

**WILDLIFE MANAGEMENTY PLAN
FOR
WIDENING OF MEGHA-SINGPUR-DUGLI ROAD**



Submitted to

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Submitted by

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WILDLIFE MANAGEMENT PLAN FOR WIDENING OF MEGHA-SINGPUR-DUGLI ROAD

FOREST DIVISION DHAMTARI, CHHATTISGARH

1. INTRODUCTION

Increase in extent of linear developments, outside protected areas (PAs), presents a major challenge to wildlife management and conservation, as the linear developments create barriers or breaks in habitat, which is detrimental to the long term conservation of species and ecosystems. There is a pressing need for conservation and development to go hand in hand, complementing rather than conflicting with each other.

Linear infrastructure development should be animal friendly by providing pathway for movement of species. In addition, linear infrastructure would need to be “green” to mitigate any negative impact on sensitive habitats. Importantly, designing green infrastructure can encourage community support for and reduce opposition to economic development. Green infrastructure is, thus, a design and develops with nature concept. It helps to build robust, healthy and enduring landscape which enable species to move and adapt.

Integrating transport infrastructure with living landscape, for economic growth, has become the most urgent priority of the day. Let us have the twin benefits of conserving nature and promoting road and rail development (Negi, 2016) The task to prepare guideline document “**Ecofriendly measures to mitigate impacts of linear infrastructure on wildlife**”. was assigned by the MoEF&CC, to the Wildlife Institute of India (WII). The WII has prepared an exhaustive document on this issue. Mitigation refers to measures to avoid, reduce or remedy harms. In the context of developing linear infrastructure such as road and railway lines, the purpose of mitigation is to identify strategies and measures that will address the conservation concerns likely to be associated with the development proposals. In order to deliver the potential benefits of

green infrastructure development, these strategies and measures must follow a set of key mitigation principles, as set out below. To achieve this, SMART (specific, measurable, achievable, realistic and timely) approach will be used. Mitigation, proposed presently, will aim to address not only direct footprint impacts on natural systems but also ecological effects caused by the development of linear infrastructure which may be manifest in decades to come.

2. LOCATION OF THE ROAD FOR WIDENING

The area is Megha-Singpur –Dugli road which comes under block Magarload and Nagri in Dhamtari district of Chhattisgarh. The site is located 18.7 from Nagri bus stand. The area comes under the forest ranges of Keregaon, north singpur, south singpur and Dugli in Dhamtari forest division. The proposal road is covered under the survey of India Toposheet numbers 64H13, 64H14 and 64H15.

Table 2.1: Details of forest area coming under the road

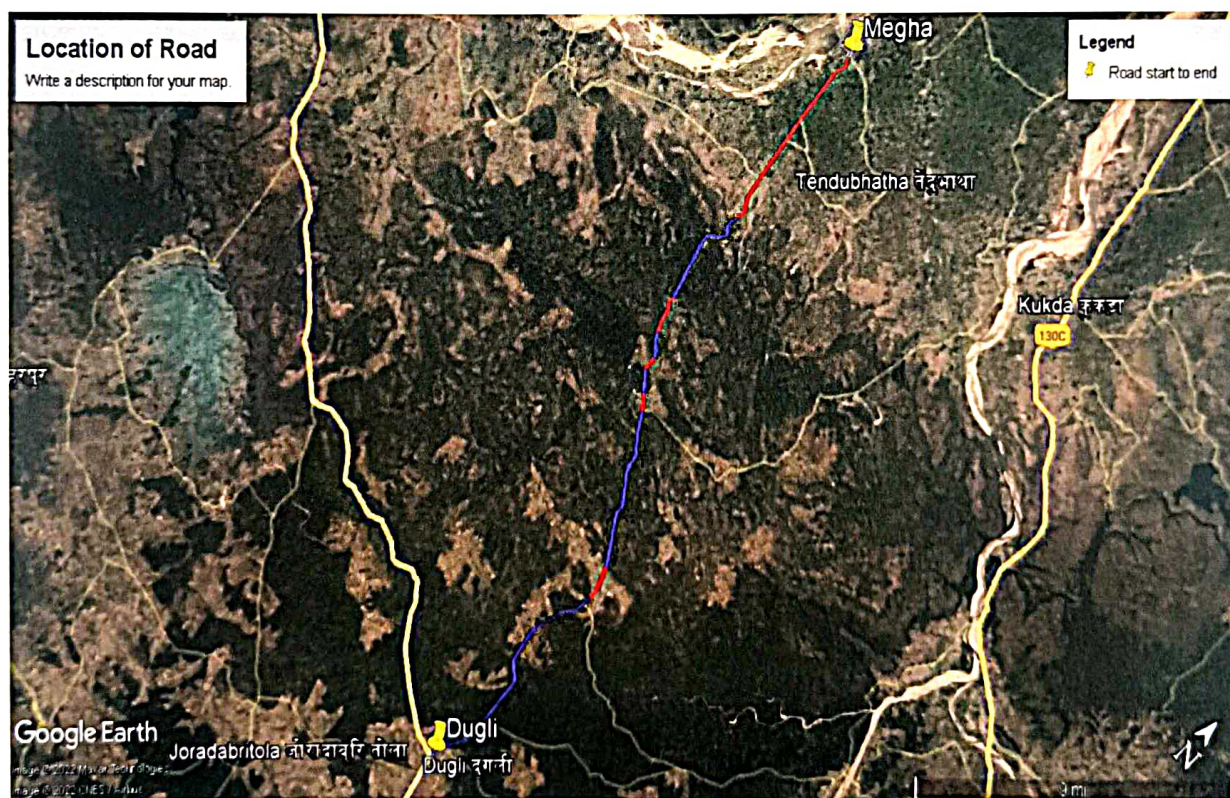
Sl. No	Forest division	Land types	Forest compartment No	Area in Ha.
1	Dhamtari	Reserve Forest	64	0.596
2	Dhamtari	Reserve Forest	74	0.955
3	Dhamtari	Reserve Forest	38	6.041
4	Dhamtari	Reserve Forest	76	1.399
5	Dhamtari	Reserve Forest	55	6.240
6	Dhamtari	Reserve Forest	57	1.466
7	Dhamtari	Reserve Forest	78	3.297
8	Dhamtari	Reserve Forest	39	3.534
9	Dhamtari	Reserve Forest	77	3.979
10	Dhamtari	Reserve Forest	87	0.259
11	Dhamtari	Reserve Forest	254	1.564
12	Dhamtari	Reserve Forest	260	2.292
13	Dhamtari	Reserve Forest	258A	0.725
14	Dhamtari	Reserve Forest	69	1.527
15	Dhamtari	Reserve Forest	259	1.457
16	Dhamtari	Reserve Forest	258	1.761
17	Dhamtari	Reserve Forest	63	0.881
TOTAL			17 compartments	37.973

Table 2.2: Details of revenue area coming under the road

Sl. No	District	Name of block	Land type	Area in Ha.
1	Dhamtari	Magarload	Revenue non forest	20.721

Table 2.3: Land summary of the road

Sl. No	Land description	Width in Meter	Length in KM	Area in Ha.
1	Reserve forest	16	23.715	37.973
2	Revenue land		12.971	20.721
	Total		36.686	58.694



Map 2.1: Location of Megha - Singpur - Dugli road

3. NEED FOR STRENGTHENING AND WIDENING THE ROAD

The constructed road connects Magarload, Nagri and Kurud towns but the constructed road is narrow in width and due to heavy traffic load the road causes hindrance to smooth movement of traffic, as well as due to poor condition of the road traffickers face additional problems. The people of adjoining villages of Chhoti Kareli, Chhipli, Mohandi, Kusumkhuda suffer most the condition of the roads. Looking to the problem of local people, to make the travel easier, a detailed proposal has been prepared for technical approval for strengthening and widening the road.

Up-gradation renewal and widening work of Megha–Singhpur-Dugli Road (MDR) I/c Culverts is proposed for a total length of 35 km. Proposal for strengthening and widening of road is: formation width of road - 10 meter, B T (carriage width) - 7 meter, hard shoulder width - 1.5 m (both sides), Design crust thickness - 560mm (230mm metal GSB, 250mm Wmm, 50mm DBM & 30mm B C), 21 nos. Culverts and 3670 meters RCC open drains & required Toe wall.

4. THE STUDY AREA

4.1. Geology and rock

Major rock types are Schist and Gneiss of Cuddapah series of Archean age. Some other rocks are granite, sandstone and quartzite. Archean rocks are overlain by the cuddapah rocks. Soil is mainly sandy loam. Granite is more resistant to erosion. Soil produced by the erosion of this rock is sandy and shallow and is less productive. Laterite occurs sporadically, on the hill tops. Soil produced by the weathering of cuddapah rock is either shallow or deep. Sand stone produces sandy and shallow soil. Over such soil, sal forest is replaced by mixed forest. Over sandy-loam soil good quality sal or mixed forests develop. Due to local variation in geo-morphology, at some places clay soil also is found. In such areas, with poor drainage of water sal is replaced by saja (*Terminalia tomentosa*). However, in well drained areas both, sal and saja occur together. In the area, cut and broken plains are observed. In such areas sheet and gully erosion is very common. Due to overgrazing and recurrent fire soil erosion is more in these areas. In these areas, at places, low quality sal or mixed forests occur.

Undergrowth is poor. Dhawai (*Woodfordia fruticosa*) and Kurru (*Gardenia resinifera*) are the common undergrowth.

4.2. Soil

On the plateaus at places rocks are exposed with shallow soil supporting low, open forests. Near to nalas, alluvial soil supports better growth of trees. Foliated granite form better soil. Due to richness of iron the soil is red. Un-foliated granite decomposes slowly, but the soil formed by them is deeper. In the absence of summer fire, the surface bears a cognizable layer of litter, as well as A1 (humus) horizon is clearly discernible which may be up to 15 cm in depth. Soil below the humus layer is yellow or red which becomes more red with increasing depth. Soil at such places is soft, rich in sesquioxide. Soil may be 3-4 m in depth supporting good quality sal. More eroded gravelly soil supports Chhind (*Phoenix accaulis*).

4.3. Climate

Climate has very important bearing on the life forms of an area. Infact Global climatic classifications, given by Wladimir Koeppen and C. W. Thornthwaite are based mainly on the vegetation, while climatic classification, given by G.T. Trewartha is a blending of empirical and genetic systems. Climate of the area, according to Koeppen and Trewartha is Tropical Wet and Dry climate while according to Thornthwaite it is Tropical Sub-humid climate. Present description of climate is based on last 10 years data (2007 - 2016), obtained from Meteorology Department, Indira Gandhi Krishi Vishwavidyalaya, Raipur.

Temperature

Temperature data is based on 10 years average from 2007 to 2016. Mean maximum temperature ranged from 28.55°C, recorded for the month of December to 42.45°C recorded for the month of May. In some years, in this month, maximum temperature may go up to 46.8°C, as has been recorded for the year 2015.

