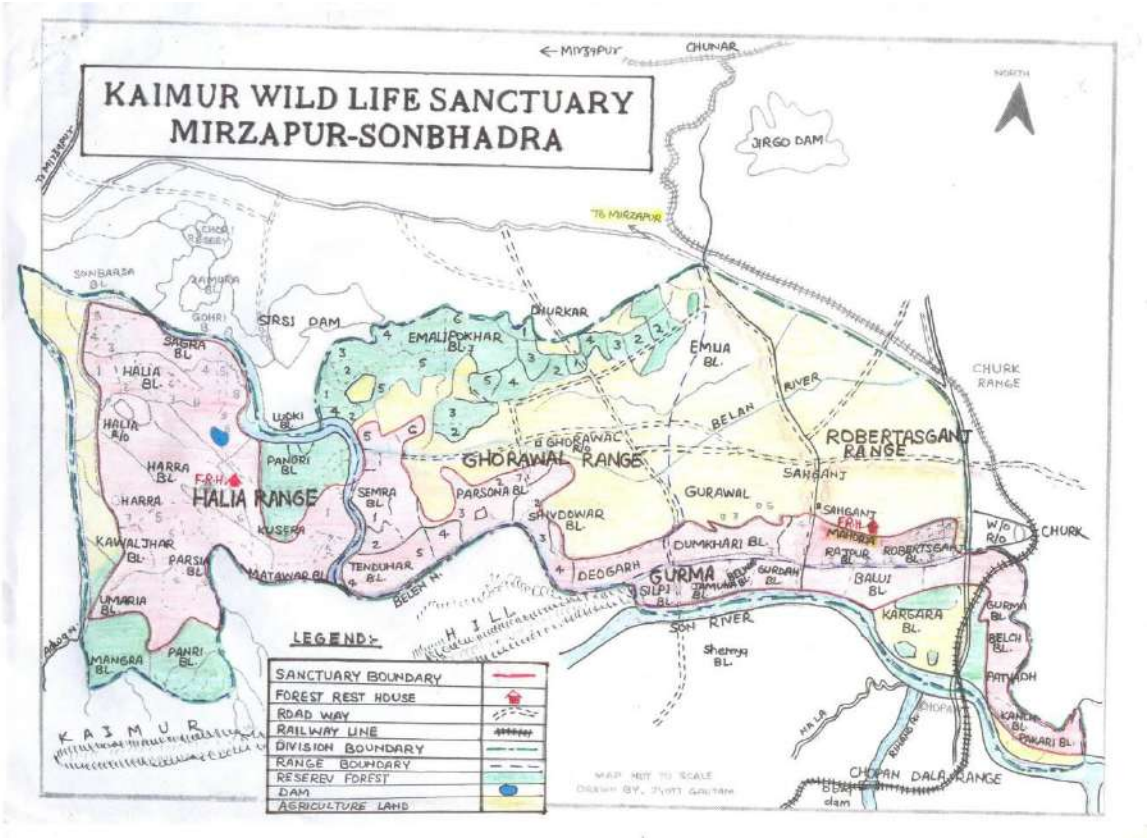


Figure 3: Kaimur Wildlife Sanctuary Map

2.4 Forest Ecosystem in the study area

Forests are the prominent areas that support a huge variety of living beings. Uttar Pradesh is not a rich state in terms of forest cover. Based on interpretation of satellite data pertaining to Oct-Dec 2015, the forest cover in the state is 14,679 sq km which is 6.09% of the State's geographical area. In terms of forest canopy density classes, the state has 2, 617 sq km area under very dense forest, 4069 sq km under moderately dense forest and 7993 sq km under open forest **(ISFR, 2017)**. Present project falls in the Sonbhadra District of Uttar pradesh having highest percentage of forest cover. The District have a total of 36.77 % forest cover including 130 sq km very dense forests, 967 sq km moderately dense forests and 1,442 sq km open forests. 28 sq km scrub forests is also present in the district with a forest cover change of -17 Sq km **(ISFR, 2017)**.

The forests present within the sanctuary area are dominated with Northern Dry Deciduous and Deciduous Scrub types. The main forest types found in the study area are Deciduous Scrub, Northern Dry Deciduous Forest, Boswellia forest, Dry Bamboo Breaks, Dry Peninsular Sal Forest, Tropical riverine forest and Dry mixed Deciduous forest in consociation of *Chloroxylon Sp*. **(Management Plan Kaimur WLS).**

Present Transmission Line Route (46m wide transect beneath proposed transmission line) is situated within three types of forests; Northern Dry Deciduous forest, Deciduous Scrub forest and Tropical Riverine forest.

Northern Dry Deciduous Forests: They represent a transitional type; on the wetter side, they give way to moist deciduous and on the drier side they degenerate into thorn forests. Such forests are characterized by closed and rather uneven canopy, composed of a mixture of a few species of deciduous trees, rising up to a height of 20 metres or so. Enough light reaches the ground to permit the growth of grass and climbers. Bamboos also grow but they are not luxuriant. The tropical dry deciduous forests are widely distributed over a large area. They occur in an irregular wide strip running north-south from the foot of the Himalayas to Kanniyakumari except in Rajasthan, Western Ghats and West Bengal. The important species are Teak, Axlewood, Tendu, Bijasal, Amaltas, Palas, Haldu, Bel, common Bamboo, Harra, Achar, Sal, Khair etc. Large tracts of this forest have been cleared for agricultural purposes and these forests have suffered from severe biotic factors such as over cutting, over grazing and fire, etc. More than any other factor, the lack of precipitation during a prolonged portion of the year is what produces true dry forest, an ecosystem type characterized by plants and animals with specific adaptations to survive the long dry season. Deciduousness is the single most important adaptation among plants to the extended droughts. Most of the trees drop their leaves after the rains end, and essentially halt photosynthesis, as they would otherwise be unable to survive the water loss during the dry season. Tropical Dry Deciduous forests are subject to intensive anthropogenic disturbances. This forest type found between AP 7/2 and AP 10 and south facing slopes near AP26A.

Deciduous Scrub Forests: These types of forests are found on plateau surface, valleys, and ravines, and on rugged surfaces. Surface of these forests are dry, stony and rugged. In these forests mainly shrubs are found with scattered small-sized trees. Vegetation like *Acacia*, *Ziziphus*, *Adhotoda*, *Calotropis*, *Lantana* and *Cassia* species are very common in these forests. This forest type was widely distributed all along the present project Route; between AP26A and AP29, AP7/2 and AP10. It was also present in the fringes of habitation and agricultural areas between AP10 and AP15, and AP27 and AP30.

Tropical Riverine Forests: Narrow along the hilly section of the longer streams in the dry deciduous forest widening as valleys get boarder and extend to the moist deciduous type. The foliage of the dominants is more or less evergreen in general. Moisture contents in soil of this type of forest remains high. This type of forest present with a very thin line on both banks of river Ghaghar.

Cropland Ecosystems: Agricultural practices are present within the project Route. All seasonal crops are being cultivated on agriculture land. Paddy, Wheat, Sesame, Arhar, Maize, Jwar etc. are the main crops along with seasonal vegetables. Horticulral practices are also present with the cultivation of fruits like Mango, Guava, Citrus etc. Cropland ecosystems are pominantly

present near AP8, between AP10 and AP15, near AP26, and near AP29. There are intensive agricultural practices available where project Route falling in eco sensitive zone of Kaimur Wildlife Sanctury (AP3 to AP7, Near AP26, around AP29 and AP30).

2.5 Landuse pattern in the study area

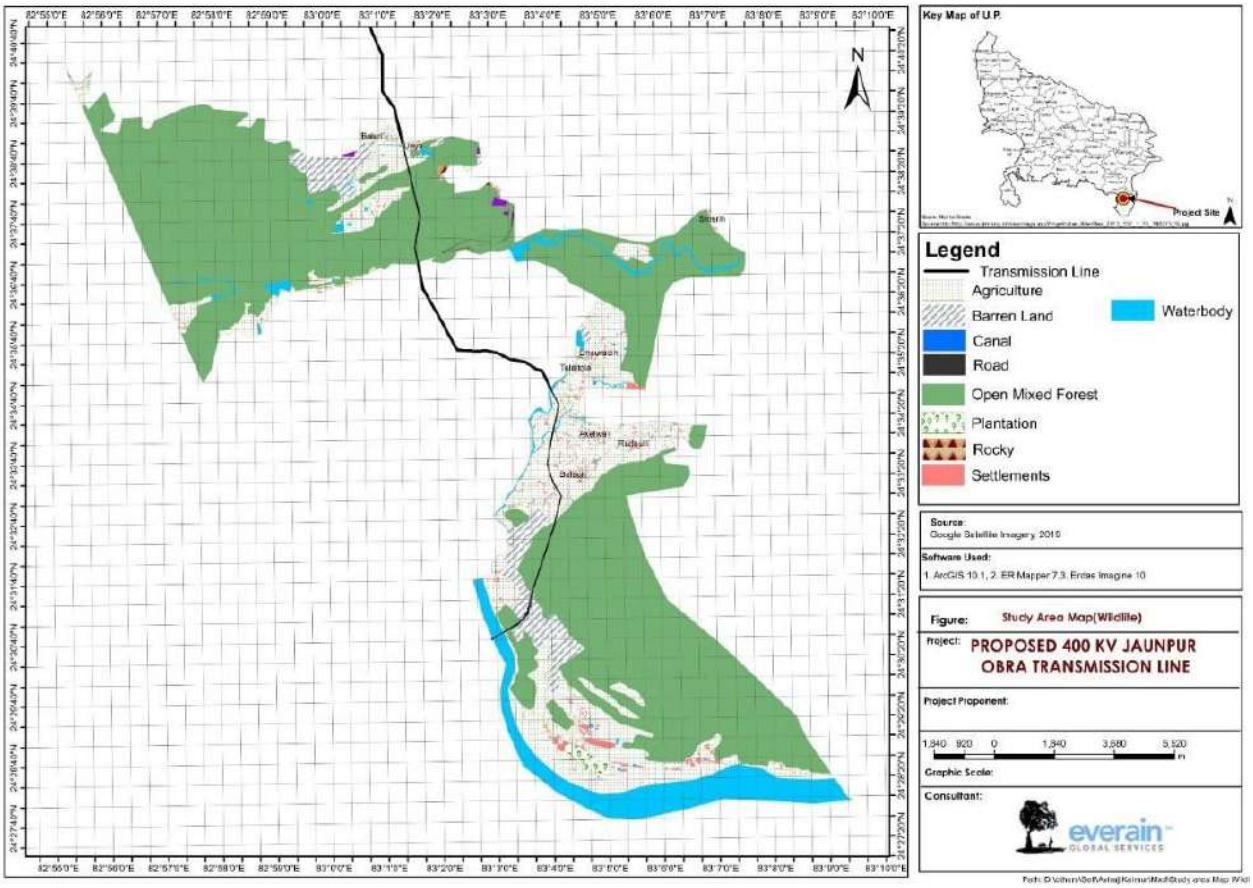


Figure 4: Landuse pattern in the study area

2.6 Existing transmission lines in the study area

Figure 5: Existing Transmission Lines in the study area

3 SAMPLING LOCATIONS AND METHODOLOGY

3.1 Biodiversity Field Study

3.1.1 Sampling Design

The entire study area was divided into 5 Km x 5 Km grids coveringtwozones from the centre point of ROW viz. Direct Impact Zone (46m) and Buffer Zone (Kaimur WLS excluding Direct Impact Zone).

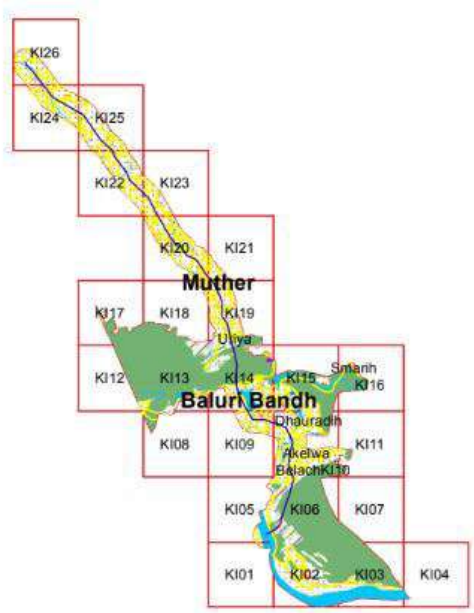


Figure 6: Sampling Design (Each square labelled with prefix K denotes a grid of 5 km x5 km in which a sample should be taken)

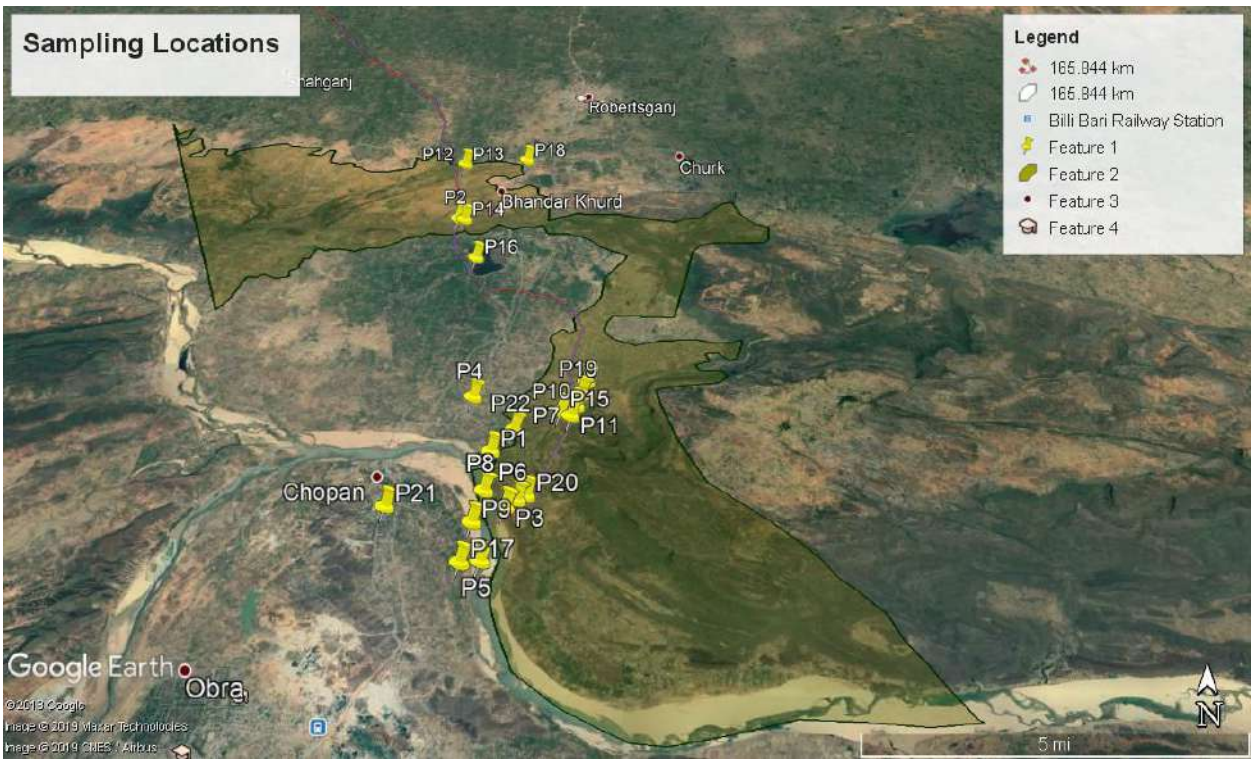
3.1.2 Sampling Locations

Table 2: Sampling Locations

Point	Location Remarks	GPS Coordinates	Point	Location Remarks	GPS Coordinates
P1	Ghagar Right Bank – Narayandi	24°31'42.6"N 83°02'47.4"E	P12	Right Bank	24°30'26.6"N 83°02'49.0"E
P2	B/w AP 26/0 & AP 26A/0	24°36'58.2"N 83°01'40.3"E	P13	View point of AP 28/0 to 29/0	24°38'32.4"N 83°01'38.2"E

P3	Left Bank	24°30'43.9"N 83°03'05.6"E	P14	Utarvashi Primary School	24°36'57.5"N 83°01'47.3"E
P4	Bamboo Makers	24°32'44.6"N 83°02'24.7"E	P15	Cottages Near AP 10	24°32'26.8"N 83°03'49.0"E
P5	Fisherman's Boat on Shore	24°29'53.0"N 83°02'49.1"E	P16	Adjacent AP 25/2 on Baluee Dam	24°35'55.9"N 83°02'07.2"E
P6	Near AP 7/2	24°30'51.2"N 83°03'15.0"E	P17	Fishermen's Village Pani Intake Basti	24°29'51.5"N 83°02'32.4"E
P7	Near AP 10	24°32'33.0"N 83°04'03.1"E	P18	Khushboo Bagh Nursery	24°38'40.2"N 83°02'51.7"E
P8	Seasonal Stream Near AP 8	24°30'54.0"N 83°03'21.6"E	P19	Near AP 10-1	24°32'47.4"N 83°04'07.9"E
P9	Near AP 7/1	24°30'29.8"N 83°02'38.0"E	P20	Near AP 8:	24°30'55.6"N 83°03'22.9"E
P10	Near AP 11	24°33'02.5"N 83°04'12.1"E	P21	Fish Market (Secondary Information)	24°30'44.6"N 83°01'21.3"E
P11	Near AP 9/4	24°32'21.3"N 83°03'58.8"E	P22	Bridge on Ghagar	24°32'06.4"N 83°03'06.9"E

3.1.3 Sampling locations plotted on google earth



3.1.4 Flora Survey

Plant community structure has been estimated through systematic vegetation survey carried out in project zone. A fixed transect of 500m wide underneath proposed transmission line was used for vegetation survey. The size of sampling unit (quadrat) was determined using the species-area-curve method. Quadrats of 10m x 10m were laid out to examine the tree layer in the direct impact zone (46m) as well as buffer zone (from 23m to 250m both side). Within these sample plots, two 3m x 2m plots were laid out randomly for sampling the shrub layer. To collect information on ground layer and other herbaceous species, five quadrats of 1m x 1m size were laid out within the quadrats used for trees. Species-wise counting of all individuals has been carried out in each quadrat along with their CBH (Circumference at Breast Height) or DRC (Diameter at Root Collar) whatever applicable.

Data analysis: The structural aspect of vegetation such as frequency, density, abundance and dominance (basal area) were determined following **Mishra (1968)**. Importance Value Index (IVI) was computed for all the species by adding the relative values of frequency, density and dominance following **Curtis & McIntosh (1950)**. Species distribution was calculated by Abundance to Frequency ratio following **Curtis and Cottom (1956)**. Species diversity was computed using Shannon-Weaver Index (**Shannon and Wiener 1949**). $H' = \Sigma (ni/N) \times \ln (ni/N)$ Where, H' = Shannon's index of species diversity ni = Total number of individuals of one species N = Total number of individuals of all the species in one stand.

Figure 7: Biodiversity Impact Survey with the local forest officials

Figure 8: Sampling of herbs and shrubs at the locations marked for erection of TL

Figure 9:Flora Study (above) and Collecting Secondary References from Nursery (Below)

Figure 10: Recording DBH for flora study

3.1.5 Fauna and Avi-fauna Survey

A wide variety of fauna inhabits the forested areas in Kaimur WLS due to its high forest cover and diversity. During the Biodiversity survey, a transact walk has been organized to explore the presence of mammals. Fecal dropping, footprints, claw marks, voice and trophies along with direct sighting were recorded during transect walks. Faunal distribution and their occurrence were also confirmed by looking at specific plots of 20x20m, every 400m along the transect running parallel to the Transmission line. Within each plot, observations on visual observation of wildlife signs (rooting, feeding, resting, fecal droppings, footprints, or wildlife sounds) were recorded. Also, during public consultation meetings, additional information on wildlife presence was also discussed.

Figure 11: Transect Walk for Fauna Study

Figure 12: Capturing avi-fauna sightings during the transact walks.

3.1.6 Aquatic Survey

Figure 13: Preparation of materials for aquatic samplings

Figure 14: Identification of fish species in a catch in Son River

Figure 15: Recording of Physical parameters in Son River before aquatic sampling

Figure 16: Fisherman showing fish species found in a catch

3.1.7 Herpeto-fauna and Insects

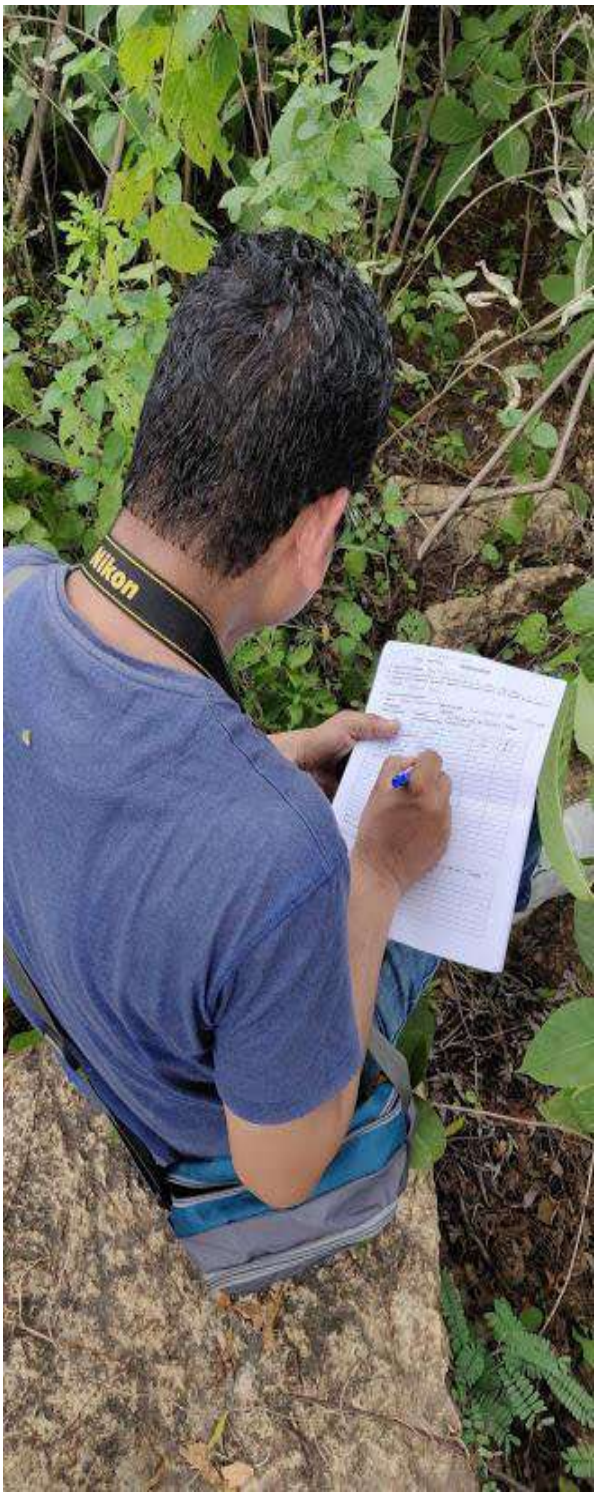


Figure 17: Recording of Herpetofauna during sampling

3.1.8 Data collection and sensitization of local people

Figure 18: Interaction with local villagers for gathering information on flora and fauna

Figure 19: Interaction with people involved in forest-based activities


Figure 20: Interaction with local herders

3.2 Team Profile

Sh. Ambarish Chandra Chaubey, IFS, Retd. PCCF(HoFF) Rajasthan

Mr. Chaubey has been an IFS batch (1977) and retired from office as Principle Chief Conservative of Forest (PCCF). He has completed Forestry Planning and Management from Oxford University. He is experienced in drafting plans for forest diversion extraction, numerous land diversion projects, conformities relevant to forest clearing, expert in providing consultancy and training in total pollution prevention and control solutions. He has skilled in designing and implementing Environmental Management, devising significant solutions for maintaining sound Environmental and, showed competency in safety condition. He has proudly enjoyed the distinction of undertaking the most prestigious initiatives, such as Rajasthan Forestry funded by JICA and Biodiversity Projects Phase I/II, Luni Watershed Development Project, Preparation of management plans for Tripura Forest Development. He has Undertaken Technical examination project proposals for funding by ITTO, and Joint Forest Management.

He had headed the BIA projects such asBiodiversity Impact Assessment of proposed Tiuni-Plasu HEP in Chakrata, Uttarakhand and Biodiversity Impact Assessment of proposed Song Dam Drinking Water Project, Dehradun District, Uttarakhand. He had been a part of the NCCF Sustainable Development Team for the qualification of sustainable management forest standards and metrics.

Dr. Sunil Bhatt

Dr. Bhatt, an Ecology and Biodiversity expert, and a qualified Functional Area Expert(Ecology & Biodiversity)Cat ‘A’ by QCI-NABET. He has been working in the field ofBaseline studies with respect to ecology and biodiversity since 8 years.He has an expert in quantitative and quantitative analysis of baseline data usingEnvironmental Impact Assessment with respect to biodiversity, NaturalResource Management; Biodiversity Management; Conservation Plans,Assessment of project specific impacts on biodiversity, EIA and EMP(Biodiversity) reports

writing with appropriate standard.He has also worked in response of Himalayan Forests under different levels ofAnthropogenic Pressure.

He has been awarded Ph. D. in Forestry, from HNB Garhwal University,Uttarakhand. He has been awarded S K Seth Prize for best publication-2014(The Indian Forester Society).

Dr. AsheeshShivam

Dr. Asheesh, a zoologist, currently working as an HOD (Deptt. of zoology) inNehru Gram Bharti University since 2014.He has an expert in Environment Impact Assessment and performed EIAworks for various Hydroelectric Projects in the river of North-East Himalaya. Hehas also worked as an expert for Benthic invertebrate community AquaticBiodiversity Group for the Environment Flow assessment for the riverRamganga operated by WWF(India), and for Benthic invertebrate and fishfauna in the Aquatic Biodiversity Group for the Living Ganga Program- WWF,India.

He has skilled in handling of microscope, biological laboratory methods,microphotography, fresh water and marine field work.

He has been awarded Ph. D. in Aquatic Ecology, from University of Allahabad,Uttar Pradesh

Mr. Abhishek Rajdeep

Mr. Rajdeep, a forestry & conservation specialist, has been employed in the forestry and its related industries from the past six years. He has also undertaken a number of projects relating to habitat evaluation, sustainability, and climate change. He has gained practical experience in handling multiple projects at different geographical locations simultaneously (particularly in northeastern countries), following strict deadlines, and collaborated on various national and international programs with the State Forest Departments and international agencies such as Ecological assessment of KasuBrahmanada Reddy National Park, Green India Mission, CAMPA, Project Elephant, He has post Graduate in Environment Management from Forest Research Institute, Dehradun, and has been pursuing a PGD- Environment Law and Policy from National Law University, Delhi. He is also the accredited Certified Lead Auditors under URS Certification Limited, ISO 9001:2008 QMS Practice. In cooperation with the Indian Space Research Organization (ISRO), he receives also a certificate for & Remote Sensing, Geographical Information and Global Positioning System &; from the Indian Institute for Remote Sensing (IIRS). He has skilled at Arc GIS, GPS, MAXQDA.

Mr. Ranir Pal Saini

Mr. Saini is a project management consultant with Everain Global Services. He has interests in social science research methodologies, project management and program management. His academic training has been in civil engineering and international affairs and he has had professional experience in sustainability standards, monitoring & evaluation, biodiversity & ecosystem services and forest resources inventory design. He is also the founding director of RProSys Private Limited that specializes in project management consulting and research

&analysis services. At Everain Global Services he is involved in project design, planning and execution, as well as providing operations and management advisory.

Ms. Ankita Krishna

Ms. Krishna is a zoology graduate from Magadh Mahila College, PatnaUniversity, and is currently persuing M.Sc. in Environmental Science fromNalanda Open University.She is skilled in handling of microscope, preparing permanent and temporaryslide, zoological laboratory methods, microphotography, preparation ofherbarium, and biological classification. She has attended seminar inBiodiversity of India, ecological importance of flora and fauna.She has workedon “Affect of Dental Fluorosis” in the year of 2017, and also has an experiencein copy writing, and editing.

4 RESULTS OF BIODIVERSITY IMPACT ASSESSMENT

4.1 Results of vegetative surveys

4.1.1 Plant Community

As per the primary study, the plant community in the study area is generally comprised with a total of 88 species. Out of 88 plant species, 23 were trees, 22 were shrubs and 43 were herbs/climbers/grasses.The list of recorded species is given in below **tables.**

Table 3: Tree species recorded in primary study:

Name	**Scientific Name**	**Family**
Acacia	*Acacia auriculiformis*	Mimosaceae
Babul	*Acacia Arabica*	Mimosaceae
-	*Careyaarborea*	Lecythidaceae
Bel	*Aegle marmelos*	Rutaceae
Siris	*Albizialebbeck*	Mimosaceae
-	*oroxylumindicum*	Bignoniaceae
Dhau	*Anogeissuslatifolia*	Combretaceae
Neem	*Azadirachtaindica*	Meliaceae
Dhak	*Butea monosperma*	Fabaceae
Amaltas	*Cassia fistula*	Caesalpiniaceae
Shisham	*Dalbergia sissoo*	Fabaceae
Tendu	*Diospyros melanoxylon*	Ebenaceae
Amla	*Emblica officinalis*	Euphorbiaceae
Chilbil	*Holopteleaintegrifolia*	Ulmaceae
Simal	*Lagerstromiaparviflora*	Lythraceae
Jhingan	*Lanneacoromandelica*	Anacardiaceae
Mahua	*Madhucalongifolia*	Sapotaceae
Sahjan	*Moringa oleifera*	Moringaceae
Kanji	*Pongamiapinnata*	Fabaceae
Bahera	*Terminalia bellirica*	Combretaceae
-	*Terminalia sp*	Combretaceae
Ber	*Zizyphusmauritiana*	Rhamnaceae
Imli	*Tamarindusindica*	Fabaceae

Table 4: Shrub species recorded in primary study

Name	Scientific Name	Family
-	*Abutilon indicum*	Malyaceae
Rambans	*Agave Americana*	Rambans
Madar	*Calotropis procera*	Asclepiadaceae
-	*Sidaacuta*	Malvaceae
Basanta	*Indigoferasp*	Fabaceae
-	*Xanthium indicum*	Asteraceae
Nagphani	*Opuntia dilleniid*	Cactaceae
Bhant	*Clerodendruminfortunatum*	Lamiaceae
-	*Grewiahirsute*	Tiliaceae
Behaya	*Ipomeacarnea*	Convolvulaceae
Lantana	*Lantana camara*	Verbenaceae
Kantkarica	*Solanum indicum*	Solanaceae
Semari	*Vitex negundo*	Lamiaceae
PhoolDhawai	*Woodfordiafruticosa*	Lythraceae
Jharber	*Ziziphusnummularia*	Rhamnaceae
-	*Prosopis juliflora*	Fabaceae
-	*Senna alata*	Fabaceae
-	*Sesbaniasesban*	Fabaceae
-	*Triumfettapentandra*	Tiliaceae
Bans	*Bambusa bamboos*	Poaceae
Bans	*Dendrocalamusstrictus*	Poaceae
Bagnakhi	*Martyniaannua*	Martyniaceae

Table 5: Herb species recorded in primary study

Name	Scientific Name	Family
Ghumchi	*Abrusprecatorius*	Fabaceae
-	*Acanthospermumhispidum*	Asteraceae
-	*Acmella calva*	Asteraceae
-	*Aervalanata*	Amaranthaceae
-	*Ageratum conyzoides*	Asteraceae
-	*Alternanthera sessilis*	Amaranthaceae
-	*Amaranthus viridis*	Amaranthaceae
-	*Andrographis paniculata*	Acanthaceae
-	*Anisomelesindica*	Lamiaceae