Table – 4:1. Climatic data for Raipur (the nearest meteorological station)

Months	Temperature °C		Rainfall (mm)	Relative Humidity		Evapo ration (mm)	Suns hine (hrs)
	Mean Max	Mean Min.		7 am	5 pm		
Jan	29.08	9.86	9.35	86.2	35	2.98	7.86
Feb	33.00	13.78	15.01	79.6	32	4.2	8.53
Mar	37.67	18.40	6.45	64.7	24	6.32	8.58
Apr	41.40	22.66	23.84	49.3	22	9.23	9.28
May	42.45	26.56	20.70	45.3	21	10.23	8.87
Jun	39.60	25.35	213.61	69.6	48	7.9	5.54
Jul	31.63	23.95	426.86	89.4	74	4.4	3.28
Aug	31.02	23.97	297.33	91.7	78	4.14	3.74
Sep	30.84	23.61	250.16	91.9	72	3.44	4.63
Oct	31.42	17.70	39.44	90.8	57	3	7.23
Nov	30.42	15.45	9.70	89.8	40	3.1	7.96
Dec	28.55	10.06	9.05	89.7	35	2.63	7.72
			1321.5		Av.	5.13	6.94

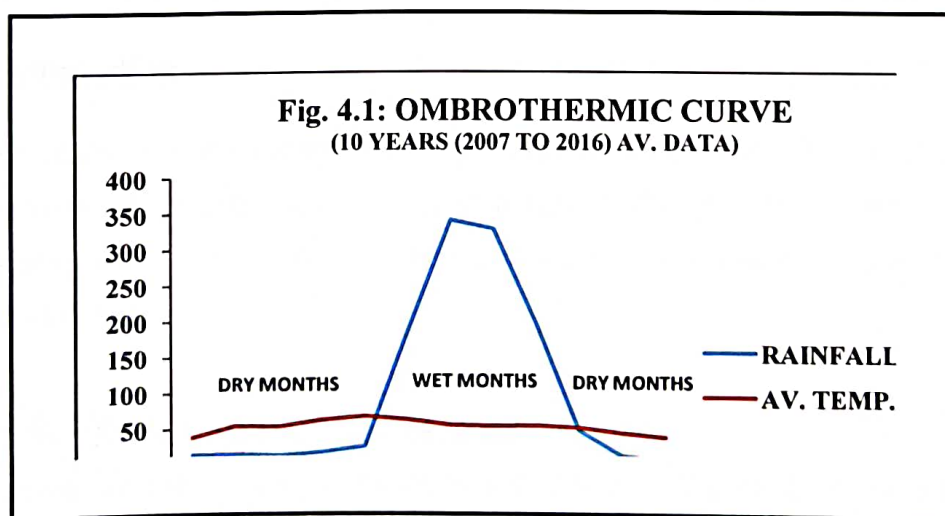
The day time temperature, during the peak summer season, are maintained very high, right from the second fortnight of April to first week of June. Mean minimum temperature ranges from the lowest of 9.86°C, recorded for the month of January to 26.56°C recorded for the month of May. Monthly average of minimum temperature, during winter months, is generally between 9.0 – 12°C but may go down even to 7.4°C. Annual average temperature, in most of the years, remains at about 27°C. However, in last 10 years, 2007 and 2008 have been recorded as the coldest years with yearly average temperature of 24.27°C and 23.24°C, respectively, while 2015 has been recorded as the hottest year with annual average temperature of 27.93°C.

The temperature, based on last 10 years data, indicates a slightly increasing trend, however, with a very low R^2 value, indicating that the yearly variation in temperature is much erratic.

Rainfall

The monsoon in the area sets in around 15th of June. Average annual rainfall in the last 10 years is 1321.5 mm. The monsoon normally starts withdrawing from 15th of September. Nearly 85% of rain is received only in three to four months in a year, between the months of June to September. On an average there are only 65 rainy days, during which most of the rainfall occurs within 25 days or more precisely within less than 125 hours. Due to this most of the rainwater is lost as runoff to the rivers, ultimately to the ocean. Rainfall exhibits wide variation in monthly as well as annual values. In the last 46 years 1988 was the driest year with 709.0 mm rainfall while 1994 with 1688 mm rainfall was the wettest year. On the basis of 10 year average the month of March is the driest month followed by the months of December and January. The month of July is the wettest month when as high as 639 mm rainfall was received in this month, in the year 2012. The rainfall, based on last 10 years data, indicates an increasing trend, however, with a very low R^2 value, indicating that the yearly variation in rainfall is much erratic.

Ombrothermic curve:



Ombrothermic curve (Fig. 3) is based on last 10 years data of temperature and rainfall. The curve gives a better idea of the temperature and rainfall, together. In the curve rainfall is taken in mm while temperature in $^{\circ}\text{C}$ is taken, multiplied by 3. Months in which rainfall curve exceeds temperature curve, the months are taken as wet months while the months in which the rainfall curve is below the temperature curve, the months are taken as dry months. On this basis, months of June to September (4 months) are wet months, month of October is on the borderline between dry and wet months while the remaining seven months are dry months. Thus in the area dry period prevails for a very long time, at least for 7 - 8 months, and becomes testing to the survival of plants.

Humidity

The atmospheric humidity is usually low during the summer months (March-May). However, right from about the second fortnight of June the humidity slowly starts building up and as soon as the monsoon sets in, it reaches a peak value of over 90 percent. This high humidity condition persists till the end of October.

Sunshine

During July and August the average bright sun shine hours are only around 3-4 hours per day. During active monsoon season the bright sunshine hours become zero even continuously for more than 10 days. Sunshine hours never exceed more than 10 hours. Month of April receives maximum sun shine, averaging at 9.28hrs a day.

Evaporation

As regards evaporation rates peak rate of evaporation is during the summer months, reaching to more than 10 mm in a day in the month of May. In addition, advection losses increase the evaporation and evapotranspiration values by two to three folds during May.

4.4. Water source in the area

There are only a few ponds along either side of the road. These are generally seasonal retaining water only, at the most, to the end of winter season. These ponds/tanks are

located near to village settlements, sufficient reason to distract the wildlife to approach the ponds for water. However, due to scarcity of water even these ponds are visited by the wildlife, as evidenced by the hoof marks of Chital and pug marks (probably) of hyaena and Jackal. This is a seasonal river, however, retaining water at some places along its course, throughout the year. Very interestingly there is an area where the water accumulates during rainy season, major part of this area gets dried, but a small ditch retains water, even during the dry months. Due its being very small in area, with heavy amount of nutrients flowing in from surrounding area, the ditch becomes highly eutrophicated, promoting growth of floating plants on its surface. A dug well of unknown age is there, near to the ditch. The well also retains water throughout the year. There is also a small dam near to the road. The dam is also perennial. However, a hut has been constructed on the bund of the dam. Whatsoever, the purpose of the hut may be, but it is probably distracting the wild animals from approaching the dam as very few hoofmarks and pug marks have been observed near to the dam. Periphery to some depth of water of almost all the water bodies, particularly the dam, are heavily infested with the notorious weed, Besharam (*Ipomoea carnea*). The weed makes it difficult to the wildlife to approach the water bodies.

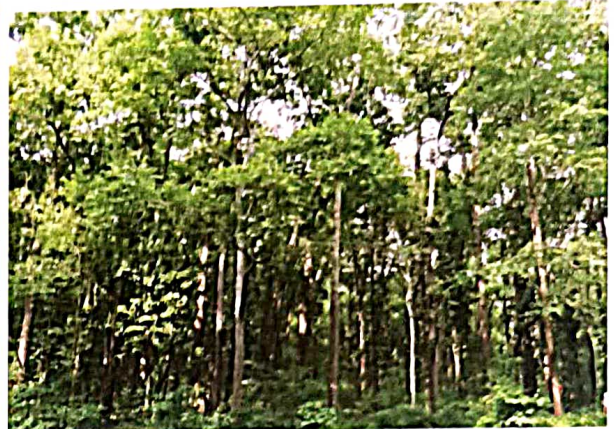
5. Vegetation and forest types of the area

Vegetation of the study area is mainly forest or cultivated fields with very little area covered with lentic (static) and lotic (running) water bodies. Three types of forests are encountered in the area, viz: Mixed forest, Sal forest and Teak forest. Mixed forest and Sal forest are natural forests of the area while planted teak form the teak forest area. Extensive teak plantation has been made on both the sides of the road near Dugli village of Dugli forest range. Due to its extent in large area, although, it is an artificial (plantation) forest, teak forest has been included as a type of forest. The North Singpur, south Singpur and Keregaon forest ranges have mixed forest while Dugli forest range have good sal forest patch and teak plantation.

FORESTS IN THE STUDY AREA



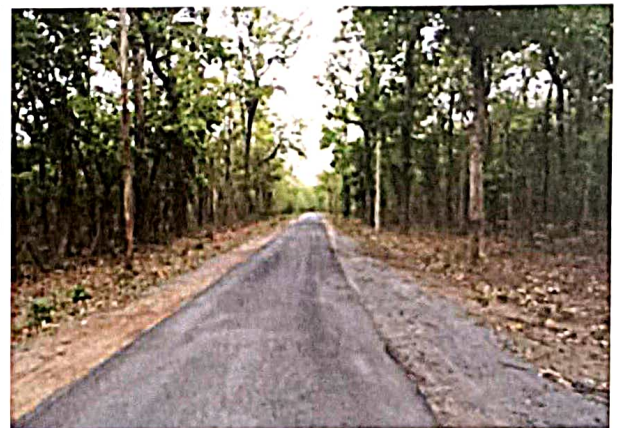
Teak (Plantation) Forest



Sal Forest



Mixed deciduous forests



Mixed deciduous forests

Forest types

There are three types and several subtypes of forest in the area. According to Revised Classification of the Forest Types of India (Champion & Seth, 1968) the forests of the area are:

1. Sal forest 3C2e(ii), (iii) and 5B/C1c
2. Mixed forest 5A/C3, C3/a, E1
3. Teak (plantation) forest 5A/C1b, 3B/C1

Details of the types of the forests are as follows:

Sal Forests

I Moist tropical forests

Group 3 - Tropical moist deciduous forests

Sub-group 3B South Indian moist deciduous forests

C1 – Moist teak bearing forest

1b – Moist teak forest

Sub-group 3C - North Indian moist deciduous forest

C2 – Moist sal bearing forest

2e – Moist peninsular sal forest

(ii) – Moist peninsular low level sal

(iii) – Moist peninsular valley sal

C3. – Moist mixed deciduous forest (without sal)

3a – West Gangetic moist mixed deciduous forest

General edaphic and seral types of moist deciduous forests

E1 – *Terminalia tomentosa* forest

II Dry tropical forest

Group 5 – Tropical dry deciduous forests

Sub-group 5A – Southern tropical dry deciduous forests

C1 – Dry teak bearing forests

- 1b – Dry teak forest
- C3 – Southern dry mixed deciduous forests
- Sub-group 5B – Northern tropical dry deciduous forests
- C1 – Dry sal bearing forest
- 1b – Dry plains sal forest

6. METHODOLOGY FOR PHYTOSOCIOLOGY & DIVERSITY INDICES

Phytosociology of trees

Phytosociology includes multiple parameters to evaluate the relative importance of the trees in forests. Importance value index (IVI) is one of the best estimate to determine the relative importance of trees. Diversity of the trees is determined with the help of various diversity indices.

To determine the Importance value index of trees 5 nos square quadrats of 30 x 30 m size were laid in each of the three type of forests, viz: Mixed forest, Sal forest and Teak forest. Circumference (girth) at breast height (CBH or GBH) of each of trees in the quadrat, species wise, was recorded from which phytosociological calculations were made. Plants with girth ≤ 30 cm with ≤ 5 m in height were taken as trees, plants smaller than above and woody and perennials were taken as shrubs while soft bodied plants were taken as herbs.

Basal area, frequency and density, their relative values and importance value index (IVI) of individual tree species were calculated using the following formulae:

$$\text{Basal area} = \frac{(\text{Circumference at breast height})^2}{12.56}$$

$$\text{Frequency} = \frac{\text{No. of sampling plots in which the species is}}{\text{Total No. of plots sampled}} \times 100$$

$$\text{Density (Ha}^{-1}\text{)} = \frac{\text{No. of individuals of the species}}{\text{Total area sampled (ha)}}$$

$$\text{Relative basal area} = \frac{\text{Basal area of the species}}{\text{Basal area of all the species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of the species}}{\text{Frequency of all the species}} \times 100$$

$$\text{Relative Density} = \frac{\text{Density of the species}}{\text{Density of all the species}} \times 100$$

$$\text{IVI (of trees)} = \text{Relative basal area} + \text{Relative frequency} + \text{Relative density}$$

Shrubs were sampled with the help square quadrats of 5 x 5 size. Five such quadrats were laid in each forest type. In these quadrats all the woody plants with < 30 cm CBH were recorded species wise. Herbs were sampled with the help of 1 x 1 m square quadrat. Five such quadrats were laid in each forest type. Here also only the species present in quadrats were recorded.

Diversity indices:

Diversity indices have played very little practical role in the conservation of ecosystems. However, the values are calculated as a tradition, therefore have been calculated during present studies, also. Calculation of biodiversity, as Shannon index of diversity, was made with IVI.

Shannon index

Shannon index was calculated using the formula (Shannon 1948):

$$H' = - \sum P_i \ln P_i$$

Where, P_i is the proportion (basal area) of the species relative to the total basal area of all the species, $\ln$ is the natural logarithm, the final product is multiplied by -1.

7. VEGETATION IN STUY AREA

7.1. Phytosociology of trees

There are 34 tree species found during the study. Some trees like *Cleistanthus collinus*, *Chloroxylon sweitenia*, *Lagerstroemia parviflora*, *Anogeissus latifolia*, *Buchanania lanzan*, *Diospyros melanoxylon*, *Shorea robusta* and *Terminalia tomentosa* are recorded in all plots during the study.

During the survey, the *Cleistathus collinus* was found to have maximum Importance Value Index (45.07), followed by *Shorea robusta* (33.65), *Lagerstroemia parviflora* (33.36), *Terminalia tomentosa* (27.77), *Chloroxylon sweitenia* (20.61), *Diospyros melanoxylon* (14.73), respectively in IVI values.

In term of density number per hectare, maximum was *Cleistanthus collinus* (62.40/ha) followed by *Lagerstroemia parviflora* (52.80/ha), *Chloroxylon sweitenia* (38.40/ha), *Shorea robusta* (36/ha), *Terminalia tomentosa* (33.60/ha), *Buchanania lanzan* (21.60/ha), *Tectona grandis* (21.60/ha), *Diospyros melanoxylon* (19.20/ha), *Casearia elaptica* (19.20/ha), *Anogeissus latifolia* (16.80/ha), *Holharhina antidysenterica* (16.80/ha) was recorded. Details are depicted on following table 1.

Table 7.1: Photosociology of tree species in study area

Sl. No	Name of species	Basal area	Freq. (%)	Density no/ha	R. BA	RF	RD	IVI
1	<i>Acacia catechue</i>	326.11	10.00	2.40	0.07	1.11	0.55	1.72
2	<i>Antidesma ghaesembilla</i>	357.40	20.00	4.80	0.07	2.22	1.09	3.39
3	<i>Anogeissus latifolia</i>	15204.54	50.00	16.80	3.09	5.56	3.83	12.47
4	<i>Aegle marmelos</i>	183.44	10.00	2.40	0.04	1.11	0.55	1.69
5	<i>Buchanania lanzan</i>	11740.13	40.00	21.60	2.38	4.44	4.92	11.75

6	<i>Butea monosperma</i>	286.62	20.00	4.80	0.06	2.22	1.09	3.37
7	<i>Boswellia serrata</i>	1345.54	10.00	2.40	0.27	1.11	0.55	1.93
8	<i>Bobax ceiba</i>	249.68	10.00	2.40	0.05	1.11	0.55	1.71
9	<i>Cleistanthus collinus</i>	108244.90	80.00	62.40	21.97	8.89	14.21	45.07
10	<i>Casearia elaptica</i>	4857.40	40.00	19.20	0.99	4.44	4.37	9.80
11	<i>Casearia graveolens</i>	97.53	10.00	2.40	0.02	1.11	0.55	1.68
12	<i>Chloroxylon sweitenia</i>	25596.26	60.00	38.40	5.20	6.67	8.74	20.61
13	<i>Carriya arborea</i>	191.16	10.00	2.40	0.04	1.11	0.55	1.70
14	<i>Diospyros melanoxylon</i>	18191.40	60.00	19.20	3.69	6.67	4.37	14.73
15	<i>Dalbergia paniculata</i>	168.47	10.00	2.40	0.03	1.11	0.55	1.69
16	<i>Emblia officinalis</i>	1560.51	20.00	4.80	0.32	2.22	1.09	3.63
17	<i>Gardenia gummifera</i>	390.13	20.00	4.80	0.08	2.22	1.09	3.39
18	<i>Gardenia latifolia</i>	1987.58	20.00	7.20	0.40	2.22	1.64	4.26
19	<i>Holharhina pubescence</i>	4472.05	30.00	16.80	0.91	3.33	3.83	8.07
20	<i>Haldina cordifolia</i>	630.65	10.00	2.40	0.13	1.11	0.55	1.79
21	<i>Lannia coromendelica</i>	24084.39	40.00	16.80	4.89	4.44	3.83	13.16
22	<i>Lagerstroemia parviflora</i>	66803.82	70.00	52.80	13.56	7.78	12.02	33.36
23	<i>Madhuca longifolia</i>	535.35	20.00	4.80	0.11	2.22	1.09	3.42
24	<i>Mitragyna parvifloya</i>	109.00	10.00	2.40	0.02	1.11	0.55	1.68
25	<i>Ougenia oojenensis</i>	161.23	10.00	2.40	0.03	1.11	0.55	1.69
26	<i>Pterocarpus marsupium</i>	7165.61	20.00	7.20	1.45	2.22	1.64	5.32
27	<i>Syzygium cumini</i>	42.12	10.00	2.40	0.01	1.11	0.55	1.67
28	<i>Schleichera olosa</i>	2410.51	20.00	7.20	0.49	2.22	1.64	4.35
29	<i>Shorea robusta</i>	108988.85	30.00	36.00	22.12	3.33	8.20	33.65
30	<i>Terminalia arjuna</i>	92.04	10.00	2.40	0.02	1.11	0.55	1.68
31	<i>Terminalia bellerica</i>	1304.46	20.00	7.20	0.26	2.22	1.64	4.13
32	<i>Terminalia tomentosa</i>	60818.15	70.00	33.60	12.34	7.78	7.65	27.77
33	<i>Tectona grandis</i>	23996.89	20.00	21.60	4.87	2.22	4.92	12.01
34	<i>Ziziphus xylopyra</i>	81.53	10.00	2.40	0.02	1.11	0.55	1.67
		492675.48	900.00	439.2	100.00	100.00	100.00	300

Fr = Frequency RF = Relative frequency
 Den = Density RD = Relative density
 BA = Basal area RBA = Relative basal area
 IVI = Importance value index

- ✓ **Shannon index of diversity was found to be = 1.282**
- ✓ **Simpson index is 0.073**
- ✓ **Simpson's Index of Diversity 0.927**

Table 7.2: List of saplings

1. *Anogeisus latifolia*
2. *Aegle marmelos*
3. *Antidesma ghaesembila*
4. *Buchanania lanzan*
5. *Butea monosperma*
6. *Butea superba*
7. *Casearia graveolens*
8. *Casearia elliptica*
9. *Cassia fistula*
10. *Chloroxylon sweitenia*
11. *Cleistanthus collinus*
12. *Dalbergia paniculata*
13. *Dendrocalamus strictus*
14. *Diospyros melanoxylon*
15. *Emblica officinalis*
16. *Flacauritia ramontchi*
17. *Gardenia gummifera*
18. *Gardenia latifolia*
19. *Gardenia resinifera*
20. *Gardenia turgida*
21. *Helicteris isora*

22. *Holarrhena antidysenterica*
23. *Ixora pavetta*
24. *Lagerstroemia parviflora*
25. *Lannea coromandelica*
26. *Madhuca indica*
27. *Mitragyna parviflora*
28. *Scheiechera oleosa*
29. *Shorea robusta*
30. *Terminalia tomentosa*
31. *Terminalia bellerica*
32. *Zizyphus oenoplia*
33. *Zizyphus xylopyra*

Table 7.3: List of climbers

1. *Olax scandense*
2. *Smilax microphylla*
3. *Zymnema sylvestre*
4. *Zizyphus oenoplia*
5. *Olax scandense*
6. *Dioscorea bulbifera*
7. *Dioscorea alata*
8. *Dioscorea hispida*
9. *Amplimeros repunda*
10. *Ventilago clyculata*
11. *Cessampilas pariera*
12. *Ampelocissus latifoia*
13. *Cocculus hirsutus*
14. *Gloriosa superb*

Table 7.4: List of major weeds

1. *Phoenix occaulis*
2. *Hyptis suaveolens*
3. *Lantana camara*
4. *Eupatorium odorata*
5. *Ageratum conyzoides*
6. *Cassia tora*
7. *Urena lobata*