-	*Argemone maxicana*	Papaveraceae
-	*Artemisia vulgaris*	Asteraceae
-	*Bidenspilosa*	Asteraceae
-	*Chenopodium murale*	Chenopodiaceae
-	*Chrysopogonfulvus*	Poaceae
Kaduri	*Cocciniagrandis*	Cucurbitaceae
-	*Commelinabenghalensis*	Commelinaceae
-	*Commelinadiffusa*	Commelinaceae
-	*Convolvulus pluricaulis*	Convolvulaceae
-	*Conyzaleucantha*	Asteraceae
-	*Crotalaria prostrata*	Fabaceae
Akasbel	*Cuscutareflexa*	Cuscutaceae
Doob	*Cynodondactylon*	Poaceae
-	*Cyperus compactus*	Cyperaceae
-	*Cyperusrotundus*	Cyperaceae
-	*Dimeriaornithopoda*	Poaceae
-	*Echinopsechinatus*	Asteraceae
Anantmool	*Hemidesmus indicus*	Apocynaceae
-	*Leucas aspera*	Lamiaceae
Ban Tulsi	*Ocimum sanctum*	Lamiaceae
-	*Phyllanthus niruri*	Euphorbiaceae
GajarGhas	*Parthenium hysterophorus*	Asteraceae
-	*Saccharum spontaneum*	Poaceae
-	*Sidarhombifolia*	Malvaceae
Chakonda	*Cassia tora*	Caesalpiniaceae
-	*Solanum surattense*	Solanaceae
-	*Sonchus asper*	Asteraceae
Sarphoka	*Tephrosiapurpurea*	Fabaceae
-	*Tridaxprocumbens*	Asteraceae
-	*Vernonia cinerea*	Asteraceae
-	*Arundo donax*	Poaceae
Dudhi	*Euphorbia hirta*	Euphorbiaceae
Fern	*Adiantum caudatum*	Pteridaceae
Sanjiwani	*Selaginellabryopteris*	Selaginaceae

4.1.2 Phyto-sociological characters of plant community

(a) Forest Route between AP8 and AP9: 13 trees, 12 shrubs and 22 herbs species has been recorded from the direct impact zone (46m strip) of forest. The stand density values for tree, shrub and herb species were recorded as 71 individuals/ha, 1935 individuals/ha and 32866.67 individuals/ha for tree, shrub and herb species respectively. *Diospyros melanoxylon*in tree layer, *Lantana camara* in shrub layer and *Cassia tora*in herb layer were found the dominant floral species. **(Table 6)**

Table 6: Phyto-sociological characters of plant community between AP8 and AP9 in DIZ

Name of Species	Density/ha.	Frequency%	Abundance	A/F	IVI
Tree					
Azadirachtaindica	3.00	3.00	1.00	0.33	13.41
Lanneacoromandelica	10.00	7.00	1.43	0.20	42.95
Butea monosperma	12.00	8.00	1.50	0.19	47.00
Pongamiapinnata	1.00	1.00	1.00	1.00	3.63
Acacia Arabica	5.00	3.00	1.67	0.56	15.62
Careyaarborea	2.00	2.00	1.00	0.50	7.26
Dlabergia sissoo	1.00	1.00	1.00	1.00	3.44
Albizialebbek	2.00	2.00	1.00	0.50	7.32
Terminalia sp	7.00	4.00	1.75	0.44	22.72
Diospyros melanoxylon	21.00	20.00	1.05	0.05	111.39
Holopteliaintergrifolia	4.00	4.00	1.00	0.25	15.17
Ziziphusmauritiana	1.00	1.00	1.00	1.00	3.26
Lagerstroemia parviflora	2.00	2.00	1.00	0.50	6.82
Total	**71.00**	**58.00**			**300.00**
Shrub					
Abutilon indicum	130.00	22.50	1.44	0.06	18.31
Calotropis procera	110.00	27.50	1.00	0.04	16.57
Sidaacuta	160.00	37.50	1.07	0.03	24.72
Xanthium indicum	375.00	25.00	3.75	0.15	32.08
Clerodendruminfortunatum	155.00	37.50	1.03	0.03	24.76
Grewiahirsuta	80.00	23.75	0.84	0.04	16.08
Lantana camara	245.00	27.50	2.23	0.08	51.22
Vitex negundo	165.00	18.75	2.20	0.12	31.22
Woodfordiafruticosa	175.00	10.00	4.38	0.44	25.96
Ziziphusnummularia	75.00	10.00	1.88	0.19	10.39
Prosopis juliflora	115.00	50.00	0.58	0.01	31.94
Martyniaannua	150.00	13.75	2.73	0.20	16.74
Total	**1935.00**	**303.75**			**300.00**

Herb					
Euphorbia hirta	1500.00	10.67	1.41	0.13	12.00
Adiantum caudatum	1833.33	5.00	3.67	0.34	9.45
Tephrosiapurpurea	4433.33	14.00	3.17	0.30	52.54
Tridaxprocumbens	833.33	3.33	2.50	0.23	4.93
Vernonia cinerea	1300.00	6.67	1.95	0.18	11.87
Parthenium hysterophorus	733.33	5.00	1.47	0.14	7.26
Saccharum spontaneum	700.00	4.00	1.75	0.16	13.13
Sidarhombifolia	1500.00	8.00	1.88	0.18	15.11
Cassia tora	6300.00	15.33	4.11	0.39	57.20
Hemidesmus indicus	233.33	2.00	1.17	0.11	1.97
Leucas aspera	2566.67	10.33	2.48	0.23	20.11
Ocimum sanctum	1166.67	10.00	1.17	0.11	12.24
Phyllanthus niruri	1500.00	12.00	1.25	0.12	12.33
Crotalaria prostrate	733.33	5.33	1.38	0.13	5.85
Cuscutareflexa	433.33	3.33	1.30	0.12	3.42
Cynodondactylon	1166.67	7.33	1.59	0.15	8.42
Cocciniagrandis	300.00	2.67	1.13	0.11	2.78
Commelinabenghalensis	866.67	7.33	1.18	0.11	8.36
Bidenspilosa	1800.00	10.33	1.74	0.16	16.98
Abrusprecatorius	633.33	4.67	1.36	0.13	5.57
Alternanthera sessilis	1100.00	6.33	1.74	0.16	8.72
Anisomelesindica	1233.33	6.67	1.85	0.17	9.77
Total	**32866.67**	**160.33**			**300.00**

Buffer zone of this transmission line Route was comprised with 19 trees, 18 shrubs and 32 herbs species. *Diospyros melanoxylon* was the dominant species co-dominated with *Butea monosperma* in tree layer, *Lantana camara* was dominated in shrub layer with the co-domination of *Xanthium indicum* whereas *Tephrosiapurpurea* and *cassia tora* were dominant and co-dominant herb species respectively. Stand density values were recorded as 99 individuals/ha, 2320 individuals/ha and 42766.67 individuals/ha for tree, shrub and herb layers respectively. **(Table 7)**

Table 7:Phyto-sociological characters of plant community between AP8 to AP9 in BZ

Name of Species	**Density/ha.**	**Frequency%**	**Abundance**	**A/F**	**IVI**
Tree					
Azadirachtaindica	7.00	5.00	1.40	0.28	19.96
Lanneacoromandelica	11.00	8.00	1.38	0.17	35.65
Butea monosperma	15.00	10.00	1.50	0.15	49.45

Pongamiapinnata	3.00	3.00	1.00	0.33	9.84
Acacia Arabica	6.00	4.00	1.50	0.38	15.94
Careyaarborea	3.00	2.00	1.50	0.75	6.90
Oroxylumindicum	1.00	1.00	1.00	1.00	2.74
Albizialebbek	3.00	2.00	1.50	0.75	8.15
Terminalia sp	12.00	7.00	1.71	0.24	30.74
Diospyros melanoxylon	22.00	12.00	1.83	0.15	77.49
Holopteliaintergrifolia	3.00	3.00	1.00	0.33	9.03
Ziziphusmauritiana	2.00	2.00	1.00	0.50	5.31
Lagerstroemia parviflora	4.00	3.00	1.33	0.44	10.10
Acacia auriculiformis	1.00	1.00	1.00	1.00	2.73
Aegle marmelos	1.00	1.00	1.00	1.00	2.72
Anogeissuslatifolia	2.00	2.00	1.00	0.50	5.55
Cassia fistula	1.00	1.00	1.00	1.00	2.59
Emblica officinalis	1.00	1.00	1.00	1.00	2.57
Terminalia bellirica	1.00	1.00	1.00	1.00	2.52
Total	**99.00**	**69.00**			**300.00**
Shrub					
Abutilon indicum	160.00	25.00	1.60	0.06	16.33
Calotropis procera	80.00	15.00	1.33	0.09	8.74
Sidaacuta	165.00	30.00	1.38	0.05	17.27
Xanthium indicum	510.00	43.75	2.91	0.07	42.86
Clerodendruminfortunatum	210.00	37.50	1.40	0.04	24.03
Grewiahirsuta	50.00	10.00	1.25	0.13	5.93
Lantana camara	325.00	56.25	1.44	0.03	77.78
Vitex negundo	110.00	22.50	1.22	0.05	16.60
Woodfordiafruticosa	95.00	15.00	1.58	0.11	14.02
Ziziphusnummularia	95.00	13.75	1.73	0.13	13.74
Prosopis juliflora	135.00	23.75	1.42	0.06	24.32
Martyniaannua	205.00	37.50	1.37	0.04	21.71
Agave Americana	30.00	3.75	2.00	0.53	2.74
Indigoferasp	25.00	5.00	1.25	0.25	2.56
Opuntia dillenii	30.00	5.00	1.50	0.30	2.76
Ipomeacarnea	50.00	5.00	2.50	0.50	3.80
Solanum indicum	35.00	7.50	1.17	0.16	3.66
Senna alata	10.00	2.50	1.00	0.40	1.14
Total	**2320.00**	**358.75**			**300.00**
Herb					

Euphorbia hirta	1866.67	11.00	1.70	0.15	10.59
Adiantum caudatum	2566.67	7.67	3.35	0.30	10.67
Tephrosiapurpurea	5200.00	18.67	2.79	0.25	58.13
Tridaxprocumbens	1066.67	4.00	2.67	0.24	4.70
Vernonia cinerea	1366.67	8.33	1.64	0.15	9.30
Parthenium hysterophorus	1200.00	5.00	2.40	0.22	6.98
Saccharum spontaneum	733.33	4.00	1.83	0.17	5.71
Sidarhombifolia	1533.33	8.00	1.92	0.17	15.64
Cassia tora	6666.67	16.67	4.00	0.36	47.44
Hemidesmus indicus	266.67	2.33	1.14	0.10	1.76
Leucas aspera	2833.33	13.67	2.07	0.19	16.70
Ocimum sanctum	1266.67	10.67	1.19	0.11	11.49
Phyllanthus niruri	1533.33	11.67	1.31	0.12	11.51
Crotalaria prostrate	700.00	5.33	1.31	0.12	4.47
Cuscutareflexa	400.00	3.33	1.20	0.11	2.64
Cynodondactylon	1466.67	7.67	1.91	0.17	7.81
Cocciniagrandis	366.67	2.67	1.38	0.13	2.24
Commelinabenghalensis	966.67	6.33	1.53	0.14	5.58
Bidenspilosa	2166.67	11.00	1.97	0.18	12.72
Abrusprecatorius	800.00	5.00	1.60	0.15	4.56
Alternanthera sessilis	1300.00	6.00	2.17	0.20	7.07
Anisomelesindica	1466.67	7.33	2.00	0.18	9.28
Acanthospermumhispidum	733.33	3.67	2.00	0.18	3.76
Acmella calva	633.33	3.67	1.73	0.16	3.53
Aervalanata	466.67	3.33	1.40	0.13	2.77
Ageratum conyzoides	733.33	4.00	1.83	0.17	3.98
Chrysopogonfulvus	500.00	3.67	1.36	0.12	3.92
Commelinadiffusa	533.33	4.00	1.33	0.12	4.25
Convolvulus pluricaulis	466.67	3.67	1.27	0.12	3.31
Cyperus compactus	600.00	3.67	1.64	0.15	4.42
Echinopsechinatus	66.67	0.67	1.00	0.09	0.50
Solanum surattense	300.00	2.67	1.13	0.10	2.57
Total	**42766.67**	**209.33**			**300.00**

(b) Forest Route between AP9/0 and AP10/0:

Direct Impact zone from AP 9/0 to AP 10/0 comprised with 7 trees, 13 shrubs and 19 herbs species with the stand density of 21 individuals/ha, 1115 individuals/ha and 17800 individuals/ha for tree, shrub and herb species respectively. *Azadirachtaindica* and *Butea monosperma* in tree layer, *Xanthium indicum* and *Prosopis juliflora* in shrub layer and, *Cassia tora* and *Tephrosiapurpurea* were found dominated and co-dominated species respectively. **(Table 8)**

Table 8: Phyto-sociological characters of plant community between AP 9/0 to AP10/0 inDIZ

Name of Species	Density/ha.	Frequency%	Abundance	A/F	IVI
Tree					
Azadirachtaindica	5.00	3.00	1.67	0.56	71.06
Lanneacoromandelica	2.00	2.00	1.00	0.50	28.28
Butea monosperma	5.00	4.00	1.25	0.31	68.23
Acacia Arabica	4.00	4.00	1.00	0.25	58.38
Dlabergia sissoo	2.00	2.00	1.00	0.50	28.40
Albizialebbeck	2.00	2.00	1.00	0.50	27.80
Madhucalongifolia	1.00	1.00	1.00	1.00	17.84
Total	**21.00**	**18.00**			**300.00**
Shrub					
Abutilon indicum	90.00	15.00	1.50	0.10	18.55
Calotropis procera	60.00	8.75	1.71	0.20	11.81
Sidaacuta	110.00	17.50	1.57	0.09	24.47
Xanthium indicum	270.00	22.50	3.00	0.13	52.00
Bamboosa bamboos	5.00	1.25	1.00	0.80	2.07
Grewiahirsuta	25.00	5.00	1.25	0.25	5.82
Lantana camara	90.00	13.75	1.64	0.12	32.90
Sesbaniasesban	40.00	8.75	1.14	0.13	9.54
Woodfordiafruticosa	85.00	15.00	1.42	0.09	33.21
Ziziphusnummularia	60.00	11.25	1.33	0.12	21.38
Prosopis juliflora	100.00	21.25	1.18	0.06	48.01
Martyniaannua	110.00	11.25	2.44	0.22	24.00
Triumfettapentandra	70.00	12.50	1.40	0.11	16.24
Total	**1115.00**	**163.75**			**300.00**
Herb					
Euphorbia hirta	733.33	5.67	1.29	0.23	10.37
Adiantum caudatum	500.00	1.00	5.00	0.88	4.16
Tephrosiapurpurea	1466.67	10.33	1.42	0.25	41.99
Tridaxprocumbens	1300.00	3.67	3.55	0.63	14.20

Amaranthus viridis	500.00	4.00	1.25	0.22	12.64
Chenopodium murale	633.33	5.00	1.27	0.22	13.12
Saccharum spontaneum	500.00	4.00	1.25	0.22	9.04
Sidarhombifolia	1166.67	8.00	1.46	0.26	26.15
Cassia tora	2933.33	7.67	3.83	0.68	44.60
Cyperusrotundus	266.67	2.00	1.33	0.24	4.51
Leucas aspera	1366.67	10.00	1.37	0.24	23.54
Ocimum sanctum	633.33	5.00	1.27	0.22	13.12
Crotalaria prostrata	600.00	3.33	1.80	0.32	7.14
Cynodondactylon	733.33	3.33	2.20	0.39	8.08
Cocciniagrandis	166.67	1.67	1.00	0.18	2.85
Commelinabenghalensis	1100.00	6.33	1.74	0.31	15.81
Bidenspilosa	1333.33	7.00	1.90	0.34	19.10
Alternanthera sessilis	1166.67	6.67	1.75	0.31	16.61
Anisomelesindica	700.00	3.00	2.33	0.41	12.97
Total	**17800.00**	**97.67**			**300.00**