Table 7.5: List of shrubs and herbaceous species

- | | |
|------------------------------------|-------------------|
| 1. <i>Achyranthes aspera</i> | <i>Chirchita</i> |
| 2. <i>Ageratum conyzoides</i> | <i>Ghamota</i> |
| 3. <i>Alysicarpus monilifer</i> | |
| 4. <i>Andrographis paniculata</i> | <i>Chirchita</i> |
| 5. <i>Barleria cristata</i> | <i>Koranta</i> |
| 6. <i>Borreria hispida</i> | |
| 7. <i>Borreria stricta</i> | |
| 8. <i>Bryonia retusa</i> | |
| 9. <i>Cassia tora</i> | <i>Charota</i> |
| 10. <i>Convolvulus nummularius</i> | |
| 11. <i>Crotalaria montana</i> | |
| 12. <i>Crotalaria prostrata</i> | |
| 13. <i>Curculigo orchoides</i> | <i>Kali musli</i> |
| 14. <i>Desmodium triflorum</i> | <i>Teen patti</i> |
| 15. <i>Elephantopus scaber</i> | |
| 16. <i>Evolvulus alsinoides</i> | |
| 17. <i>Grewia rothi</i> | |
| 18. <i>Grewia hirsuta</i> | |
| 19. <i>Helicteris isora</i> | |
| 20. <i>Moghania nana</i> | <i>Balraj</i> |

21. <i>Moghamia strobilifera</i>	<i>Chepti</i>
22. <i>Oldenlandia corymbosa</i>	
23. <i>Phyllanthus amarus</i>	<i>Bhui neem</i>
24. <i>Polygala chinensis</i>	
25. <i>Scoparia dulce</i>	<i>Hazardana</i>
26. <i>Sida acuta</i>	<i>Bariyari</i>
27. <i>Sida cordifolia</i>	
28. <i>Sida humilis</i>	
29. <i>Sida rhomoides</i>	
30. <i>Solanum nigrum</i>	<i>Janglibhata</i>
31. <i>Triumphetta annua</i>	<i>Latkana</i>
32. <i>Triumphetta pilosa</i>	<i>latkana</i>
33. <i>Uraria picta</i>	
34. <i>Urena lobata</i>	
35. <i>Vandelia cristata</i>	
36. <i>Vandelia sp</i>	
37. <i>Zornia gibbosa</i>	

Table: 7.6. List of grasses & sedges

1. <i>Andropogon aciculatus</i>	<i>Mothi marvel</i>
2. <i>Andropogon fulvus</i>	
3. <i>Bothriochloa pertusa</i>	
4. <i>Brachiaria distachia</i>	
5. <i>Cynodon dactylon</i>	<i>Doob</i>
6. <i>Cyperus iria</i>	
7. <i>Cyperus platystylis</i>	
8. <i>Cyperus pygmea</i>	
9. <i>Cyperus rotundus</i>	
10. <i>Eragrostis stenophylla</i>	
11. <i>Eragrostis tenella</i>	<i>Bhurburi</i>
12. <i>Eragrostis viscose</i>	

13. *Fibristylis podocarpa*
14. *Heteropogon contortus* *Kusal, Sukal, Lampa*
15. *Iseilema laxum* *Mushan*
16. *Oplismannus burmanii*
17. *Panicum psilopodium*
18. *Pennisetum pedicellatum*
19. *Sporobolus diander*

8. WILDLIFE

Information on wildlife in the study area was obtained mainly, indirectly through information from the local people as well as through observation of hoof and pug marks of the animals, near the water holes.

Table 8.1. Mammals in study area

S.N.	Local Name	English Name	Zoological Name	Status	Schedule	Part
1.	Siyar	Jackal	<i>Canis aureus</i>		II	II
2.	Bhalu	Sloth bear	<i>Melursus ursinus</i>		I	I
3.	Kharaha	Indian hare	<i>Lepus ruficaudatus</i>		IV	-
4.	Gilhari	Squirrel	<i>Funambulus pennanti</i>		IV	-
5.	Chamgadad	Fruit bat	<i>Cynopterus sphinx</i>		V	-
6.	Choocha	Field rat	<i>Bandicota benghalensis</i>		V	-
7.	Lomadi	Indian fox	<i>Vulpus benghalensis</i>		II	II
8.	Bandar	Monkey	<i>Macaca mulatta</i>		III	-
9.	Neola	Mongoose	<i>Herpestes edwardsi</i>		IV	-
10.	Hurra	Hyena	<i>Hyaena hyaena</i>		III	-
11.	Langoor	Common langur	<i>Semnopithecus entellus</i>		II	I
12.	Chital	Spotted deer	<i>Axis axis</i>		III	-
13.	Jangali billi	Jungle cat	<i>Felis chaus</i>		II	II

14.	Jangali suar	Wid boar	Susscrofa	III	-
15.	Choocha	Common house	Rattus rattus	V	-
16.	Kotri	Indian muntjak	Muntiacus muntjak	III	
17.	Kahat	Pangolin	Manis crassicauda	I	I

Table 8.2: Birds in study area

S.N.	Local Name/English Name	Zoological Name	Status (WPA, 1972 Schedule)	Part
1.	House crow	Corvus splendens	V	
2.	Common myna	Acridothera tristis	IV	
3.	Brahminy myna	Sturnus pagodarum	IV	
4.	Pied myna	Sturnus contra	IV	
5.	Black drongo	Dicrurus paradiseus	IV	
6.	Spotted dove	Streptopelia chinensis	IV	
7.	Blue jay	Coracias benghalensis	IV	
8.	Parakeet	Psittacula krameri	IV	
9.	Little Green Bee-Eater	Merops orientalis	IV	
10.	Koel, Cuckoo	Eudynamis scolopacea	IV	
11.	Phakhta	Streptopelia chinensis	IV	
12.	Jangali Kaua	Corvus macrorhynchos	V	
13.	Jangali Tota	Taccocua leschenaultia	IV	
14.	Tania Tota	Psittacula cyanocephala	IV	
15.	Tota	Psittacula krameri	IV	
16.	Bater (Grey Quail)	Coturnix coturnix	IV	
17.	Basanti (Indian cuckoo)	Cuculus micropterus	IV	
18.	Kite	Milvus migrans	IV	
19.	Peafowl	Pavo cristatus	I	III
20.	Redwhiskered bulbul	Pycnonotus cafer	IV	
21.	Bater (Grey Quail)	Coturnix coturnix	IV	

22. Red jungle fowl	<i>Gallus gallus</i>	IV
23. Grey jungle fowl	<i>Gallus sonneratii</i>	IV
24. Jungle myna	<i>Acridotheres fuscus</i>	IV
25. Grey heron	<i>Ardeacea ineria</i>	IV
26. Golden backed woodpecker	<i>Brachypternus benghalensis</i>	IV
27. Owl	<i>Bubo bubo</i>	IV
28. Cattle egret	<i>Bubucus ibis</i>	IV
29. Blue rock pigeon	<i>Columba livia</i>	IV
30. House crow	<i>Corvus splendens</i>	V
31. Common Hawk-cuckoo	<i>Cuculus varius</i>	IV
32. Grey partridge	<i>Francolinus pondicerianus</i>	IV
33. Grey wagtail	<i>Motacilla cinerea</i>	IV
34. House sparrow	<i>Passer domesticus</i>	V
35. Grey quail	<i>Perdicula asiatica</i>	IV
36. Roseringed parakeet	<i>Psittacula krameri</i>	IV
37. Spotted dove	<i>Pycnonotus luteolus</i>	IV
38. Common kingfisher	<i>Alcedo atthis</i>	IV
39. Pond heron	<i>Ardeola grayii</i>	IV
40. Large cormorant	<i>Phalacrocorax carbo</i>	IV
41. Little cormorant	<i>Phalacrocorax niger</i>	IV
42. Little green heron	<i>Ardeola striatus</i>	IV
43. Little egret	<i>Egretta garzetta</i>	IV
44. Phakta	<i>Streptopelia senegalensis</i>	IV
45. Asian openbill	<i>Anastomus oscitans</i>	IV
46. Greater caudal	<i>Centropus pusillensis</i>	IV
47. Indian Robin	<i>Saxicoloides fulicata</i>	IV
48. Oriental Magpie Robin	<i>Copsychus saularis</i>	IV
49. Great Egret	<i>Casimarus diuallus</i>	IV
50. White stork	<i>Ciconia ciconia</i>	IV
51. Ruddy Kingfisher	<i>Halcyon coromanda</i>	IV
52. White-throated Kingfisher	<i>Halcyon smyrnensis</i>	IV

53. Pied Kingfisher	<i>Ceryle rudis</i>	IV
54. Ferruginus Pochard	<i>Aythya naroca</i>	IV
55. Black-headed Munia	<i>Lonchura malacca</i>	IV
56. Black-hooded Oriole	<i>Oriolus xanthornus</i>	IV
57. White Wagtail	<i>Motacilla alba</i>	IV
58. Common Hoopoe	<i>Upupa epops</i>	IV
59. Yellow-footed Green pigeon	<i>Treron phoenicoptera</i>	IV
60. Purple Sunbird	<i>Nectarinia asiatica</i>	IV
61. Red-wattled Lapwing	<i>Vanellus indicus</i>	IV
62. Indian Robin	<i>Saxicoloides fulicata</i>	IV
63. Indian Moorhen	<i>Gallinula chloropus</i>	IV

Table 8.3: Reptiles in study area

S.N.	Local Name /English Name	Zoological Name	Status (WPA, 1972) Schedule	Part
1.	Dhaman/Indian Rat snake	<i>Ptya smucosus</i>	II	II
2.	Dhondwa/Water snake	<i>Enhydris enhydris</i>	IV	
3.	Nag/Cobra	<i>Naja naja</i>	II	II
4.	Common Karait	<i>Bungarus caeruleus</i>	IV	
5.	Banded Krait	<i>Bungarus fasciatus</i>	IV	
6.	Russel viper	<i>Viper aruselli</i>	II	II
7.	Sita Ki Lath	<i>Amphies mastolata</i>	-	-
8.	Dhaman	<i>Xenochrophis piscator</i>	IV	
9.	Goh, Monitor lizard	<i>Varanus benghalensis</i>	I	II
10.	Python	<i>Python molurus</i>	I	II
11.	Garden lizard	<i>Calotes versicolor</i>	-	-
12.	Rock lizard	<i>Calotes rouxii</i>	IV	
13.	Forest lizard	<i>Sitanaponte ceriana</i>	IV	

9. Criteria for improving the area for wildlife

Visited the area during summer and rainy seasons to know about the physical and biological status of the area.