Tree density with 35 individuals/ha, shrub density with 1590 individuals/ha and herb density with 18600 individuals/ha were recorded in the buffer zone of this project Route. *Butea monosperma*, *Xanthium indicum*and *Cassia tora* were found dominant species in tree shrub and herb layer respectively. As per the A/F ratio, most of the floral species were found contagiously distributed. **(Table 9)**

Table 9: Phyto-sociological characters of plant community between AP 9/0 to AP10/0 in BZ

Name of Species	Density/ha.	Frequency%	Abundance	A/F	IVI
Tree					
Azadirachtaindica	7.00	4.00	1.75	0.44	61.63
Lanneacoromandelica	5.00	3.00	1.67	0.56	51.99
Butea monosperma	8.00	5.00	1.60	0.32	63.05
Acacia Arabica	6.00	4.00	1.50	0.38	41.73
Dlabergia sissoo	3.00	2.00	1.50	0.75	24.39
Albizialebbeck	3.00	2.00	1.50	0.75	30.61
Moringa oleifera	1.00	1.00	1.00	1.00	7.91
Tamarindusindica	1.00	1.00	1.00	1.00	9.28
Madhucalongifolia	1.00	1.00	1.00	1.00	9.41
Total	**35.00**	**23.00**			**300.00**
Shrub					
Abutilon indicum	95.00	15.00	1.58	0.11	13.48
Calotropis procera	205.00	22.50	2.28	0.10	26.29

Sidaacuta	115.00	17.50	1.64	0.09	16.32
Xanthium indicum	290.00	31.25	2.32	0.07	45.50
Bamboosa bamboos	5.00	1.25	1.00	0.80	4.26
Grewia hirsute	40.00	7.50	1.33	0.18	6.17
Lantana camara	125.00	12.50	2.50	0.20	31.04
Sesbaniasesban	55.00	10.00	1.38	0.14	8.41
Woodfordiafruticosa	75.00	15.00	1.25	0.08	21.97
Ziziphusnummularia	90.00	15.00	1.50	0.10	25.50
Prosopis juliflora	115.00	22.50	1.28	0.06	34.25
Martyniaannua	180.00	21.25	2.12	0.10	24.09
Clerodendruminfortunatum	25.00	5.00	1.25	0.25	4.04
Opuntia dillenii	5.00	1.25	1.00	0.80	0.90
Dendrocalamusstrictus	5.00	1.25	1.00	0.80	3.16
Vitex negundo	75.00	13.75	1.36	0.10	21.36
Triumfettapentandra	90.00	12.50	1.80	0.14	13.23
Total	**1590.00**	**225.00**			**300.00**
Herb					
Euphorbia hirta	800.00	5.67	1.41	0.25	11.86
Adiantum caudatum	733.33	4.00	1.83	0.32	8.26
Tephrosiapurpurea	1533.33	8.33	1.84	0.32	39.56
Tridaxprocumbens	1500.00	8.33	1.80	0.32	19.87
Amaranthus viridis	700.00	4.00	1.75	0.31	13.18
Chenopodium murale	866.67	6.67	1.30	0.23	16.06
Hemidesmus indicus	166.67	1.33	1.25	0.22	2.25
Andrographis paniculata	100.00	0.67	1.50	0.26	1.18
Artemisia vulgaris	266.67	1.67	1.60	0.28	3.46
Saccharum spontaneum	633.33	4.67	1.36	0.24	11.76
Sidarhombifolia	1100.00	8.00	1.38	0.24	18.77
Cassia tora	1833.33	12.00	1.53	0.27	42.47
Cyperusrotundus	333.33	1.00	3.33	0.59	3.77
Leucas aspera	1833.33	10.33	1.77	0.31	26.35
Conyzaleucantha	400.00	2.67	1.50	0.26	5.12
Dimeriaornithopoda	600.00	2.00	3.00	0.53	6.60
Ocimum sanctum	733.33	6.33	1.16	0.20	15.23
Crotalaria prostrate	333.33	2.33	1.43	0.25	5.54
Cynodondactylon	466.67	1.33	3.50	0.62	4.43
Argemone maxicana	66.67	0.67	1.00	0.18	1.00
Commelinabenghalensis	500.00	2.00	2.50	0.44	6.48
Bidenspilosa	1133.33	4.00	2.83	0.50	11.35

Alternanthera sessilis	1033.33	3.67	2.82	0.50	10.91
Anisomelesindica	933.33	4.67	2.00	0.35	14.53
Total	**18600.00**	**106.33**			**300.00**

(c) Forest Route between AP26A/0 and AP28/5:

A very low tree density (7 individuals/ha) was recorded in this study Route (along proposed transmission line). Shrub density was recorded as 895 individuals/ha and herbaceous density was found as 6333.33 individuals/ha. *Diospyros melanoxylon*, *Lantana camara* and *Cassia tora* were the dominant tree, shrub and herb species respectively with highest values of IVI. Contagious distribution of species has been seen in most of the species in all the layers.**(Table 10)**

Table 10: Phyto-sociological characters of plant community between AP26A/0 to AP28/5 in DIZ

Name of Species	Density/ha.	Frequency%	Abundance	A/F	IVI
Tree					
Azadirachtaindica	1.00	1.00	1.00	1.00	43.19
Acacia Arabica	2.00	2.00	1.00	0.50	90.57
Diospyros melanoxylon	4.00	3.00	1.33	0.44	166.23
Total	**7.00**	**6.00**			**300.00**
Shrub					
Indigoferasp	60.00	12.50	1.20	0.10	22.87
Calotropis procera	70.00	7.50	2.33	0.31	15.20
Senna alata	20.00	3.75	1.33	0.36	6.27
Xanthium indicum	275.00	17.50	3.93	0.22	54.13
Clerodendruminfortunatum	90.00	13.75	1.64	0.12	25.57
Solanum indicum	35.00	6.25	1.40	0.22	10.14
Lantana camara	175.00	28.75	1.52	0.05	109.28
Woodfordiafruticosa	75.00	11.25	1.67	0.15	31.24
Prosopis juliflora	20.00	2.50	2.00	0.80	9.41
Martyniaannua	75.00	7.50	2.50	0.33	15.88
Total	**895.00**	**111.25**			**300.00**
Herb					
Euphorbia hirta	400.00	3.33	1.20	0.36	17.35
Tephrosiapurpurea	533.33	3.67	1.45	0.44	39.35
Tridaxprocumbens	400.00	3.33	1.20	0.36	18.08
Parthenium hysterophorus	433.33	3.33	1.30	0.39	19.55
Selaginellabryopteris	633.33	4.00	1.58	0.48	35.18
Cassia tora	1966.67	5.33	3.69	1.11	67.04
Leucas aspera	733.33	4.67	1.57	0.47	55.80

Ocimum sanctum	133.33	0.67	2.00	0.60	6.52
Cynodondactylon	166.67	0.67	2.50	0.75	6.15
Sonchus asper	200.00	1.00	2.00	0.60	8.20
Bidenspilosa	200.00	0.67	3.00	0.90	6.24
Abrusprecatorius	66.67	0.33	2.00	0.60	2.33
Alternanthera sessilis	100.00	0.67	1.50	0.45	4.10
Anisomelesindica	366.67	1.33	2.75	0.83	14.09
Total	**6333.33**	**33.00**			**300.00**

Buffer zone of the Route was dominated with scrub forests having least density values for trees (8 tree/ha), 1220 individuals/ha for shrubs and 8366.67 individuals/ha for herbs. **(Table 11)**

Table 11: Phyto-sociological characters of plant community between AP26A/0 to AP28/5 in BZ

Name of Species	**Density/ha.**	**Frequency%**	**Abundance**	**A/F**	**IVI**
Tree					
Azadirachtaindica	1.00	1.00	1.00	1.00	41.41
Acacia Arabica	2.00	2.00	1.00	0.50	87.00
Diospyros melanoxylon	5.00	3.00	1.67	0.56	171.59
Cassia fistula	1.00	1.00	1.00	1.00	40.32
Total	**8.00**	**6.00**			**300.00**
Shrub					
Indigoferasp	75.00	13.75	1.36	0.10	17.24
Calotropis procera	95.00	8.75	2.71	0.31	14.09
Senna alata	50.00	7.50	1.67	0.22	9.46
Xanthium indicum	345.00	25.00	3.45	0.14	52.67
Clerodendruminfortunatum	105.00	18.75	1.40	0.07	24.00
Ipomeacarnea	45.00	8.75	1.29	0.15	10.26
Solanum indicum	30.00	5.00	1.50	0.30	6.30
Lantana camara	225.00	25.00	2.25	0.09	102.66
Woodfordiafruticosa	100.00	13.75	1.82	0.13	30.42
Ziziphusnummularia	30.00	5.00	1.50	0.30	6.44
Prosopis juliflora	25.00	3.75	1.67	0.44	11.01
Martyniaannua	95.00	10.00	2.38	0.24	15.46
Total	**1220.00**	**145.00**			**300.00**
Herb					
Euphorbia hirta	466.67	3.00	1.56	0.52	13.57
Echinopsechinatus	133.33	1.00	1.33	0.44	4.17
Tephrosiapurpurea	666.67	3.33	2.00	0.67	34.05
Tridaxprocumbens	833.33	4.67	1.79	0.60	34.45
Parthenium hysterophorus	633.33	3.00	2.11	0.70	19.16

Arundo donax	133.33	1.00	1.33	0.44	4.07
Selaginellabryopteris	666.67	5.33	1.25	0.42	30.33
Cassia tora	2200.00	6.67	3.30	1.10	67.23
Leucas aspera	1100.00	6.00	1.83	0.61	43.71
Ocimum sanctum	166.67	1.67	1.00	0.33	8.66
Cynodondactylon	266.67	1.67	1.60	0.53	8.13
Acanthospermumhispidum	33.33	0.33	1.00	0.33	1.18
Sonchus asper	300.00	1.33	2.25	0.75	8.09
Bidenspilosa	166.67	1.00	1.67	0.56	4.47
Abrusprecatorius	200.00	1.00	2.00	0.67	5.02
Alternanthera sessilis	200.00	1.33	1.50	0.50	5.73
Anisomelesindica	200.00	1.33	1.50	0.50	7.98
Total	**8366.67**	**43.67**			**300.00**

4.1.3 Species diversity

(a) Forest Route between AP8 and AP9: Shannon Diversity values were found higher in buffer zone for all the vegetation layers. These values were ranged from 2.13 (tree layer in direct impact zone to 3.09 (herb layer in buffer zone).

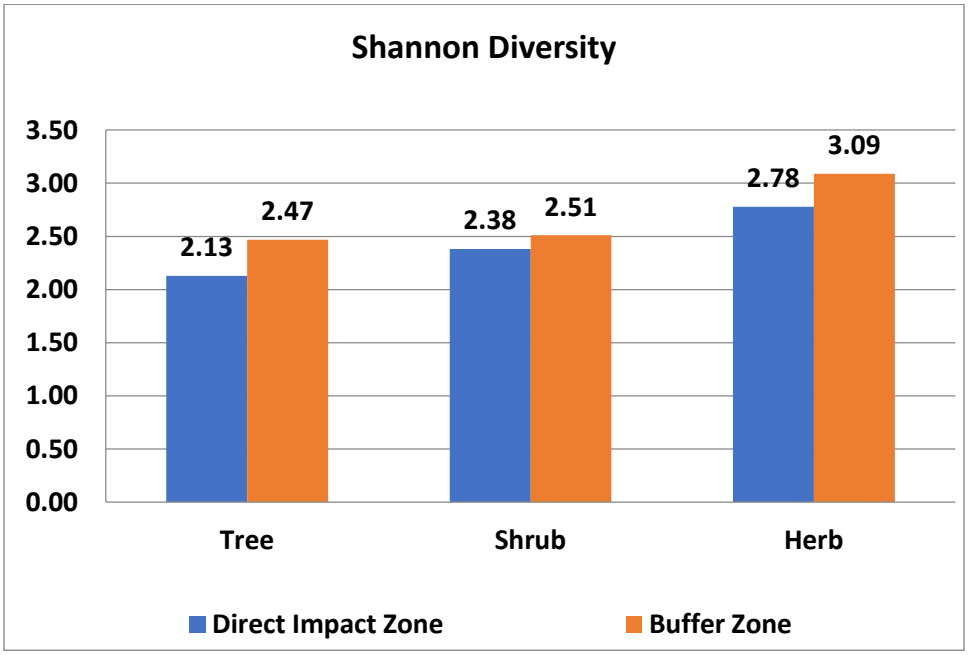


Figure 21: Shannon Diversity for floral species in DIZ and BZ between AP8 to AP9

(b) Forest Route between AP9 and AP10: Higher diversity values were recorded in buffer zone of forest Route as compare to direct impact zone.Highest diversity was recorded in herb layer followed by shrub and tree layer.

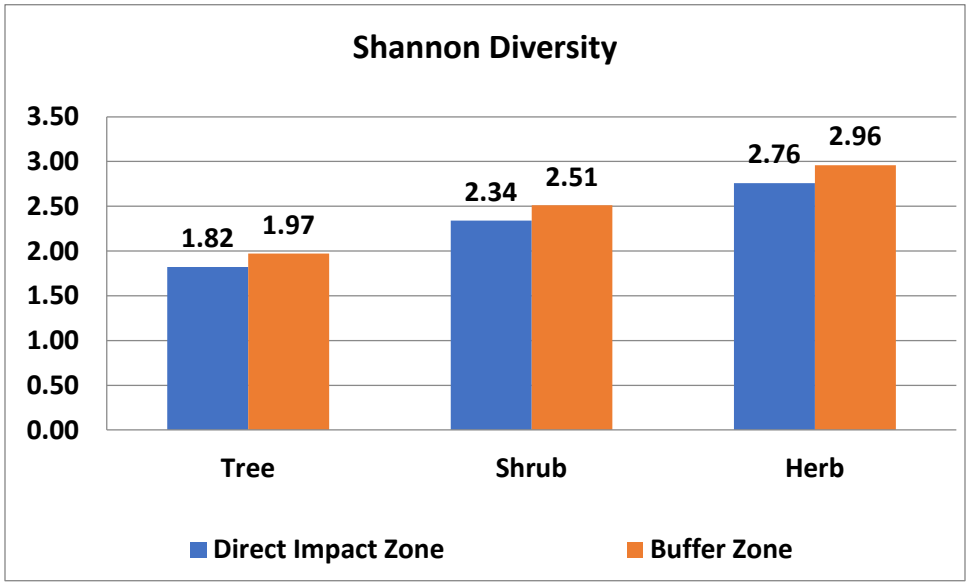


Figure 22: Shannon Diversity for floral species in DIZ and BZ between AP9 to AP10

(c) Forest Route between AP26A/0 and AP28/5: Very low diversity values were observed in tree layer (0.96 in DIZ and 1.15 in BZ) in this Route. Diversity values were found higher in buffer zone for all three vegetation layers.

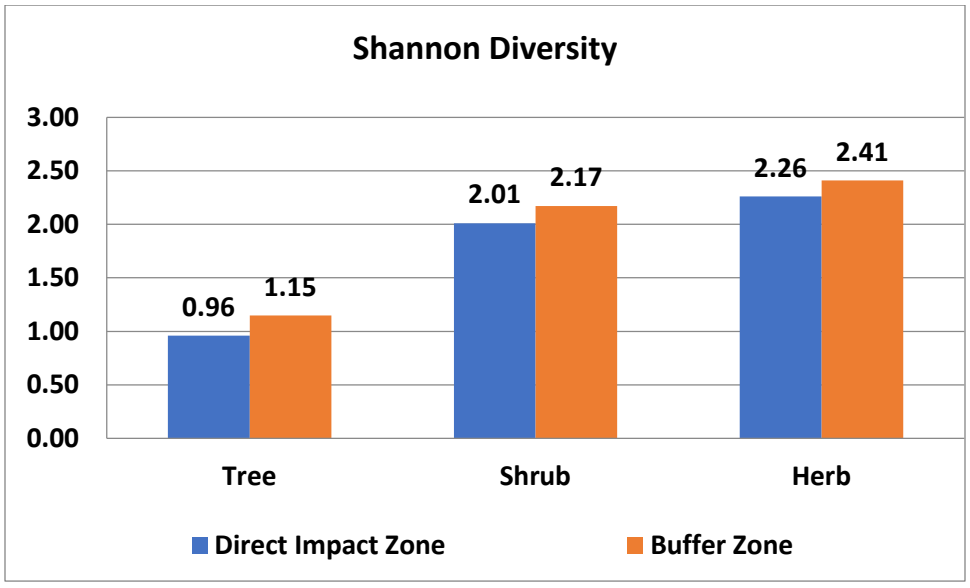


Figure 23: Shannon Diversity for floral species in DIZ and BZ between AP26A/0 to AP28/5

4.2 Results of fauna surveys

Kaimur WLS falls in Deccan Peninsula: Central Highlands bio-geographic reason (6B) of India **(Menon, 2014).** There are very limited studies on faunal elements of Kaimur WLS available. Wildlife Management Plan of WLS reports 35 species of mammals, 221 species of birds, 25 species of reptiles, 06 species of Amphibians, 21 species of fish and 32 species of invertebrates. There are 17 key wildlife areas were reported within the WLS described below:

Table 12: Key wildlife areas present within WLS

Range	Block	Remarks
Robertsganj	Robertsganj	Black buck valley
Robertsganj	Rajpur	Amdah fall, Eco valley
Halia	Halia	Chinkara
Halia	Harra	Cheetal and Sloth Bear
Halia	Matwar	Black Buck
Halia	Kushera	Black Buck
Halia	Padari	Sloth Bear, Black Buck
Ghorawal	Persauna	Sambar Deer
Ghorawal	Tenduhar	Sambar Deer
Ghorawal	Semara	Sambar Deer
Ghorawal	ImliPokhar	Sambar Deer
Ghorawal	Murtia	Sambar Deer
Ghorawal	Kanhari	Sambar Deer
Gurma	Kargara	Salkhan Tree Fossils
Gurma	Kanhaura	Dense Forest
Gurma	Kanach	Dense Forest
Gurma	Patwadh	Sambar Deer

Source: Wildlife Management Plan, Kaimur Wildlife Sanctuary

4.2.1 Mammals

A wide variety of fauna inhabits the forested areas in Kaimur WLS due to its forest cover and diversity. During the Biodiversity survey, a transact walk has been organized to explore the presence of mammals. Fecal dropping, foot prints, claw marks, voice and trophies along with direct sighting were recorded during transect walks. Faunal distribution and their occurrence were also confirmed by looking at specific plots of 20x20m, every 400m along the transect running parallel to the Transmission line. Within each plot, observations on visual observation of wildlife signs (rooting, feeding, resting, fecal droppings, foot prints, or wildlife sounds) were recorded. Also, during public consultation meetings, additional information on wildlife presence was also discussed.

From a total of 20 plots, wildlife signs were found in 6 plots. Species signs that were observed during mammal surveys include those of Sambar Deer (footprints), Indian hare (scat/dung), Wild Pigs (digging signs), Northern Plain Langoor (direct sighting) and Rhesus Macaque (direct sighting). The presence of Barking deer, Blue bull, Indian fox, Porcupine, Spotted deer, Civet, Mongoose and House mouse has been confirmed in people consultation and discussion.

Based on the forest type and higher level of disturbance along project Route, the rarer and more elusive species like Sloth Bears, Indian Gazelle, Black buck, Grey wolf, Honey Badger, and Indian Pangolin are not expected along the project zone. Moreover, there is no prominent wildlife habitat, breeding and lekking site, and forage area present within project Route. List of present/expected wildlife in the project area is represented in **Table 13.**

Table 13: List of wildlife in the project area and Kaimur WLS

Name	Scientific Name	Order	Family	WPA (S)	CS (IUCN)	Source
Indian Fox	*Vulpes bengalensis*	Carnivora	Canidae	II	LC	PS, SS, SMP
Blue Bull	*Boselaphustragocamelus*	Artiodactyla	Bovidae	IV	LC	PS, SS,
House Srew	*Suncusmurinus*	Soricomorpha	Soricidae	NL	LC	PS, SS, SMP
Indian Hare	*Lepus nigricollis*	Lagomorpha	Leporidae	IV	LC	PS, SS, SMP
Palm Squirrel	*Funambuluspennantii*	Rodentia	Sciuridae	IV	LC	PS, SS, SMP
Porcupine	*Hystrixindica*	Rodentia	Hystricidae	IV	LC	PS, SS, SMP
Rhesus macaque	*Macaca mulatta*	Primates	Cercopithecidae	II	LC	PS, SS, SMP
Indian muntjac	*Muntiacusmuntjak*	Artiodactyla	Cervidae	III	LC	PS, SS, SMP

Spotted Deer	*Axis*	Artiodactyla	Cervidae	III	LC	PS, SS, SMP
Wild Boar	*Sus scrofa*	Artiodactyla	Suidae	III	LC	PS, SS, SMP
Northern Plain Langoor	*Semnopithecus entellus*	Primates	Cercopithecidae	II	LC	PS, SS, SMP
Sambar	*Rusa unicolor*	Artiodactyla	Cervidae	III	VU	SS, SMP
Indian Gazelle	*Gazellabennettii**	Artiodactyla	Bovidae	I	LC	SMP
Blackbuck	*Antilope cervicapra**	Artiodactyla	Bovidae	I	NT	SMP
Jungle Cat	*Felischaus*	Carnivora	Felidae	II	LR	PS, SS, SMP
Common Palm Civet	*Paradoxurus hermaphroditus*	Carnivora	Viverridae	II	LR	PS, SS, SMP
Small Indian Civet	*Viverriculaindica*	Carnivora	Viverridae	II	LC	PS, SS, SMP
Grey Mongoose	*Herpestesedwardsii*	Carnivora	Herpestidae	II	LC	PS, SS, SMP
Stripped Hyaena	*Hyaena*	Carnivora	Hyaenidae	III	NT	SS, SMP
Grey Wolf	*Canis lupus**	Carnivora	Canidae	I	LC	SS, SMP
Golden Jackal	*Canis aureus*	Carnivora	Canidae	II	LC	SS, SMP
Sloth Bear	*Melursus ursinus**	Carnivora	Ursidae	I	VU	SS, SMP
Honey Budger	*Mellivoracapensis**	Carnivora	Mustelidae	I	LR	SS, SMP
Indian Pangolin	*Manis crassicaudata**	Pholidota	Manidae	I	NT	SS, SMP

House mouse	*Mus musculus*	Rodentia	Muridae	V	LC	PS, SS, SMP
Field Mouse	*Mus booduga*	Rodentia	Muridae	V	LC	SS
	Bandicotabengalensis	Rodentia	Muridae	V	LC	SS, SMP
Black Rat	*Rattus*	Rodentia	Muridae	V	LC	PS, SS, SMP
Tomb Bat	*Taphozousnudiventris*	Chiroptera	Emballonuridae	UN	LC	PS, SS, SMP

*WPA (S)- Schedule as per Wildlife Protection Act-1972, CS (IUCN)- Conservation Status as per IUCN, PS- Primary Survey, SS-Secondary Source, SMP-Sanctuary Management Plan, 2001-2010, LC- Least Concern, NT- Near Threatened, LR- Lower Risk, VU-Vulnerable, *High conservation value mammals*

4.2.2 Results of avi-fauna surveys

A total of 117 species of birds have been recorded/reported in and around the Project site as per all available secondary sources. These are presented in the **Table 14.** From these the Indian Peafowl (*Pavocristatus*), and Indian Vulture (*Gyps indicus*) are listed in Schedule-I category of Indian Wildlife Protection Act-1972. Out of these two species, a female of Peafowl (*Pavocristatus*) were spotted by us once during the field survey.

Avifauna was sampled on the same trails (100m wide transect) used in mammalian survey. In addition, important bird areas (ponds, riversides and agricultural areas) were also visited to capture bird species. A prismatic field binocular (Nikon ACULON A211 10x50) was used for the bird watching during survey walk. 06 to 09 AM hrs has been used for bird survey during this study. Most of the birds have been identified in the field by using the field guide. A total of fifty-eight Bird species were spotted by us during this study.

Most of the species that are found in the project site fall in the “Least Concern” category of IUCN. Commonly spotted bird species during field survey were Common Pigeon, Egret, House Crow, Rufous Treepie, Green Bee-eater, House Sparrow, Baya Weaver, Black Drongo, Brahmini Starling, Indian Pond Heron, Indian Roller, Laughing Dove, Spotted Dove, Red-wattled Lapwing, Rose-ringed Parakeet, Red-vented Bulbul, Sparrow Lark and Common Hoopoe.

Table 14: List of avifauna recorded/reported from study area as per secondary sources

Name	Scientific name	Status	CS (IUCN)	Source
Common Myna	*Acridotheres tristis*	Widespread resident	LC	Primary Study
Common lora	*Aegithina tiphia*	Widespread resident	LC	Grimmett et al, 2011
Oriental Skylark	*Alauda gulgula*	Widespread resident	LC	Primary Study
Common Kingfisher	*Alcedo atthis*	Widespread resident	LC	Primary Study
Brown Crake	*Amaurornis akool*	Resident	LC	Primary Study
White-breasted Waterhen	*Amaurornis phoenicurus*	Resident	LC	Primary Study MP-Kaimur WLS
Common Teal	*Anas crecca*	Widespread winter visitor	LC	Primary Study
Asian Open bill	*Anastomus oscitans*	Widespread resident in plains	LC	Grimmett et al, 2011
Darter	*Anhinga melanogaster*	Widespread resident	NT	Grimmett et al, 2011 MP-Kaimur WLS
Oriental pied Hornbill	*Anthracoceros albirostris*	Resident	LC	Grimmett et al, 2011
Paddyfiled Pipit	*Anthus rufulus*	Widespread resident	LC	Primary Study
Little Swift	*Apus affinis*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Bonelli's Eagle	*Aquila fasciata*	widespread resident	LC	Grimmett et al, 2011
Tawny Eagle	*Aquila rapax*	Widespread resident	VU	Grimmett et al, 2011
Purple Heron	*Ardea purpurea*	Resident and winter visitor	LC	Grimmett et al, 2011 MP-Kaimur WLS
Indian Pond Heron	*Ardeola grayii*	Widespread resident	LC	Primary Study
Spotted Owlet	*Athene brama*	Widespread resident	LC	Grimmett et al, 2011
Indian Eagle Owl	*Bubo (bubo) bengalensis*	Resident	LC	Grimmett et al, 2011

Cattle Egret	*Bubulcus ibis*	Widespread resident	LC	Primary Study
White-eyed Buzzard	*Butastur teesa*	Widespread resident	LC	Grimmett et al, 2011
Striated Heron	*Butorides striata*	Widespread resident	LC	Primary Study
Little Stint	*Calidris minuta*	Widespread winter visitor	LC	Grimmett et al, 2011 MP-Kaimur WLS
Temminck's Stint	*Calidris temminckii*	Widespread winter visitor	LC	Grimmett et al, 2011
Savanna Nightjar	*Caprimuglus affinis*	Widespread resident	LC	Primary Study
Indian Nightjar	*Caprimuglus asiaticus*	Widespread resident	LC	Primary Study
Great Egret	*Casmerodius albus*	Widespread resident	LC	Primary Study
Pied Kingfisher	*Ceryle rudis*	Widespread resident	LC	Primary Study
Emerald Dove	*Chalcophaps indica*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Little Ringed Plover	*Charadrius dubius*	Widespread resident	LC	Primary Study
Yellow-eyed Babbler	*Chrysomma sinense*	Widespread resident	LC	Primary Study
Woolly-necked Storck	*Ciconia episcopus*	Widespread resident	VU	Grimmett et al, 2011 MP-Kaimur WLS
Purple Sunbird	*Cinnyris asiaticus*	Widespread resident	LC	Primary Study
Short-toed Snake Eagle	*Circaetus gallicus*	Widespread winter visitor	LC	Grimmett et al, 2011
Pallied Harrier	*Circus macrourus*	Widespread winter visitor	NT	Grimmett et al, 2011
Jacobin Cuckoo	*Clamator jacobinus*	Widespread resident and partial migrant	LC	Primary Study
Common Pigeon	*Columba livia*	Widespread resident	LC	Primary Study
Oriental Magpie Robin	*Copsychus saularis*	Widespread resident	LC	Primary Study
Large Cuckooshrike	*Coracina macei*	Widespread resident	LC	Primary Study
House Crow	*Corvus splendens*	Widespread resident	LC	Primary Study
King Quail	*Conturnix chinensis*	Widespread resident	LC	Grimmett et al, 2011
Asian Palm	*Cypsiurus*	Resident	LC	Grimmett et al,

Swift	*balasiensis*			2011 MP-Kaimur WLS
Rufous Treepie	*Dendrocitta vagabunda*	Widespread resident		Primary Study
Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*	Resident	LC	Grimmett et al, 2011
Brown-capped Pygmy Woodpecker	*Dendrocopos nanus*	Resident	LC	Grimmett et al, 2011
White-bellied Drongo	*Dicrurus caerulescens*	Widespread resident	LC	Primary Study
Black Drongo	*Dicrurus macrocercus*	Widespread resident	LC	Primary Study
Lesser Goldenback	*Dinopium benghalense*	Widespread resident	LC	Grimmett et al, 2011
Little Egret	*Egretta garzetta*	Widespread resident	LC	Primary Study
Black-winged kite	*Elanus caeruleus*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Ashy-crowned Sparrow Lark	*Eremopterix griseus*	Widespread resident	LC	Primary Study
Asian Koel	*Eudynamys scolopaceus*	Mainly resident Widespread	LC	Primary Study
Indian Silverbill	*Euodice malabarica*	Widespread resident	LC	Primary Study
Grey Francolin	*Francolinus pondicerianus*	Widespread resident in lowlands and low hills	LC	Grimmett et al, 2011
Eurasian Coot	*Fulica atra*	Widespread resident	LC	Grimmett et al, 2011
Asian Pied Starling	*Gracupica contra*	Resident	LC	Primary study
Common Crane	*Grus grus*	Winter visitor	LC	Grimmett et al, 2011
Indian Roller	*Coracias benghalensis*	Resident	LC	Primary Study
Indian Vulture*	*Gyps indicus*	Resident	CR	Grimmett et al, 2011 MP-Kaimur WLS
Brahminy kite	*Haliastur indus*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS

Common Hawk Cuckoo	*Hierococcyx varius*	Widespread resident	LC	Primary Study
Brown Fish Owl	*Ketupa zeylonensis*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Long-tailed Shrike	*Lanius schach*	Widespread resident	LC	Primary Study
Bay-backed Shrike	*Lanius vittatus*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Lesser Adjutant	*Leptoptilos javanicus*	Widespread resident in lowlands	VU	Grimmett et al, 2011
Scaly-breasted Munia	*Lonchura punctulata*	Widespread resident	LC	Primary Study
Coppersmith Barbet	*Megalaima haemacephala*	Resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Brown-headed Barbet	*Megalaima zeylanica*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Green Bee-eater	*Merops orientalis*	Widespread resident	LC	Primary Study
Intermediate Egret	*Mesophoyx intermadia*	Widespread resident	LC	Primary Study
White- browed Wagtail	*Motacilla maderaspatensis*	Widespread resident	LC	Primary Study
Yellow Wagtail	*Motacilla flava*	Widespread in winter	LC	Primary Study
Black kite	*Milvus migrans*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Indian Bushlark	*Mirafra erythroptera*	Resident	LC	Primary Study
Painted Stork	*Mycteria leucocephala*	Widespread resident in Plains	NT	Grimmett et al, 2011
Egyptian Vulture	*Neophron percnopterus*	Resident	EN	Grimmett et al, 2011 MP-Kaimur WLS
Brown Hawak Owl	*Ninox scutulata*	Resident	LC	Grimmett et al, 2011
Black-crowned Night Heron	*Nycticorax nycticorax*	Visitor	LC	Grimmett et al, 2011