- The area has wildlife species as mentioned later. The wildlife have been observed to cross the road, hence, proper measures have to be adopted to facilitate safe crossing of the road by the wildlife. The wildlife survival depends upon availability of food. The food source starts from the primary producers or the green plants of which the grasses are more important. Hence it is important also to promote growth of grasses in the open patches in the forest in the area. Water is another vital requirement of the wildlife. Only a single dam namely Belora is located in compartment number 55 (GPS location is 20° 42' 29.6 latitude and 81° 49' 22.2 longitude). The dam is the main source of water during the summer months. However, water holding area of the dam is relatively shallow hence the dam becomes almost dry during the summer months with very little water available in the dam during summer. Following are the suggestions for construction of crossing points to wildlife along the road promote growth of grass as source of food and improve water availability in the area.

Location of wildlife crossing points (underpass/overpass)

- From compartment number 60 to 55, GPS location is 20° 42' 24.7 latitude and 81° 48' 55.7 longitude in North Singpur forest range
- From compartment number 260 to 265 in Dugli forest range
- From compartment number 77 to 54 on Dugli and South Singhpur forest ranges, GPS location is 20° 31' 47.1 latitude and 81° 52' 31.2 longitude in

Location of Grassland development/habitat improvement

- Compartment number 60 North Singpur forest range location is 20° 42' 18.1 latitude and 81° 48' 51.1 longitude
- Compartment number 55 North Singpur forest range location is 20° 42' 29.6 latitude and 81° 49' 22.2 longitude

- Need grassland in forest compartment 73
- Need habitat improvement work/grassland development in forest compartment 254 in Dugli range

Location of Water hole development

- Stop dam has been constructed on a nullah located Kushukhuta villages location is $20^{\circ} 40' 20.7$ latitude and $81^{\circ} 49' 00.4$ longitude
- A nala located on the boarder of compartment 39 and 73 need to construct stop dam for wildlife. Location is $20^{\circ} 37' 18.3$ latitude and $81^{\circ} 56' 59.4$ longitude
- Need for construction of a tank in compartment 254 for wildlife in Dugli range
- Need deepening of pond in compartment number 259 located about 300 meter from road. Location is $20^{\circ} 30' 17.9$ latitude and $81^{\circ} 52' 37.9$ longitude

Wildlife road crossing points: Although, difficult to know about the road crossing Map:

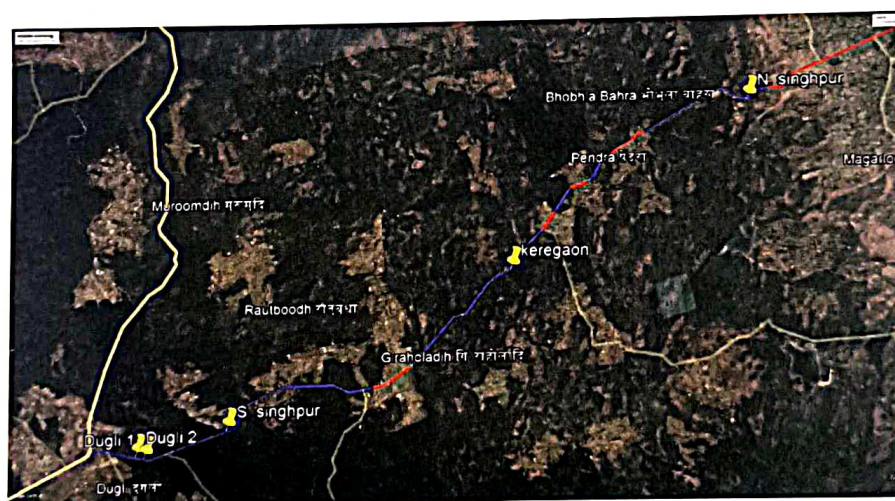


Fig. 9.1. Proposed wildlife crossing points

points of wildlife. Discussed with frontline forest field staff, villagers and water availability and direct sighting of spotted deer identified following points on the propose road.

Habitat improvement work

Based on field study habitat improvement work likewise removal of invasive weed and grass meadow development work selected for wild ungulates. The some areas are most suitable for grass meadow development while some area for removal of

invasive weeds. This work is requiring at least continuing three year for proper maintenance so that area can convert in to grassland which would be very important for wild ungulates.

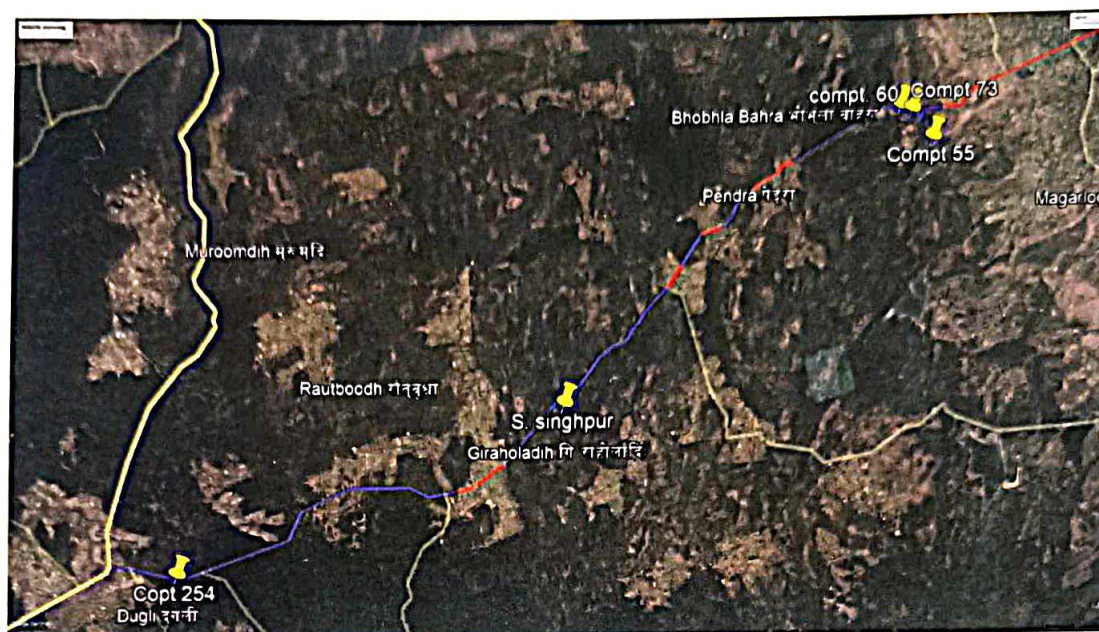
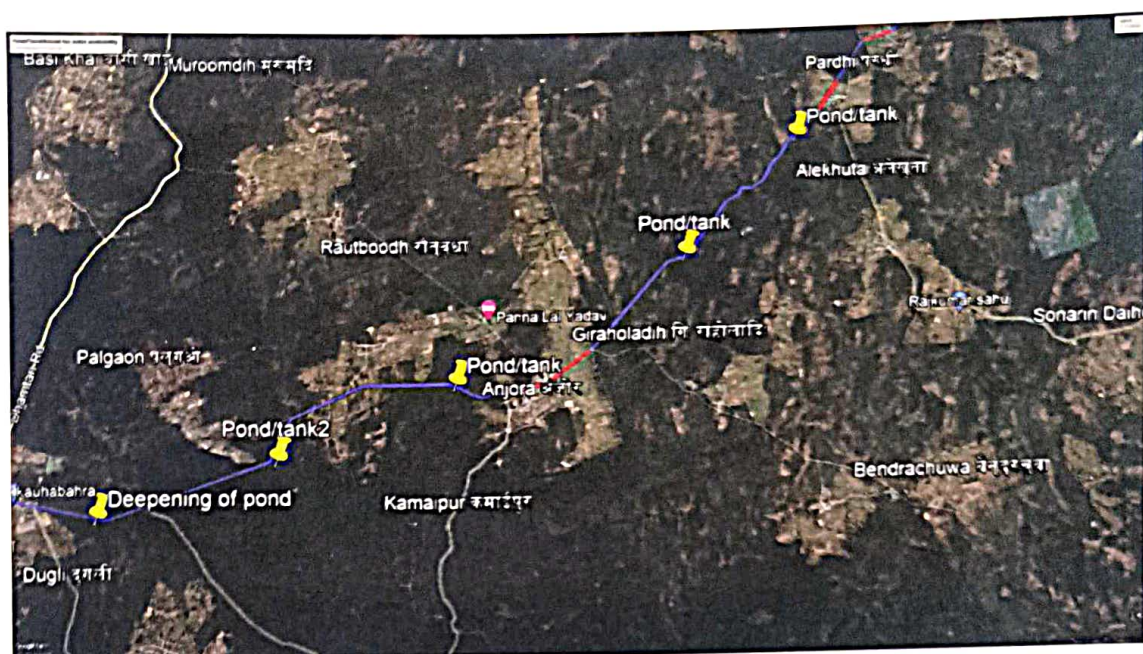


Fig. 9.2. Proposed habitat improvement work

Water availability

Water is essential factor for wildlife management specially during summer season. It was noticed that there are poor water availability in propose road site therefore wildlife moving towards habitation. It is necessary to provide perennial waterholes (tank, stop dam, anicuts etc) inside the forest. The deepening of existing pond in scientific manners are also possible for insure to perennial water in the area.



Map: 9.3. Proposed water holes in road side

10. ECOFRIENDLY MEASURES TO MITIGATE IMPACTS OF LINEAR INFRASTRUCTURE ON WILDLIFE

Increase in extent of linear developments, outside PAs, presents a major challenge to wildlife management and conservation, as the linear developments create barriers or breaks in habitat, which is detrimental to the long term conservation of species and ecosystems. There is a pressing need for conservation and development to go hand in hand, complementing rather than conflicting with each other.

Linear infrastructure development should be animal friendly by providing pathways for movement of species. In addition, linear infrastructure would need to be “green” to mitigate any negative impact on sensitive habitats. Importantly, designing green infrastructure can encourage community support for and reduce opposition to economic development. Green infrastructure is thus a design and develop with nature concept. It helps to build robust, healthy and enduring landscape which enable species to move and adapt.

Integrating transport infrastructure with living landscape, for economic growth, has become the most urgent priority of the day. Let us have the twin benefits of conserving nature and promoting road and rail development (Negi, 2016) The task to prepare guideline document “Eco-friendly measures to mitigate impacts of linear infrastructure on wildlife” was assigned by the MoEFCC, to the Wildlife Institute of India (WII) for National Highway Authority of India, Ministry of Road Transport and Highways, Government of India. Following account is based mainly on this document.

Mitigation refers to measures to avoid, reduce or remedy harms. In the context of developing linear infrastructure such as road and railway lines, the purpose of mitigation is to identify strategies and measures that will address the conservation concerns likely to be associated with the development proposals. In order to deliver the potential benefits of green infrastructure development, these

strategies and measures must follow a set of key mitigation principles, as set out below. To achieve this, SMART (specific, measurable, achievable, realistic and timely) approach will be used. Mitigation, proposed presently, will aim to address not only direct footprint impacts on natural systems but also ecological effects caused by the development of linear infrastructure which may be manifest in decades to come.