				MP-Kaimur WLS
Indian Grey Hornbill*	*Ocyceros birostris*	Widespread resident	LC	Primary Study
Black-hooded Oriole	*Oriolus xanthornus*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Common Tailorbird	*Orthotomus sutorius*	Widespread resident	LC	Primary Study
House Sparrow	*Passer domesticus*	Widespread resident	LC	Primary Study
Indian Peafowl*	*Pavo cristatus*	Resident	LC	Primary Study
Stock-billed Kinggisher	*Pelargopsis capensis*	Widespread resident	LC	Primary Study
Oriental Honey-buzzard	*Pernis ptilorhynchus*	Visitor to coastal waters	LC	Grimmett et al, 2011
Little Cormorant	*Phalacrocorax niger*	Widespread resident	LC	Grimmett et al, 2011, MP-Kaimur WLS
Red Phalarope	*Phalaropus fulicarius*	India and Pakistan	LC	Grimmett et al, 2011
Black Redstart	*Phoenicurus ochruros*	Resident	LC	Grimmett et al, 2011
Baya Weaver	*Ploceus philippinus*	Widespread resident	LC	Primary Study
Grey-breasted prinia	*Prinia hodgsonii*	Widespread resident	LC	Grimmett et al, 2011
Plain Prinia	*Prinia inornata*	Widespread resident	LC	Grimmett et al, 2011
Jungle prinia	*Prinia sylvatica*	Widespread in lowlands	LC	Primary Study
Red- naped Ibis	*Pseudibis papillosa*	Widespread resident	LC	Primary Study
Rose-ringed Parakeet	*Psittacula krameri*	Widespread resident	LC	Grimmett et al, 2011
Plum-headed Parakeet	*Psittacula cyanocephala*	Widespread resident	LC	Primary Study
Red-vented Bulbul	*Pycnonotus cafer*	Widespread resident	LC	Primary Study
White-browed Fantail	*Rhipidura aureola*	Widespread resident	LC	Grimmett et al, 2011
Plain Martin	*Riparia paludicola*	Resident	LC	Grimmett et al,

				2011
Pied Bushchat	*Saxicola caprata*	Widespread resident	LC	Primary Study
Indian Robin	*Saxicoloides fulicatus*	Widespread resident	LC	Primary Study
Indian Nuthatch	*Sitta castanea*	Resident	LC	Grimmett et al, 2011
Crested Serpent Eagle	*Spilornis cheela*	Widespread resident	LC	Grimmett et al, 2011
River Tern	*Sterna aurantia*	Widespread resident	NT	Grimmett et al, 2011 MP-Kaimur WLS
Spotted Dove	*Stigmatopelia chinensis*	Widespread resident	LC	Primary Study
Laughing Dove	*Stigmatopelia Senegalensis*	Widespread resident	LC	Primary Study
Eurasian Collared Dove	*Streptopelia decaocto*	Widespread resident	LC	Primary Study
Oriental Turtle Dove	*Streptopelia orientalis*	Resident and winter visitor	LC	Grimmett et al, 2011 MP-Kaimur WLS
Brahminy Starling	*Sturnia Pagodarum*	Widespread resident	LC	Primary Study
Sirkeer Malkoha	*Taccocua leschenaultii*	Widespread resident	LC	Grimmett et al, 2011
Little Grebe	*Tachybaptus ruficollis*	Widespread resident	LC	Grimmett et al, 2011
Common Woodshrike	*Tephrodornis pondicerianus*	Widespread resident	LC	Grimmett et al, 2011
Yellow-footed Green Pigeon	*Treron phoenicopterus*	Widespread resident	LC	Grimmett et al, 2011
Jungle Babbler	*Turdoides striata*	Widespread resident	LC	Grimmett et al, 2011 MP-Kaimur WLS
Common Hoopoe	*Upupa epops*	Summer visitor and resident	LC	Primary Study
Red-wattled Lapwing	*Vanellus indicus*	winters in NW subcontinent	LC	Primary Study
Oriental White-eye	*Zosterops Palpebrosus*	Widespread resident	LC	Grimmett et al, 2011

LC- Least Concern, MP-Kaimur WLS –Management Plan, Kaimur Wildlife Sanctuary, NT- Near Threatened, CR-Critically Endangered, EN-Endangered, VU-Vulnerable

4.2.3 Reptiles, Insects and Amphibians

Reptiles have been surveyed with ***Walkabout Search*** survey method. This involves walking through likely habitat areas focusing attention upon local hotspots that reptiles might use to warm up. Stony areas with crevices e.g. dry-stone walls, cliffs, rocky outcrops, densier vegetation or woodland Edge of woodland/scrub patches and grassy areas, compost heaps, log piles, cut grass etc. were used to spot the reptiles. During the field surveys, snakes such as Rat snake (*Ptyasmucosus*) and Buff stripped Keelback (*Amphiesmastolatum*) were recorded from the Kaimur WLS. Garden Lizard (*Calotes versicolor*) and the Yellow Belly Gekko (*Hemidactylus flaviviridis*) were also spotted during field survey. The presence of Indian Monitor (*Varanus bengalensis*) was also confirmed during people consultation. 10 species of reptiles were recorded from the study area during these studies that are listed below in **Table 15**.

Table 15: Reptiles recorded/reported from study area

Sl. No.	Name	Scientific Name	CS (IUCN)	Source
1	House Gekko	*Hemidactylus brookii*	LC	Primary Study
2	Blood Sucker	*Calotes versicolor*	LRnt/N	Primary Study
3	Common or Brahminy Skink	*Mabuya carinata*	LC	SC
4	Indian Monitor*	*Varanus bengalensis*	LC	SC
5	Buff stripped Keelback	*Amphiesma stolatum*	NE	Primary Study
6	Cheekered keel back	*Xenochrophis piscator*	NE	MP-Kaimur WLS, SC
7	Rat Snake	*Ptyas mucosus*	NE	Primary Study
8	Russell's Viper	*Vipera russelli*	NE	MP-Kaimur WLS, SC

SC- Stakeholder Consultation, LC-Least Concern, LRnt/N- lower Risk Near Threatened, NE-Not Evaluated

Butterfly survey has been done through fixed-route walk (Pollard Walk). The routes have been fixed prior to walk and butterflies have been recorded in a fixed width band (typically 5m wide) along the Route during second half of October. Transect walks were undertaken between 10.45am and 3.45pm and only when weather conditions are suitable for butterfly activity. During present survey, a total of 12 species of butterfly has been recorded. Some common recorded species were Grass Yellow, Plain Tiger, Lemon Pansy, Blue Moon and Danaid Eggfly. **(Table 16.)**

Table 16: Butterfly recorded from study area

Name	Scientific Name
Common Albatross	*Appias albino*
Small cupid	*Chiladesparrhasius*
Plain Tiger	*Danaus chrysippus*
Common tiger	*Danaus genutia*
Common Jay	*Graphiumdoson*
Yellow pansy	*Junoniahierta*
Lemon Pansy	*Junonialemonius*
Common Mormon	*Papiliopolytus*
Common Leopard	*Phalanta*
Small Grass yellow	*Euremabrigitta*
Blue Moon	*Hypolimnasbolina*
Danaid Eggfly	*Hypolimnasmisippus*

Amphibians have been recorded near ponds. Although management plan of Kaimur WLS confirmed the presence of 6 amphibian species within WLS but only Skipper frog or Indian Skittering Frog (*Euphlyctiscyanophlyctis*) has been spotted during present primary survey.

4.3 Results of aquatic sampling

Both lentic and lotic water bodies are present within the project zone. Son and Ghagar rivers are the perenial lotic water bodies whereas there are some seasonal lentic water bodies in the form of ponds also present. In order to assess the aquatic biodiversity and to understand the impact of present project, the samples were taken from the various points both right and left bank of river Son and the river Ghagar (a left side tributary of the river Son).

4.3.1 Sampling Rationale for Aquatic Biodiversity

In order to understand the aquatic ecosystems, the abiotic components of physical (temperature, substrate type, width, depth, and transparency), and chemical nature (pH, conductivity etc.) were recorded. Under biological components, bottom dwelling benthos, plankton (both zoo and phyto), and nectones (Fish) were sampled. The phytoplanktons were abundant in the lowland area of the river and they are opted to represent the autotrophs. In case of the heterotrophs, the benthic macroinvertebrates with high indicator value were considered suitable. Fish is important to ecosystem for the same functions. Fish is a cheap source of high-quality animal protein and hence as nutritional food. A qualitative study of these indicator groups provide the knowledge of aquatic flora and fauna while quantitative studies help to understand

the community features such as taxonomic composition, abundances and assemblages which vary with the physical and chemical attributes of the ecosystem.

Sampling for Plankton Communities (Phytoplankton and Zooplankton): Planktons were sampled by sieving 100 litres of water through plankton net mesh size (45 µ). The sieved samples were preserved in 4% formalin for microscopic study. Identifications has completed with the help of standard keys (Edmondson 1959; Prasad & Mishra 1992,Krammer and Lange-Bertalot 1999; 2004; Lange Bertalot 2001, Jaiswal & Tiwari 2003).

Benthos (Phytobenthos): The phytobenthos were collected by scraping 3 x 3 cm surface area of submerged algal substrate. Temporary mounts were prepared from the preserved samples and then examined under x400 magnification to record the algal (green, blue green etc) flora. However, to record the diatom flora, permanent Naphrax mounts prepared after treating the samples in acid-peroxide, and then examined at x1500. Literature cited above was used to identify the diatoms.

Zoobenthos (Benthic Invertebrates): The macroinvertebrate fauna was sampled carefully. Soft substratum in the form of clay and silt was sampled with test sieve (mesh size 0.05 mm). Samples were preserved in 5% formalin for laboratory analysis. Macroinvertebrate samples were identified up to species level with help of standard keys (Edmondson 1959; Edington &Hildrew 1995).

Nekton (Fish): Fish samples have been collected by experimental fishing through cast net and gill net and through local fishermen. The samples were preserved in 10% formalin for species identification with the help of standard keys (Day 1958; Talwar & Jhingran1991; Jayaram 2002).

4.3.2 Physio-chemical profile of aquatic ecosystem:

The physio-chemical parameters are studied in the river Son & Ghagar **(Table 17)**.

Table 17: Physico-chemical characteristics of sampling site

Parameters	Son river	Ghagar River (right side tributary of the Son river
Date/Time	21.10.2019/12:15 pm	22.10.2019/9:50 am
AT (^oC)	29.5	24.8
WT (^oC)	32.3	28.5
Current velocity (ms^{-1})	0.3	0.2
pH	7.00	7.13
DO (mgl^{-1})	8.0	7.2
Conductivity (mho/cm)	0.911	0.883
Transparency (m)	0.4	0.5
Alkalinity (mgl^{-1})	350	300
Width of river (m)	200 m	50 (approx.)

Habitat Type	Riffles & Runs	Riffles & Pools
Land-use	Forest type at left bank and agriculture & village at right bank	Forest canopy
Substrate composition	Coarse sand & silt	Cobble/pebbles/silt/clay

4.3.3 Biological profile of aquatic ecosystem:

Phytoplankton: In primary study, a total of 13 phytoplankton genera were recorded from the river Son and Ghagar belonging to 3 classes; Bacillariophyceae, Chlorophyceae and Cyanophyceae. Among 13 genera, 5 were common in both Son and Ghagar while 3 were restricted to Son and 5 to Ghagar river. **(Table 18)**

Table 18: Distribution of phytoplankton taxa in the Sone and Gagar river

Phytoplankton	Taxa	Son	Ghagar
Bacillariophyceae	*Synedra sp.*	+	+
	Cymbella sp.	+	+
	Cyclotella sp.		+
	Navicula sp.	+	+
	Fragilaria sp.		+
Chlorophyceae	*Ulothrix sp.*	+	+
	Closterium	+	+
	Hydrodictyon	+	
	Spirogyra sp.		+
	Pediastrum	+	
	Stigeoclonium		+
Cyanophyceae	*Lyngbyasp.*	+	
	Spirulina sp.		+

Zooplankton: The zooplankton community was mainly compraised of Protozoans and rotifers in both water bodies.

Benthos

Phytobenthos: A total of 6 phytobenthos genera were recorded from study area belonging to class Bacillariophyceae. These genera were *Achnanthes*sp.,*Gomphonema*sp.,*Naviculas*p., *Cymbella*sp. *Synedra* sp. and *Caloneis*sp.

Zoobenthos: The zoobenthos community was mainly dominated by phylum mollusc followed by arthropoda (dipterans). Among the mollusca, pelecypoda were most dominant class followed by gastropoda. Total 6 species viz *Parreysiaandersoniana*, *Parreysiacaerulea*, *Corbicula striatella*, *Lamellidenscorrianus*, *Lamellidansmarginali, Radiatulagaudichaudi*were recorded in

the species for pelecypoda, however, *Lymnaeaaccuminata*, *Thiarascabra*, *Pila globosa*were common genera found in the study area of river Son and Gagar.

Nectons (Fish): Total 10 species viz. *Labeorohita*, *Puntius sophore, Puntius chola, Bagarius, Clupisomagaura, Rita, Wallago attu, Mystustengara, Catla and Cyprinus carpio* were recorded form Son river in 2 km up and downstream near P7/1. However, from the secondary information **Joshi *et al* (2014)** reported 89 species belonging to 10 orders and 25 families in the Son river at 4 sampling points between Uttar Pradesh and Bihar stretch.

5 IDENTIFICATION, EVALUATION AND MITIGATION OF IMPACTS

5.1 Identification of impact

The degree of impact of the proposed transmission line (400 KV D/C JaunpurObra) on biodiversity of Kaimur WLS is determined by the following factors:

(i) The degree of disturbance that already exists in the project site;
(ii) The uniqueness of the resources or protected nature of the habitat/forest/landscape;
(iii) The threat of future disturbance or considering how this project will affect land use in the future;
(iv) Duration of the impact or activity. Long term impacts exist as long as the Transmission line is in place, while temporary impacts occur only during pre-construction and construction phases or at infrequent intervals during operation phase (in case of accidents or repair or RoW maintenance)

Existing Impacts in the study area

- Habitat degradation on account of grazing by cattle; regeneration adversely affected
- Inter and Intra-species competition for forage
- Increased weed population and lack of regeneration
- Trampling by cattle increases soil erosion and poor aeration of soil; poor growth of vegetation
- Extraction of fuel wood by cutting pole crops and new regeneration: Hampers regeneration
- Long hot summer; scarcity of water
- Fragmentation of Habitat; Large number of habitations inside the forest, agriculture land and other anthropogenic pressure; not providing time to recovery of forest
- 4 Transmission projects of different voltage rating is existing which has led todisturbance in sanctuary.

5.2 Impacts on terrestrial biodiversity

5.2.1 During Pre-Construction Phase

Mobilization of Construction Equipment and Materials: The construction of the Transmission Line (TL) within Sanctuary area require movement of construction materials and tower parts at pre-marked locations. The material will be delivered through existing roads and

forest approach roads.For transportation at the site where there are no existing paths/roads for movement of vehicles, head loading shall be done eliminating the need of any vehicle. Thus, the impacts of mobilization of construction equipment are marginal since large numbers of heavy vehicles and machines shall not be deployed compared to any other mega project.

Influx of Project Staff and Contract workers: It is estimated that each gang comprising of small size groups (<20) of workers will be hired/deputed during the pre-construction and construction stage. This include contractors and their regular staff plus migrant workers. It must be ensured that that no activity is carried out after sunset within the sanctuary area.

5.2.2 During construction phase

Loss of forest cover and habitat for wildlife: There will be little impact due to TL as there is not much of forest coverand food/prey for wildlife. For 400 kV transmission line maximum width of RoW is 46 m. A 8.84 meter of ground clearance is required for 400kV Transmission Line. The total area of transmission line passing through the wildlife sanctuary is 55.44 ha (12.054 Km X 46 m) and this amount is about 0.11% of the total area of the Kaimur WLS. A total of 592 trees (including bamboo clumps) are present in the proposed corridor, out of which only 312 are proposed to be felled in present project. Tree cutting and vegetative ground clearance may affect local biodiversity in following ways:

a) Loss of Economically and ecologically significant floral species
b) Loss of bird and wildlife habitats (nests, danes, lekking and bathing areas)
c) Loss of food and forage availability for faunal species
d) Loss of drinking zones falling in transmission Route

The removal of trees and other vegetation along the RoW of the transmission line will not have much ecological impacts as it will impact very little forest habitat and species that are living in these areas.

There is a high diversity of birds in the area as discussed in the baseline chapter. Like many other hornbills (e.g., Oriental pied Hornbill) is a large canopy-dwelling bird depend greatly on mature, large trees for feeding and nesting, as well as large expanses of forest. Pea fowls need specific sites for lekking and dust bath, and largely depend on Ziziphus berries for food in scrub forests. Indian vulture breeds mainly on cliffs and also breeds on high human-made structure.

Birds are good indicators of the health of forests. The cutting of trees can have some effect on the species' abundance (wildlife, birds and insects). The forest cover along the alignment is

quite scanty and tree density is not very high (the highest tree density was 10 per 100m^2). Thus, as stated in para above, total number of adult trees that will be felled along the 12.054 km TL is 312 trees[1].

The net impacts of the Project on forest cover is not significant. However, mitigation measures will compensate not only for loss of trees (and forest cover) but also include measure for collection of information so that specific conservation measures, if any may be implemented.

5.2.3 During Operation Phase

Operations and maintenance of the RoW will not incur major ecological impacts as there will no new towers to be erected. Maintenance works will be very small in scale and infrequent and involves few changes to the existing situation. The practice of allowing some re-growth of vegetation along the RoW will also have ecological benefits as it will allow plants and animals to Re-colonize. Because the forest canopy is now open in these areas the species will be different from those that were originally present, which may be seen as a further gain as this will increase the diversity of habitats.

Electrocution of raptors and other large birds: The impact of electrocution of birds depends on the electro technical design of a pylon and the natural features surrounding it. The net impact of electrocution of large birds is not considered significant because (a) there has been no documented evidence of large bird kills from the existing TL lines around project area; (b) the existing design incorporates construction of cage boxes for conductors to prevent birds from sitting or making nests; and (c) other mitigative measures are proposed to lessen any unforeseen impacts.

Buzzing sound of Transmission Line: A coetaneous buzzing sound has been released from high power transmission line during its cooperation. This sound may affect noise-sensitive fauna as they could avoid the transmission line Route.

5.2.4 Suggested mitigation measures

Ensure Minimal Land clearing and Removal of Vegetation for housing: The project will ensure that wherever possible no land conversion will be required for additional housing. No permanent houses for labors shall be installed in the WLS and all the movement shall be ensured during day hours or as per the guidelines/directions of Sanctuary authority.

[1] Forest Diversion Proposal for Proposed 400 kV D/C JaunpurObra Transmission Line

Forest Conservation: In order to minimize the adverse impacts of clearing the forest cover, contractors shall be made aware of the exact delineation of the RoW and only those trees marked per directives/delineation of Forest staff within the RoW shall be cleared. Moreover, minimum clearance allowed between conductors of transmission lines and trees that are 5.5 m shall be ensured. In this way, all those trees which do not exceed the clearance shall be left undisturbed.

Compensatory Afforestation: The loss of trees will be addressed according to the current guidelines issued by MoEF&CC, Govt. of India, with compensatory afforestation scheme over degraded forest land on twice area of forest land proposed for diversion in WLS area.

The project proponent shall provide funds for the compensatory afforestation as per the guidelines of MoEF&CC and the plantation under compensatory afforestation shall be implemented by the concerned Divisional Forest Officer.

Plantation of Medicinal and Dwarf Species below Transmission Line: Also, plantation of medicinal and/or dwarf species of plants will be carried out below the transmission line as per MoEF&CC guidelines the scheme for which will be prepared by the Divisional Forest Officer.

5.3Biodiversity Conservation Measures

It is expected that no significant irreversible change in local biodiversity will occur as a result of the project. The transmission line will not create any large barriers to wildlife and bird movements. While the transmission line alignment does not pass through any key wildlife habitat discussed in Kaimur Wildlife Sanctuary Management Plan (much of it is barren or scrub forest present in the project route) and is not expected to cause any net loss of species. All the plant species coming within the ground clearance route are very common to the area and more vigorously distributed throughout the wildlife sanctuary.

As far as the RET species and endemism of the plant species is concerned, no rare, endangered, threatened (all the recorded plant species were assessed for their conservation status by cross-checking with Red Data book of Indian plants - Nayar and Sastry, 1987-90) and endemic category species were found.

There are some economically important species that (Tendu, Selaginella, Bamboo, Mahua, Imliand Amla) are present in the area but the commercial use of these species within the area is totally absent. *Oroxylumindicum* was the only reported species as per CAMP, 2010. There is no wildlife lekking or breeding sites, dust bathing sites and nesting sites has been detected in primary survey within project route. No specific animal drinking sites are falling within the project route except transmission line crossing Son river, Ghaghar river, and pond near Chatniya tola, Baluyee Dam and Amawali pond near Bagwari village. Some water holes have been recorded

in the buffer zone of study area; two seasonal water holes between pole 9/3 and 9/4 need to be strengthened.

Any disruption on wildlife will be temporary (just during pre-construction and construction), and animals (including birds) will be able to move around or over construction sites. Still there is always the risk that vulnerable avifaunalspecies may be affected due to reduction in habitat size, disturbance in their daily movements.

An appropriate vertical and horizontal distance between two conductors should be maintained and it is very unlikely that the birds or even monkeys could be electrocuted by contacting these lines. Also, since the distance to the nearest tree is very far from the centre on either side; this does not allow animals to jump to the line from nearby trees.

However, the following measures aim to minimize project impacts on forest and wildlife of the project area and for overall habitat management:

a) Ensure minimal land clearing and removal of vegetation by working closely with the Department of Forest to ensure that that there is no rampant clearing or felling of forest in and around work sites. Also, only those trees identified and marked by the Department of Forest will be felled and removed from the site.

b) Provide funds to the Department of Forest to conduct repeated surveys in the forest areas to determine the distribution and population of rarer and endangered species (to be prioritized by Kaimur Wild Life Division), and to conduct ecological studies to determine the precise habitat requirements, feeding, breeding and impacts on species distribution from habitat fragmentation.

c) There is a provision of conducting biodiversity surveys in and around the project site and create permanent monitoring plots to look at the trend in fauna and avifauna and the change in use of habitat. These studies shall be carried out through biodiversity experts engaged in the primary survey of present project in consultation of Kaimur Wildlife Division.

d) As much as possible, large trees on the edge of the RoW should not be disturbed or damaged, as these are favored habitats of the various large birds. The potential loss of bird and wildlife habitats can be countered by planting suitable trees at other locations which are currently degraded (habitat enhancement in those areas). For example, for Peafowl, which are largely frugivorous (feeding mainly on Ziziphus berries), this would involve replanting of Ziziphus species and well as species like *Ficusroxburghii* to compensate for the loss of felled species

e) Allow the vegetation along the alignment to grow back to at least 2 meters height, which will provide cover for most wildlife that need to move through the RoW

f) Collaborate with Kaimur WLS Wildlife and biodiversity Conservation Programs
g) Implement the recommendations of standing committee of NBWL suggested by Task force constituted by MoEF&CC for EcoFriendly measures to mitigate impacts of transmission line passing through protected area as per 54th meet of Standing committee of NBWL held on 18th July 2019.

Awareness Raising: Awareness-raising will be an important means to mitigate this risk. The contractor and his workers must be informed on the Forest and Nature Conservation Act, Rules and Regulations and copies of these must be made available to them. Workers must be made aware of the fines and penalties for poaching, as well as the risk of job loss, if caught in these illegal activities.

Strengthen Patrolling: To minimize the risks of poaching, awareness programs will be combined with an increase in patrolling by local forest staff. To support enhanced patrolling, the project discusses possibilities for strengthening patrolling or monitoring of illegal activities in the project sites with Sanctuary forest staff. The use of village forest guards (village guards) to alert forest officials of any illegal activities in the worker camps or at project sites can also be used.

5.3.1 Line marking to reduce bird collision:

Bird collision shall be minimized or managed through attaching bird diverters to power lines. Two types of line markers shall be used to minimize bird collision:

(a) Aerial marker spheres (or aviation balls): Aerial marker spheres are one of the earliest devices used in an attempt to reduce bird collisions. Aerial marker spheres (23 cm diameter), also known as aviation balls shall be installed to make power lines more visible above wetland habitat to within TL line corridor. Yellow colour shall be used as it reflects light better at dawn and dusk, and it does not blend in with the background colours as readily as international orange. Most of the studies reported significant reduce in collision due to behavioural avoidance as birds fly higher and react sooner.

Figure 24: Aerial Marker Spheres

(b) Bird Diverter: The swinging or fixed device (Bird Diverter) shall be used over land corridor of Transmission line with a spacing of 10 m. The bird diverter is an acrylic plastic tag, and is covered with yellow and orange reflective tape and photo reactive coatings. They are UV light stabilized and constructed to be highly reflective during the day. According to the manufacturer they glow for up to 10 to 12 hours after sunset. They are attached to the clamp by swivels so they swing and spin in the wind.

Figure 25: Bird Diverters

5.4Impact on Aquatic Ecology

5.4.1 During construction phase

The proposed transmission line would cross over the river Son, Ghaghar and two seasonal ponds. No impacts on aquatic ecology of the rivers are anticipated as the towers meant for river crossing of the transmission line have been planned to be placed at least 100 meters away from the riverbanks. No high conservation value aquatic species (RET/Endemic) has been recorded during primary survey. The impact on lotic water bodies (Son and its tributary Ghagar river) and lentic water bodies (seasonal ponds/wetlands/ditches) and aquatic biodiversity is minimum.

5.4.2 During Operation phase

In this phase there is no substantial impact on the aquatic biodiversity that is anticipated.

Impacts on Fishery: No negative impact on fishery is anticipated.

5.4.3 Suggested Mitigation Measures

Digging machinery and equipment shall not be park at immediate bank of the rivers and ponds. Construction materials like cement, stones, iron, paint etc. shall not be left over on river/pond

side after use. No disturbance in seasonal dry pond shall be ensured and construction activities will be restricted within the allowed area for pillaring.

5.5 Impact on High Conservation Value Species

Kaimur Wildlife Sanctuary is generally known for Black Buck (Mrig) but various high conservation value species have been reported/present within the sanctuary. Primary surveys, people consultation and management plan of the sanctuary confirmed the presence of various species listed below in the sanctuary. These include 02 plants, 06 mammals, 02 birds and 01 reptile. **(Table 19)**

Table 19High conservation value species recorded/reported from study area:

Name	Scientific Name	Conservation Status	Source
Plants			
Indian Caper	*Oroxylum indicum*	Threatened species as per CAMP, 2010	Primary Study
Sanjiwani	*Selaginella bryopteris*	High value medicinal plant, Endemic	Primary Study
Mammals			
Chincara	*Gazella bennettii*	Sc-I, LC	MP-Kaimur WLS, SC
Mrig, Black Buck	*Antilope cervicapra*	Sc-I, NT	MP-Kaimur WLS, SC
Bhediya	*Canis lupus*	Sc-I, LC	MP-Kaimur WLS, SC
Bhalu	*Melursus ursinus*	Sc-I, VU	MP-Kaimur WLS, SC
Bejoo/Bajra	*Mellivora capensis*	Sc-I, LR	MP-Kaimur WLS, SC
Bajra Keet/Sallu Sanp	*Manis crassicaudata*	Sc-I, NT	MP-Kaimur WLS, SC
Birds			
Indian Vulture	*Gyps indicus*	Sc-I, CR	Grimmett et al, 2011 MP-Kaimur WLS
Indian Peafowl	*Pavo cristatus*	Sc-I, LC	Primary Study
Egyptian Vulture	*Neophron percnopterus*	EN	Grimmett et al, 2011 MP-Kaimur WLS
Reptile			

Indian Monitor	*Varanus bengalensis*	Sc-I, LC	SC

SC-Stakeholder Consultation, MP-Kaimur WLS- Management Plan Kaimur Wildlife Sanctuary, Least Concern, En-Endangered, Sc- Schedule as per Wildlife Protection Act, 9172, LC- Least Concern, NT-Near Threatened, VU-Vulnerable, LR-Lower Risk, CR-Critically Endangered

5.5.1 Suggested mitigation measures

Among above mentioned high conservation value species Indian Caper, Sanjiwani, Indian peafowl and Indian Monitor has been observed directly through primary survey within project Route. Rest of the species has been reported in buffer zone through scattered secondary information collected from local people as well as from forest department records. There was no sign of presence of rest of species has been observed during primary survey. Anticipated impacts and on these valuable species due to project activities summarized below:

Table 20: Anticipated impacts on high conservation value species

Name	Scientific Name	Anticipated impacts
Plants		
Indian Caper	*Oroxylumindicum*	• Loss of individuals in land clearing, installation of towers and wires.
Sanjiwani	*Selaginellabryopteris*	
Mammals		
Chinkara	*Gazellabennettii*	• Disturbance due to congregation of labours in construction phase • Accidental intake of any oil and lubricants leaking from construction machinery • Risk of accidental falling in foundation holes during installation of towers • Noise disturbance from machinery used in construction phase • Power line buzzing sound in operation phase Risk of entangling in transmission wires during construction phase
Mrig, Black Buck	*Antilope cervicapra*	
Bhediya	*Canis lupus*	
Bhalu	*Melursus ursinus*	
Bejoo/Bajra	*Mellivoracapensis*	
Bajra Keet/SalluSanp	*Manis crassicaudata*	
Birds		
Indian Vulture	*Gyps indicus*	• Risk of collision, loss of nesting ground
Indian Peafowl	*Pavocristatus*	• Shrinkage of habitat, food, dust-bathing and breeding ground • Risk of entangling in transmission wires during construction phase
Reptile		

Indian Monitor	*Varanus bengalensis*	• Illegal poaching by construction workers • Risk of predation by mongoose, eagles and domestic dogs under exposed habitat conditions

Although the presence of high conservation value species in TL Route is negligible, but there is chance of their movement as some of them have large home range. Home range always fluctuated and largely depends on the vegetation type and availability of food. Progressive plantation, development of new water holes, and development of food plots in the buffer zone are proposed in this study. Such activities can restrict wildlife to move towards TL Route. Also, following measures shall also be implemented for wildlife conservation.