Risk mitigation planning is the process of developing options and action to enhance opportunities and reduce threats to project objectives. Mitigating against a risk is probably the most common risk management technique. It is also the easiest to understand and the easiest to implement. Measures, specifically to address habitat fragmentation effects of transportation infrastructure fall in to two broad categories: engineering (structural) options and non-structural options.

Safe, clean, humane, and habitable accommodation shall be provided for all workers during construction and repair work outside the natural areas. Residing in natural areas shall not be permitted and transport shall be provided to bring workforce to site everyday from designated outside campsites and nearby villages, townships, or cities. The construction of the linear intrusions should be in a manner (quick, with minimum disturbance) and with adequate design and technology to minimize the long-term impacts including by: (1) Using prefabricated and special methods to reduce the time taken in the erection/construction of the intrusions and (ii) Avoiding work during nights to facilitate movement of many species, especially large mammals and carnivores. There should be provision of speed breakers at every 400 m of roads passing through natural areas such that the speed is regulated so as to avoid accidental death of wild animals.

10.1. Structural(engineering) measures

Engineering options are fundamentally either underpasses to allow the animals to travel below the infrastructure or overpasses to travel above it. Overpasses are

recommended in deep valley areas. In the presently applied area, there are no deep valleys, suitable for the construction of overpass. Hence, structures like underpasses and fences will be constructed, along the road.

10.1.1. Underpass

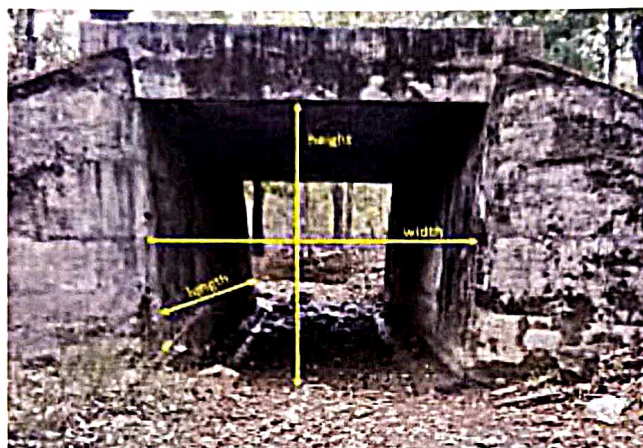


Fig: 10.1. Sketch of an underpass

Underpass is the predominant structural form of mitigation of impacts of road and railways on wildlife. In general bigger the underpasses the more they are used (Goosem 2001). Structures with greatest use have heights at least equal to their width and opening that allow unobstructed view of habitat on the other side

(Goosem & Weston 2002). Reed (in Watson & Klingel 2000) recommends that underpasses have an openness ratio or index of at least 2.0 to be effective, where:

$$\text{Openness ratio or index} = \frac{\text{Height of the opening} \times \text{Width of the structure}}{\text{Length of the underpass}}$$

For chital with a shoulder height of up to 75 cm, an openness index of 0.52 and for sambhar with a shoulder height of 160 cm, an openness index of 1.12 is needed. The underpasses will be located at places where there will be possibility of animals using them will be maximum, thus will allow natural movement of animals. Locals, familiar with the landscape and its animals will be consulted to help determining the place of underpass. Underpasses will be constructed flat and straight, as the terrain will permit. Crossings will be made as natural as possible, fitting to the surroundings. The bottom of structures will be, as far as possible, have similar substances to that which occurs naturally in the absence of the structure.

Within the engineering options, with the underpasses, there are several other

types of animal crossing structures also, that are used to mitigate impacts of highway and railway corridors on animal movement and safety, each with different levels of effectiveness and cost. Types of animal crossing are:

10.1.2. Glider poles

These are vertical poles placed in the centre, median or on the road to provide intermediate landing and launch opportunities for gliding species.

10.1.3. Pipe culverts:

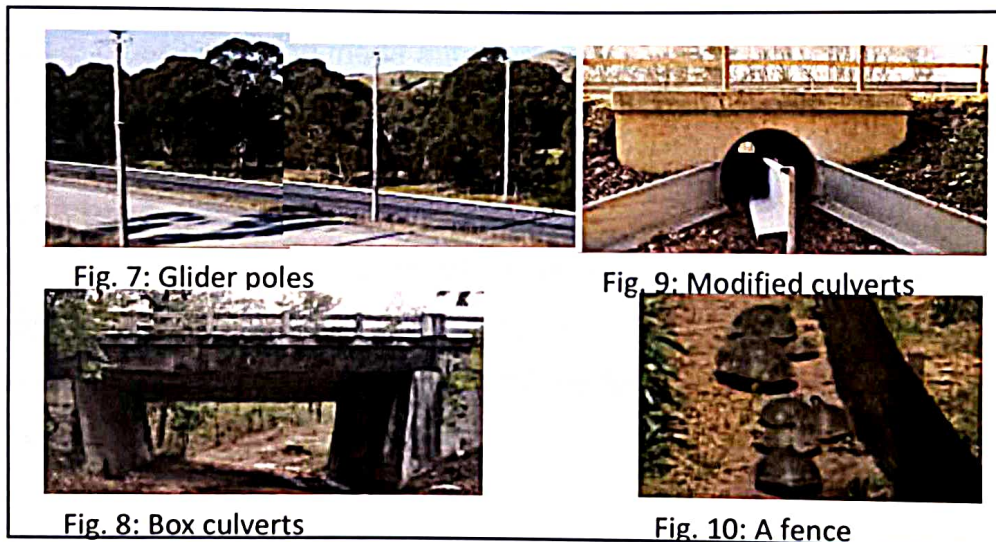


Fig. 7: Glider poles

Fig. 9: Modified culverts

Fig. 8: Box culverts

Fig. 10: A fence

Fig. 10.2. Pipe culverts

Culverts of round pipes of concrete will work as passage to small mammals, reptiles, amphibians, fishes as well as for water

10.1.4. Modified culverts (Culverts with furniture)

Additional features such as walkways and/or planks will be installed on the interior walls of the underpass to encourage medium and small sized animals to use culverts.

10.1.5. Fences

Fences will be constructed along both sides of the road, adjoining the culverts. Fences will help in directing the animals away from road and towards culverts. Fencing will make crossing structures much more efficient and effective.

Approaches to animal crossing will be managed to mimic the routs and places where the animals are most comfortable, crossing the road. The spacing of wildlife crossings will be decided mainly on the variability of landscape, terrain, densities of animal population and requirements of different species for habitat connectivity. Wildlife crossing will be made attractive with planting the natural species, adjoining to the crossing, making it fitting to the surrounding area.

10.1.6. Landscape specific measures

Wildlife Institute of India (WII) in their document on "Ecofriendly measures to mitigate impacts of linear infrastructure on wildlife" has suggested designs of structures, according to the length of the forest area, through which the road is passing:

Table -10.1: Designs of structures, for maintaining connectivity

Landscape characteristic	Design measures for maintaining connectivity
Corridor width 1 km or less	Stretch flyover, over entire width of the forest area
Corridor width 2-3 km	700 m underpass either as one structure or two 300 m each depending upon terrain and other conditions.
Corridor width 3 km or more	300 m underpass at every km of the road.
For amphibians and reptiles	Small pipe culverts or bridges at every 100 m stretch of the road

10.1.7. Measures for reducing mortality of bird

- Construction will be avoided, at the place/s of breeding of birds, which generally spans from early spring to early rainy season.
- Appropriate structures will be constructed to divert the birds from the road. Type of structure will be decided after some research in the area, that what will the type of structure to divert the birds.
- A 5 m wide clear zone, devoid of trees and shrubs, along the road with avoiding the planting of fruit trees, near to the road will be adopted.
- Proposed underpasses are of sufficient size in height and width which can be used by low flying birds like peacock and quails.

10.1.8. Measures for reducing mortality of Reptiles and amphibians

- i. Reptiles prefer road for basking, particularly during winter. Drainage pipes, minor bridges and culverts, built along the road will serve good as the passage for reptiles and amphibians. Noteworthy, however is, that the reptiles prefer circular passage while the amphibians prefer square passages.
- ii. Fatality hotspot zones of movement of reptiles and amphibians, along the road, will be determined and mapped. This will be done to pinpoint the optimum location for mounting migration structures. Detailed monitoring of amphibial road kill, for at least 3 years, will be done, at an appropriate interval (Gossi et al. 2001) In addition to the underpasses for larger animals, for amphibians and reptiles, across the landscape, small pipe culverts or bridges will be constructed in about every 100 m stretch of road.
- iii. Temporary exclusion fencing will be installed to direct turtle and other small animals to an existing culvert. It can be an effective measure to prevent turtle mortality and facilitate their safe passage across roads to seasonally

available habitat. Fencing will be zig-zag in shape as more suitable to reptiles and amphibians as compared to straight fencing.

- iv. At the places of reptiles and amphibians, near to the waterway or ponds, a 1m high, reinforced cement concrete (RCC) wall, having an outward lip of at least 50 cm (see fig, below), will be constructed along two sides of the road to prevent animals from accessing it and direct them to use passageway.
- v. Degraded amphibian breeding sites on either side of the road, will be restored.

10.2. Non-structural measures for reducing mortality: Signage and warning systems: Signs and warning systems

10.2.1. Signboards

Signs warning of wildlife will be put a long stretch of road where animals are known to occur or use local habitat.

1. Simple caution signs will be used to alert drivers to the presence of wildlife crossing zones.
2. Enhanced caution signs enhanced by using words like deer or illuminated with reflective tape in addition to silhouettes of animals will be placed.



Fig. 10.3: Enhanced caution signs to be placed at places of high animal vehicle collision (AVC).