Table 21: Remedial and mitigative measures to be used for high conservation value species

Name	Anticipated impacts	Remedial and mitigative measures
Plants		
Indian Caper (*Oroxylumindicum*)	Loss of individuals in land clearing, installation of towers and wires.	No significant numbers of the species to be cut during ground clearance. Included in the species recommended for planting that compensate appropriately
Sanjiwani (*Selaginellabryopteris*)	loss of individuals in land clearing, installation of towers and wires.	It is a small lithophyte having no use in the area- no chance of getting disturbed
Mammals		
Chinkara (*Antilope cervicapra*), Black Buck (*Antilope cervicapra*), Bhediya (*Canis lupus*), Bhalu (*Melursus ursinus*), Bejoo (*Mellivoracapensis*), SalluSanp (*Manis crassicaudata*)	Disturbance due to congregation of labours in construction phase	No sign of presence of any high conservation value species in TL Route, avoid construction activities during morning and evening hours
	Accidental intake of oil, grease and chemical substance used during construction phase	Timely repairing of machinery shall be ensured, no material shall be left over on construction site, weekly monitoring during construction phase shall be ensured
	Risk of accidental falling in foundation holes during foundation of towers	Hard barrication using Bamboo and net to be ensured during the course of construction activity, weekly monitoring of site during construction phase shall be ensured

	Noise disturbance from machinery used in construction phase as well as blasting during pillaring	Timely repairing of machinery shall be ensured, no heavy machinery will be used in construction phase, no blasting shall be carried out during construction
	Power line buzzing sound in operation phase	New polymer insulators shall be used to minimize insulator noise and dampeners shall be attached to the lines to minimize Aeolian noise
	Risk of entangling in transmission wires during construction phase	No wire shall be left over on forest ground for whole day
Birds		
Indian Vulture (*Gyps indicus*)	Risk of collision, loss of nesting ground	No nesting and breeding site have been identified within TL Route; no case of bird collision has been reported from existed TL running parallel to proposed TL of this project
	Shrinkage of habitat, food, dust-bathing and breeding ground	No dust-bathing as well as breeding ground has been spotted during primary survey within TL Route, planting of various fruit tree like *Ziziphusmauritiana* as well as food plots shall provide enough food and shelter
	Risk of entangling in transmission wires during construction phase	No wire shall be left over on forest ground for whole day

ANNEXURE

6.1Terrestrial and aquatic biodiversity recorded during field surveys

Rhesus Monkey (*Macaca mulatta*)

Common Hoopoe (*Upupa epops*)

Red-naped Ibis (*Pseudibispapillosa*)

Rufous Treepie (*Dendrocittavagabunda*)

Mexican poppy (*Argemone mexicana*)

Ashy-crowned Sparrow Lark (*Eremopterix griseus*)

Vegetation Survey

Neem (*Azadirachtaindica*)

Red-vented Bulbul (*Pycnonotuscafer*)

luxuriant growth of *Xanthium indicum*

Garden Lizard (*Calotes versicolor*)

Green Bea-eater (*Meropsorientalis*)

Buff stripped Keelback (*Amphiesmastolatum*)

Bamboo handicrafts

Northern Plain Langoor (*Semnopithecus entellus*)

Spotted Dove (*Stigmatopeliachinensis*)

Rose-ringed Parakeet (*Psittaculakrameri*)

Red-wattled Lapwing (*Vanellus indicus*)

Laughing Dove (*Stigmatopelia senegalensis*)

Common Sida (*Sidaacuta*)

Ban Tulsi (*Ocimum sanctum*)

Arhar(*Cajanuscajan*)

Bag nakhi (*Martyniaannua*)

Indian Pond Heron (*Ardeolagrayii*)

Brahminy Starling (*Sturniapagodarum*)

Sarphoka (*Tephrosiapurpurea*)

Indian Roller (*Caraciasbenghalensis*)

Baya weaver's Nest

PhulGhawai (*Woodfordiafruticosa*)

Semari (*Vitex negundo*)

Small Grass Yellow (*Euremabrigitta*)

Plain Tiger (*Danaus chrysippus*)

Tendu (*Diospyros melanoxylon*)

Wild boar digging

Indian Skittering Frog (*Euphlyctiscyanophlyctis*)

Lemon Pansy (*Junonialemonias*)

Indian Hare Dropping

Black Drongo (*Dicrurusmacrocercus*)

Blue Moon (*Hypolimnasbolina*)

Danaid eggfly (*Hypolimnasmisippus*)

Rohu (*Labeorohita*)

Goonch(*Bagariusbagarius*)

Rita rita

Clupisomagaura

Wallago attu

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6.3 Kaimur Wildlife Sanctuary Notification

उत्तर प्रदेश सरकार

वन विभाग

अनुभाग-3

अधिसूचना

10 अगस्त, 1982 ई0

सं0 908/14-3—44-78—चूंकि राज्य सरकार की राय है कि पर्याप्त पारिस्थितिक, प्राणि जात, पादपजात, भू-आकृतिक, प्राकृतिक और प्राणितत्वीय महत्व के ऐसे क्षेत्र को, जिसका ब्योरा नीचे अनुसूची में दिया गया है, उसमें वन्यजीवों और पर्यावरण के संरक्षण, संवर्धन और विकास के प्रयोजनार्थ वन्यजीव विहार के रूप में स्थापित करने की आवश्यकता है ;

अतएव, अब, वन्यजीव (संरक्षण) अधिनियम, 1972 (अधिनियम संख्या 53, 1972) की धारा 18 की उपधारा (1) के अधीन शक्ति का प्रयोग करके राज्यपाल उक्त क्षेत्र को वन्य जीव विहार के रूप में घोषित करते हैं जिसका नाम "कैमूर वन्य जीव विहार" होगा :

अनुसूची

"कैमूर वन्य जीव विहार" में सम्मिलित किये जाने वाले क्षेत्र का ब्योरा—

वन प्रभाग का नाम	रेंज का नाम	वन ब्लाक का नाम	क्षेत्रफल
1	2	3	4
			हेक्टेयर में
1—उत्तरी मिर्जापुर	1—हलिया	1—हगरा	3,000.2
		2—हलिया	4,150.0
		3—हर्रा	3,541.7
		4—परासिया	2,625.9
		5—चोरा	1,333.5
		6—मटवार	1,341.5
		योग ..	15,992.8
	2—घोरावल	1—तेंदुहार	3,113.6
		2—सिमरा	3,137.9
		3—परसोना	2,471.3
		4—शिवद्वार	2,149.8
		5—घुमघाड़ी	3,659.4
		6—राजपुर	2,608.3
		7—राबर्ट्सगंज	2,234.9
		योग ..	19,375.2
2—अगोरी	गुरमा	1—सिल्पी	1,271.9
		2—जमुना	2,521.6
		3—बेलवा	880.6
		4—[illegible]	886.0
		5—गुरदाह	925.5
		6—बलुई	291.8
अगोरी	गुरमा	7—मारकुण्डी	495.3
		8—गुरदा	942.5
		9—बेलज	1,063.0
		10—पटपप	1,002.8
		11—[illegible]	921.1
		12—पपाड़ी	1,406.7
		13—मंगेश्वर	1,325.0
		14—कन्धौरा	972.0
		योग ..	14,705.8
		कुल योग ..	50,073.8
		हेक्टेयर या	500.74
		वर्ग किमी0 या	501
		वर्ग किमी0	

सीमा का विवरण :—

1—उत्तर :—बेलन नदी, गोहरा ब्लाक, पनजरा ब्लाक, लुदकी ब्लाक, परसोना ब्लाक, घोरावल ब्लाक तथा राबर्ट्सगंज तहसील के निम्नलिखित ग्राम :—सेमरा खुर्द, परसोना, बदरिया, देवगढ़, हिनौती, पड़पनिया, लिलपाही, चिगोरी, कथा, जमखरी, रिकहरा, गढ़वा, खजुरौल, मुखधारा, डोमहर, कैथटा, तेनुई, मूसल, बघोलिया, फलझाड़ी, बड़ागाटी, ओनौल, जुड़ौली, परधानी, जुडौली, अंवाघी, रेंगुरा, संदूरी, रघुनाथपुर, बहुआर, बसौली, अगोली, बघअरी, तिलौली, सेमरा, सोंधी इत्यादि ।

2—पूर्व—राबर्ट्सगंज—चिरो सड़क मार्ग, कैमूर की पहाड़ी और तरिया रेंज का सनई ब्लाक।

3—दक्षिण—सोन नदी, गुर्मा रेंज का करगरा ब्लाक, सोन नदी, कैमूर की पहाड़ी, बेलन नदी और कैमूर की पहाड़ी।

4—पश्चिम—बजारी वन ब्लाक और मिर्जापुर सदर तहसील के निम्नलिखित ग्राम—चौरा, बिढरिया, थंगुना, परवा, पड़वरा, सौता, देवरी, फुलवारी, गजरिया, सिलहटा, बोधा, कथलकर, खाहरियाकला, अदवा जलाशय, परहुला, गुर्मा, अहुगी जलाशय, अहुगी खुर्द, बढ़ौली, मपौर, दिघिया, हलिया, बगुहरा, मदई खुर्द, देवघटा पाण्डे, खरिहर खुर्द, आदि।

आज्ञा से,

जगदीश चन्द्र पन्त,

सचिव ।

In pursuance of the provisions of clause (3) of Article 348 of the Constitution the Governor is pleased to order the publication of the following English translation of notification no. 908/14-3—44-78, dated August 10, 1982 :

No. 908/14-3—44-78

August 10, 1982

Whereas, the State Government is of the opinion that the area, the details of which are given in the Schedule below is of adequate ecological, faunal floral, geomorphological, natural and zoological significance for the purpose of protecting propogating and developing wild life therein and its environment ;

Now, therefore in exercise of the powers under sub-section (1) of section 18 of the Wild Life (Protection) Act, 1972 (Act no. 53, of 1972), the Governor is pleased to declare the said area as a sanctuary to be named as 'Kaimur Sanctuary'.

Schedule

Details of the area to be included in "Kaimur Sanctuary".

Boundary description :

1. *North*.—River Belan, Gahra Block, Panjra Block, Ladki Block, Parsona Block, Ghorawal Block and following villages of Robertsganj tehsil Semra Khurd, Parsona, Var Badricha, Deogarh, Hinauti, Parhpania, Lilpahi, Chigori, Sandha, Jamkhari, Rikhara, Garma, Khajuraul, Mokhdhara, Domihar, Kowta, Tenui, Gukhal, Chagaolia, Phaljhari, Baragalo, Onobi Jurholi, Pardhani, Olapi, Rajpura, Senduri, Raghunathpur, Bahuar, Basauli, Amauli, Badhwari, Tilauli, Simra, Lodhi, etc.

2. *East*.—Robertsganj—Pipri Road, Kaimur Hills and Sannai Block of Taria Range.

3. *South*.—Son River, Kargara Block of Gurma Range. Son river Kaimur Hills, Belan river and Kaimur Hills.

4. *West*.—Banjari Forest Block and following villages of Mirzapur Sadar Tehsil Chaura, Bidaria, Thogana, Varaya, Patwara, Tita, Deori, Phulpari, Gajuria, Silhata, Thothe, Kawalkar, Khamaria Kalan, Adwa reservoir, Barhula, Gurga, Ahugi reservoir, Ahugi Khurd, Barholi, Maghar, Dighia, Halia, Vasuhara, Madai Khurd, Deoghata Pandey and Khajuhar Khurd, etc.

Area :

This Sanctuary will comprise areas given here under :

Name of forest division	Name of range	Name of forest block		Area
1	2	3		4
				Hectare
North Mirzapur.	1. Halia	1. Sagra	..	3,000.02
		2. Halia	..	4,150.00
		3. Haria	..	3,511.07
		4. Parsia	..	2,625.09
		5. Channa	..	1,334.05
		6. Matwar	..	1,311.05
		Total	..	15,992.0
	2. Ghorawal	1. Tendular	..	3,113.08
		2. Semra	..	3,137.09
		3. Parsona	..	2,171.03
		4. Sheodawar	..	2,119.08
		5. Dandhari	..	3,659.01
		6. Rajpur	..	2,608.03
		7. Robertsganj		2,231.09
		Total	..	19,375.02
Agori	Gurma	1. Salpi	..	1,271.00
		2. Jamuna	..	2,521.06
		3. Belwa	..	880.06
		4. Alaur	..	675.00
		5. Gondah	..	925.05
		6. Bahu	..	291.08
		7. Markundi	..	195.03
		8. Gurma	..	912.05
		9. Bahuch	..	1,063.00
		10. Patwadh	..	1,002.08
		11. Kaurach	..	971.01
		12. Patari	..	1,106.07
		13. Mangeshwar		1,325.00
		14. Kandakotan	..	972.00
		Total	..	11,565.08
		GRAND TOTAL	..	50,073.08
				or
				500.73 sq. km.
				or
				501 sq. km.

By order,

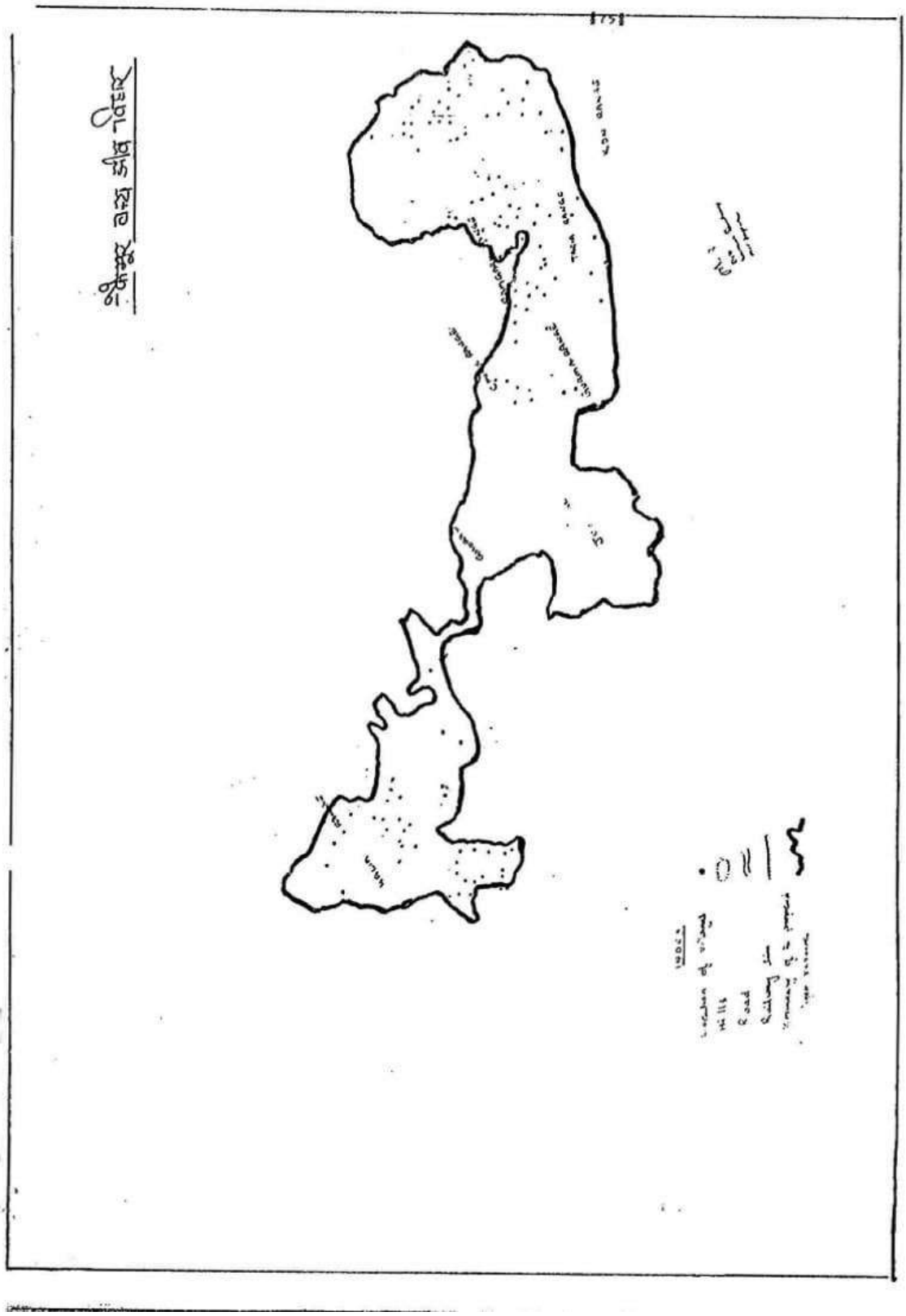
JAGDISH CHANDRA PANT,

Sachiv.

टिप्पणी—राजपत्र दिनांक 16-10-82, भाग 1 में प्रकाशित है।

[प्रतिलिपि सूचनार्थ प्रेषित——]

पी० एस० यू० पी०—15 सा० (वन)-3-11-82-25 (मोनो)।



Confluence of Ghagar and Son Rivers

Picture Credit: Ranir Pal Saini