Fig. 10.4: Poster

3. Dynamic, electric signs will be used to alert the presence of wild animals as well as in areas of high AVC.

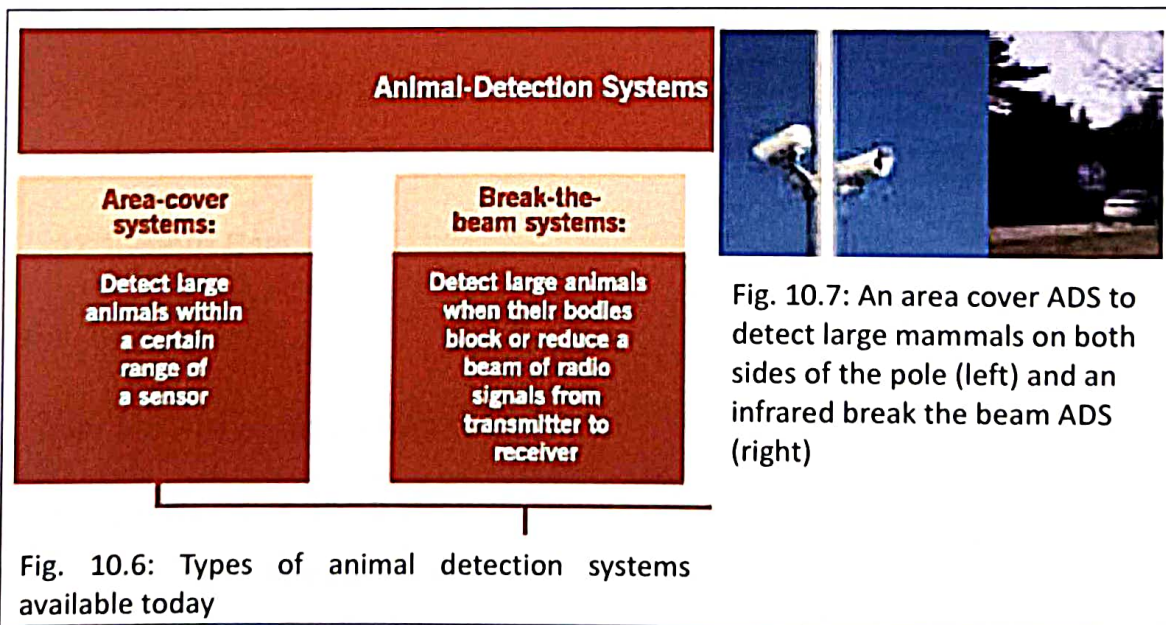
4. Posters and billboards will be placed on highways as part of programmes and campaigns to reduce animal mortalities, due to collision with vehicles.



Fig: 10.5: Simple caution signs to alert drivers of animal movement

10.2.2.Warning systems

Animal detection systems are roadside wildlife detection systems that use radar and lasers to flash warning signs to alert motorists to prevent collisions between wild animals and motorists. They may be of different types as shown in figure. A number of animal detection and early warning technologies and devices are currently being developed or tested and will be use as soon as the testing is finalised.



11. Barriers

Noise barriers:

Noise barriers will be installed in consultation with an environmental engineer . However, noise barriers may block the carriageway completely for the movement of animals across it. Thus it is difficult to decide how far the noise barriers are beneficial.

Visual barrier

Visual barrier will be created along the sides of the engineered structure, so that the traffic is not visible from the crossing. Visual barrier will be camouflaged through plantation of tall trees along the sides of the engineered structures.

Sound barriers

Underpasses or any other such structures will be fortified with sound barriers.

12. Species specific measures for animals

Sloth bear and snakes are the most fearsome as well as harmful animals in the area, hence some measures of safety from these animals are being given, in short.

12.1. Sloth Bear

Sloth Bear hazards

Bear hazards arise generally due to:

- i. NTFP collection
- ii. Fuel wood collection
- iii. Cattle grazing
- iv. Mushroom collection
- v. Open area defecation

Collection of Non-Timber Forest Produce (NTFP) is one of the common income generation activities in this region. NTFP includes mainly the mahua flower and tendu leaf, while other NTFPs are sal seed, char, mahua, mushroom and so on. Burning wood as fuel is still common in the area. Cow dung cake and some amount of wood obtained from trees out of forest in the cultivated field area fulfill some amount of fuel requirement but the major requirement is fulfilled from wood collected from the forest. Mushroom is one of the most delicious items to the local people. Mushrooms grow mainly in the rainy months. Grazing the cattle in the forest is a common phenomenon, particularly during the monsoon season. This is because during the monsoon the cultivated fields are full with crops, not allowing the cattle to enter; simultaneously food for cattle is available in the forests. Although open area defecation has reduced to a great extent but is still continuing. These processes expose human being to bear causing encounters.

Seasonal variation in encounter

Seasonal variation in the incidence of human-bear encounter varies according to the vegetation of the area. In a forested area the availability of sal seed, tendu leaf, mahua flower, mushroom and some other minor forest produce, cattle grazing and open area defecation are the main causes for entry in to the forest creating chances for bear-human encounter. In non-forested area mahua flower collection and open area defecation are the major causes for encounter.

Mahua flower collection is done in the months of March and April, Sal seed collection peaks in the month of May, tendu leaf collection in the months of April-May, cattle grazing in the forest is although a year round phenomenon but it extends mainly from July to December, mushrooms grow in the rainy months.

Time of encounter

Mahua flower collection and open area defecation are done early in the morning.

Also, there is less movement of people during the morning hours. Therefore, human-bear encounters are more in the early morning hours, say about 5 to 8 am, than any other time of the day. However, encounter occurs during other time of the day, also, but frequency is less than the frequency in the morning hours.

Things to do in a bear sensitive area

- Avoid early morning and evening time movement in bear sensitive areas.
- Always go in a group and talk loudly among the group while walking through.
- Avoid approaching silently suspected Bear den/ Bear resting places.
- During summer especially during Mahua(Madhucalongifolia) flowering time keep a dedicated watcher to guard.
- Always carry long sticks while walking through bear sensitive areas and carry bright light torch if move in night time.
- Work or move in a group in forest area.
- Take extra care during the bear cubing season (month of November to February).
- Always try to make a safe distance from the bear.

What to do when you sight a bear

- Do not approach a bear silently
- Always maintain a safe distance and make loud noise to drive it away.
- Do not corner a bear as it will never couch.
- Do not throw fire crackers at the bear.
- Avoid crowd at the spot and leave an escape route for the bear.
- Climb a tree if a bear approaches suddenly in a forest area.
- Do not try to capture/kill a bear. Wait for experts
- Do not catch or kill cubs. It may make the mother furious.
- Inform to forest department if in any problem.

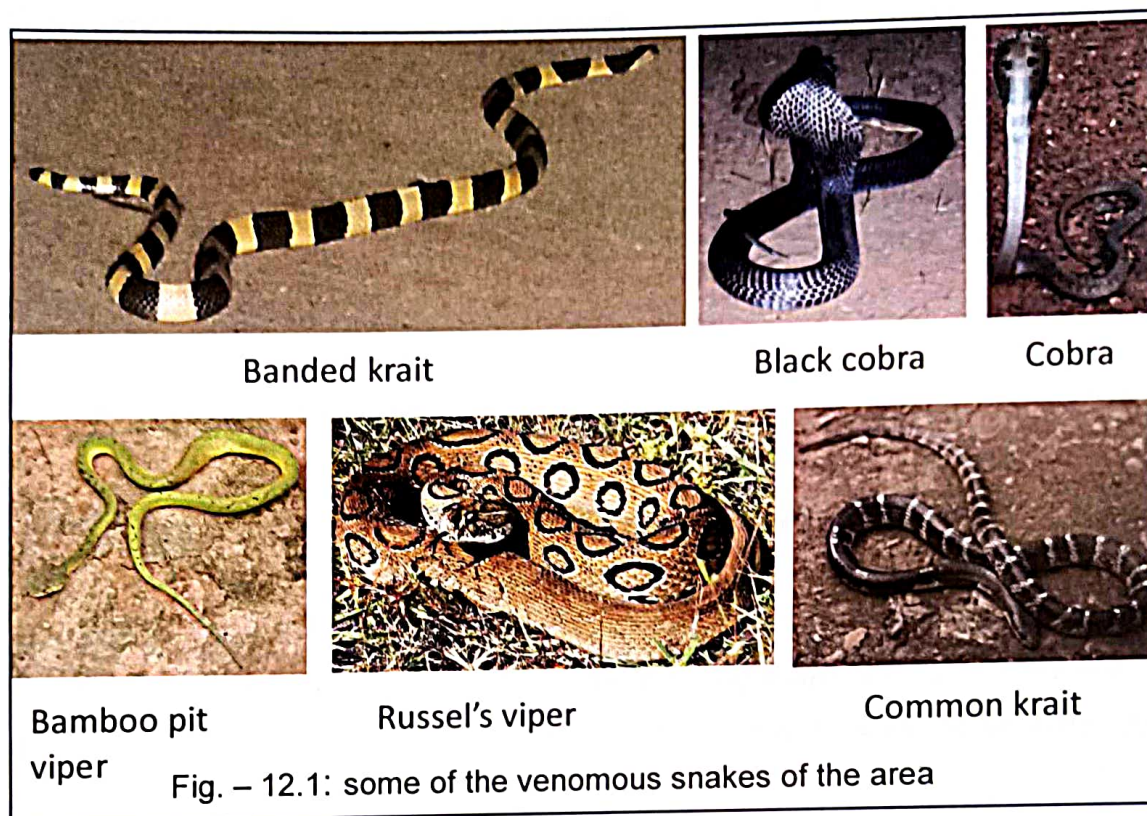
Bear safety measures

In terms of short-term mitigation measures, the first is training and capacity building of the villagers, as to how they can avoid sudden confrontations, what they should do in case of a confrontation, what to do as post-confrontation measures in terms of giving first aid and quick medical services, and educate the community regarding the existing compensation program.

Identify conditions which may attract bears such as garbage or food left in the open, use of sounds to avoid sudden confrontations and avoidance when travelling alone during nighttime hours (but not in elephant area), or by travelling in groups, may reduce conflict. Sloth bear attacks are unintentional, unlike elephants. It is important to address issues of conflict with sloth bears without alienating people from their livelihood; however, reducing dependency on forests in a sustainable manner by providing alternate income-generating options will ultimately reduce conflict.

Government programs such as 'Pradhan Mantri UjjwalaYojana' under which people living below the poverty line receive a Liquefied Petroleum Gas (LPG) connection free of charge was launched to reduce health hazards associated with burning biomass. This program could be promoted in the region, thus resulting in a reduction of fuelwood dependency which may also aid in reducing conflict. Programs such as 'Swachh Bharat Mission' ensures provision of a toilet for every household in rural India through the Village Council (Gram Panchayat) with an aim to increase hygiene and sanitation in rural areas. This program may also assist in reducing conflict with wildlife by discouraging people from open-area defecation. Grazing of livestock in forests is also a factor that results in conflict. Encouragement of stall feeding (i.e. the use of feedlots) through incentives such as providing better yielding variety of livestock and assisting subsistence animal owners in growing fodder crops, will help reduce human and livestock exposure to wild animals. Such actions may also assist in reducing anthropogenic pressure on forest regeneration.

12.1. Snakes



Snake bite symptoms and tips for first aid:

The construction area is a snake prone area, hence, following are some suggestions to be adopted after sighting a snake. Most of the snakes are non-venomous. Nevertheless, leave all snakes alone. Do not even try to identify which are venomous or non-venomous. **Always treat a snake bite as if it's venomous.**

Signs and Symptoms of Snake bite

The signs and symptoms of Snake Bites depend on the species of snake involved and the venom injected. It can vary from one individual to another. The signs and symptoms also depend on the age (whether child or adult), weight, and overall health status of the individual. Following are some of the common, but not complete, signs of snake bite.

- Two puncture wounds
- Swelling and redness around the wounds
- Pain at the bite site
- Increased thirst
- Difficulty in breathing
- vomiting and nausea
- blurred vision
- sweating and salivating
- numbness in the face and limbs

After a snake bite, following are some recommended tips

- ❖ Remain calm. Do not panic and run around, for this will cause the venom to circulate faster in the body. Keep the patient lying down and completely still.
- ❖ Immobilize the bitten arm or leg, and stay as quiet as possible to keep the poison from spreading through your body.
- ❖ Remove jewelry before you start to swell.
- ❖ Position yourself, if possible, so that the bite is at or below the level of your heart.
- ❖ Cleanse the wound, but don't flush it with water, and cover it with a clean, dry dressing.
- ❖ Apply a splint to reduce movement of the affected area, but keep it loose enough so as not to restrict blood flow.
- ❖ Don't use a tourniquet or apply ice.
- ❖ Don't cut the wound or attempt to remove the venom.
- ❖ Don't drink caffeine or alcohol.
- ❖ Apply a strong suction without cutting. The suction should be applied in the deepest puncture directly.
- ❖ Apply an antiseptic rapidly and put a compress on the bite area without interrupting the suction.
- ❖ Apply a tight bandage, about inches above the wound to prevent the venom from spreading, but do not cut-off blood circulation

- ❖ Try to remember features of the snake, to help treat the condition appropriately
- ❖ Don't try to capture the snake, but try to remember its color and shape so you can describe it, which will help in your treatment
- ❖ Call 108 or your local emergency number, if the condition is serious.

A half day training/workshop/awareness programme should be organised with the help of snake experts. I can help in searching for snake experts. All field staff should attend the workshop. The snake expert will be showing the pictures of all the venomous and non-venomous snakes of the area. Anti-venom vials must be kept ready at hand, for immediate use. Snake rescue equipments should also be available at the construction site for the rescue of the snakes and release them in their natural habitat (forest).

13. Good practice guidance

Good practice guidance in the form of do's and don'ts for avoiding and regulating the impacts of linear infrastructure projects.

Table – 13.1: Good Practice guidance in the form of Do's and Dont's

SN	Do's
Planning and design phase	
1.	A good team of professionals will be organised to review technical, financial and environmental/ecological aspects of the project
2.	An ecological/wildlife expert will be Included in the team of the linear development would be routed through forested sections and natural landscapes.
3.	Aligning roads and railway line along or through sensitive habitats (wildlife movement corridors, flight path of birds, areas of high diversity values, specialised habitats e.g. pools, dens, roosting sites, caves etc.) will be avoided.
4.	Impact on key wild species of plants and animals and habitats to integrate any special consideration in design features and structures have been

	assessed..
5.	Appropriate designs that facilitate animal movements have been planned.
6.	Estimate of costs for constructing mitigation structures in the financial proposal to avoid cost overrun, have been included
7.	Shedule for implementation of mitigation measures and institution responsibilities for mitigation measures have been prepared.
Construction phase	
1.	Construction schedule to avoid breeding/migration season of important species have been recommended.
2.	Take care to avoid direct impacts to land, water and habitats of wild animals.
3.	Construction of mitigation structures along with road upgradation projects so that damage/loss during this phase are minimised. Install sufficient drainage works under all access roads to avoid flooding land and damaging streams have been initiated.
4.	Removal of natural vegetation has been avoided/minimised.
5.	Measures to prevent animal injuries and mortality during earthworks, cleaning of vegetation, and managing pools and streams, will be taken..
6.	Good behaviour by construction workers to prevent illegal hunting, fishing and pilferage of resources will be enforced.
7.	Cleared areas wherever possible will be restored.
Operation and monitoring	
1.	Independent regular site inspections to ensure compliance with all EMP provisions, particularly in sensitive areas will be conducted.
2.	Evidence-based system of collection, collation and analysis of data to assess efficacy of mitigation measures. Use audio-visual tools for generating more convincing evidence will be implemented.
Don't's	
Planning and design phase	
1.	Inter-agency co-ordination will be given due importance.
2.	Consultation will be made with wildlife experts and conservation agencies to

	understand challenges for wildlife that may come in way of environmental decision making.
3.	Field based surveys will be made for generating primary information for impact assessment reports as a weak EIA would lead to subsequent delays in the implementation of the project.
4.	Sections of the same road, rail or pipeline passing through different landuse or states as separate projects for ease of implementation as this may pose difficulties in assessing the landscape level impacts on wildlife habitats and species with large home ranges will not be split.
5.	Mitigation structures not around a single species but around all species of conservation importance in a landscape will be planned.
6.	Mitigation measures will be suggested only after considering local ecology as themeasures suitable for implementation in one landscape may not work in another site with different ecological conditions.
Construction phase	
1.	Direct and physical impacts by careless material management and inducing avoidable disturbance will not be added.
2.	Conditions and specifications agreed upon as part of mitigation will not be violated.
3.	Construction material will not be dumped/stacked inside sensitive habitats.
4.	Debris and other excavated material will not be disposed near water bodies and in valley bottoms.
5.	Vehicles will not be washed or lubricants will not be changed in waterways or wet lands.
Operation and monitoring	
1.	Schedule for maintenance of crossing structures such as drains and culverts to ensure their functionality will be drawn.
2.	No justification will be given for lack of manpower and financial resources to neglect/avoid monitoring.

14. Some evidences for the presence of wild animals:

Fig. 14.1 Sloth bear (*Melursus ursinus*)



Front Foot



Hind Foot



Fig. 14.2: *Hyaena (Hyaena hyaena)*



Fig. 18:

Fig. 14.3. Jackal (*Canis aureus*)

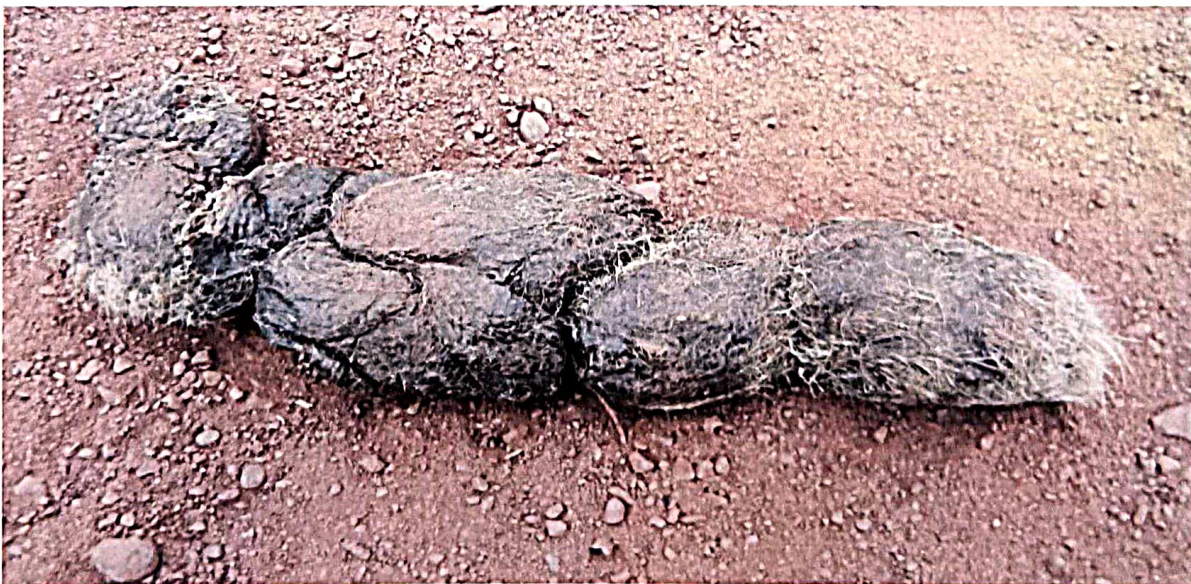


Fig. 14.4: Wild Boar (*Sus scrofa*)



15. RECOMMENDATIONS

1. The area has populations of herbivores, more particularly the Spotted deer.
2. The habitat should be improved, through the removal of invasive weeds, development of grass meadow.
3. Ponds on either side of the road should be deepened so that they retain water throughout the year.
4. The depth of dam should be increased to retain good amount of water round the year.
5. The small ditch, retaining water should be deepened and inflow of organic matter should be prevented. However, deepening should be done taking care that the animals can approach the water easily.
6. Construction of new ponds/tanks should be done in the area where water is not available in a large area, during the dry periods.
7. Water availability should be ensured on both the sides of the road so that the wild animals are minimum required to cross the road, at least, for water.
8. Fire in forest should be checked through awareness among the stakeholderes, particularly during mahua and sal seed collection and tendu leaf collection.
9. Fire watchers should be appointed from among the local villagers.
10. Regular monitoring should be carried out to control illegal activities, particularly hunting, poaching and road accidents.
11. Underpasses should be cleaned, regularly so that the underpasses remain conducive to the wildlife.

16. Financial implications for the project

Based on the strategies suggested in the plan, financial estimate for activities to be undertaken in the forest area. The financial estimate to undertake various activities in the forest. The total financial estimates in all activities in the forest area of all 4 forest ranges are Rs. **Rs.15672000.00**. The work within the forest area will be executed by the DFO, Dhamtari forest divisions within their jurisdiction. The financial forecast of the project for 10 years are depicted in following

Table 16.1. Financial imolications for the project

Sr. No.	Description	Amount (Rs.)					Total
		1 st year	2 nd year	3 rd year	4 th year	5 th year	
1	Protection: Road safety vigilance, Petroling and Control fire: 02 unskilled. Local wathcher (2X @ Rs. 400 x 30 Days X 12 months & 5% wedges per year	288000	303000	318000	335000	350800	1594800
	L.S.	L.S.	L.S.	L.S.	L.S.	L.S.	
2	Creation/deeping of waterholes Tank 03 (@ 15.50 Lakh/tank), Anicut/stopdam 01 (@ 24 Lakh)	2400000	1550000	1550000	1550000	0	7050000
	03 Tank/01 Anicut or Stopdam	01 A/SD	01 Tank	01 Tank	01 Tank	0	
3	Eradiction of weed/habitat improvement	600000	600000	400000	200000	200000	2000000
	200 Ha.	60 Ha.	60 Ha.	40 Ha.	20 Ha.	20 Ha.	
4	Soil water conservation work	800000	800000	800000	400000	400000	3200000
	200 Ha.	50 Ha.	50 Ha.	50 Ha.	25 Ha.	25 Ha.	
5	Awareness & miscellancous	60000	50000	50000	50000	50000	260000
	L.S.	L.S.	L.S.	L.S.	L.S.	L.S.	
	Total						14104800
	10 % Reserve for Adhock Campa						1567200
	Grand Total						15672000

TOTAL Rs. 1,56,72000 (One Crore Fifty six lakhs seventy two thousands Only)