CHAPTER 1

INTRODUCTION

1.1 Project Description

Wonder Cement Limited (WCL), a R. K. Group company is having its Registered & Corporate Office at Madanganj-Kishangarh, District Ajmer (Rajasthan). R. K. Marble Private Limited (RKMPL) was established on May 25, 1989. RKMPL was established with a vision to become one of the largest global marble producers by adopting innovative techniques. RKMPL could achieve its mission and became the world's largest marble mining company having Guinness Book of world record.

The RKMPL is ISO 9001-2008, ISO 14001-2004 and OHSAS 18001:2007 certified unit.

WCL is having an Integrated Cement Plant with Cement production capacity 2.0 MTPA (Clinker), 3.25 MTPA (cement), Captive Power Plant (40 MW), D.G. Set (2 MW) near villages Sangaria, Rasulpura, Peerkheda and Borakheri, Tehsil: Nimbahera along with Limestone Mine (3.75 MTPA) in 740.93 ha ML area adjoining the cement plant near Villages Bhatkotri, Lasrawan, Phalwa and Rasulpura, Tehsil: Nimbahera, Chittorgarh (Rajasthan).

Environmental Clearance was granted by MoEF, New Delhi vide Letter No.: J-11011/506/2007-1A II (I) dated 12th June, 2008 for Integrated Cement Project: Cement Production - 2.5 MTPA, *CPP -1x40 MW, *D.G. Set - 1x2 MW & Limestone Mine 3.75 MTPA (ML Area: 740.93ha).

Environmental Clearance for Expansion of Cement Production Capacity from 2.5 MTPA to 3.25 MTPA (by addition of fly ash) has been granted by MoEF, New Delhi vide Letter No.: J-11011/437/2011- 1A II (I) dated 19th June, 2012.

TOR for Environmental Clearance for Expansion of Cement Production Capacity from 3.75 MTPA to 8.0 MTPA & limestone mines (3.75 to 9.10 MTPA) has been granted by MoEF, New Delhi vide Letter No.: J-11011/298/2012- 1A II (I) dated 18th December, 2012 & Letter No.: J-11015/319/2012- 1A II (I) dated 18th March, 2013 (**Annexure 1 and Annexure 2**).

1.1.1 Project Proposal

Wonder Cement Limited (WCL) (A unit of R.K. Marble Group) is proposing for expansion of limestone production capacity from 3.75 MTPA to 9.10 MTPA in its existing Limestone Mine (ML Area 740.93 ha) located at Villages – Bhatkotari, Lasravan, Phalwa and Rasulpura, and

Expansion of Integrated Cement Project - Clinker (2.0 to 6.0 MTPA), Cement (3.25 to 8.0 MTPA), CTPP (40 MW to 80 MW), D.G. Set (2.0 MW to 7.0 MW) & WHRB (2 x 9 MW) at Villages: Sangaria, Borakheri, Peerkhera and Rasulpura, Tehsil - Nimbahera, District - Chittorgarh (Rajasthan) Tehsil– Nimbahera, District–Chittorgarh (Rajasthan).

1.1.2 Brief Description about the Nature, Size, Location of the Site

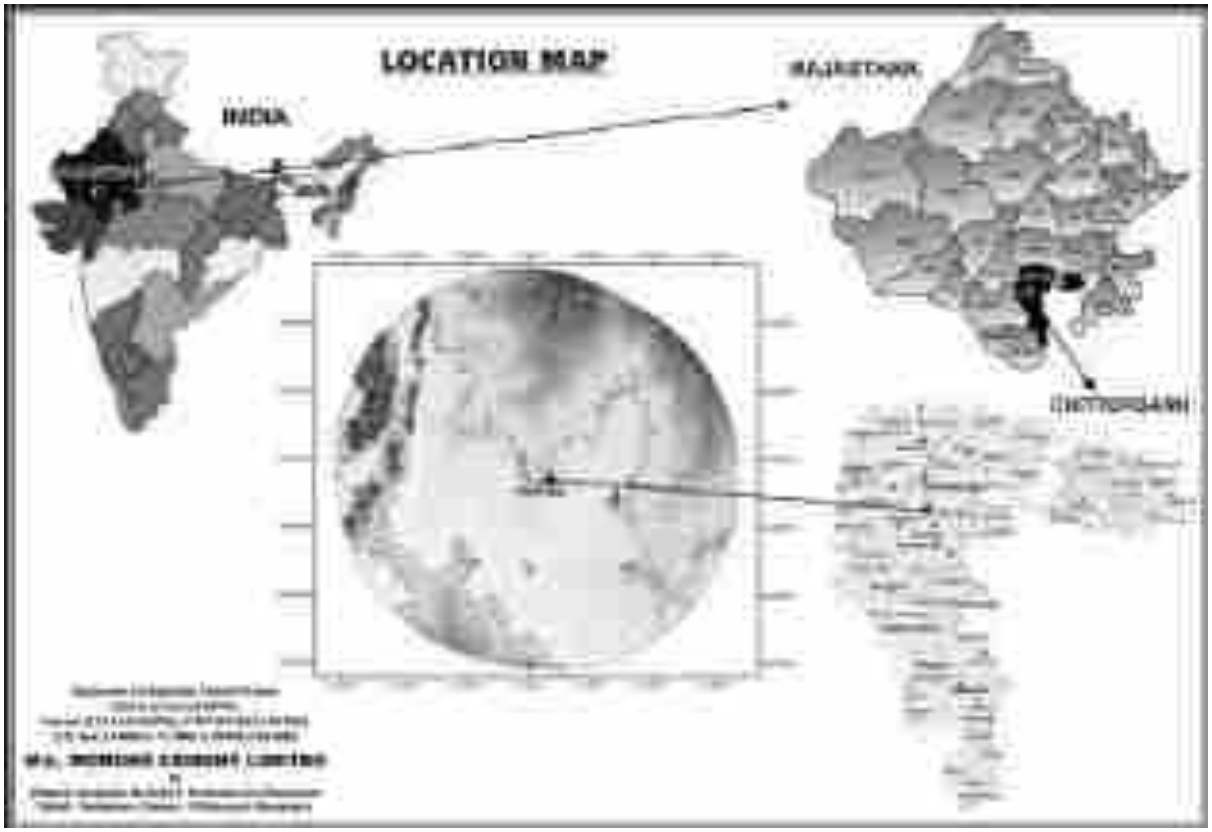
The details about the nature, size, and location of the limestone mining project are given below.

Table-1.1

Salient Features of the Project

S.No.	Particulars	Details
A.	**Nature of project**	**Limestone Mining & Cement Plant Project**
B.	**Size of project**	
1.	ML area /Plant area	740.93 ha & 191.064 ha
2.	Proposed Production capacity	9.10 Million Tonne / Annum Expansion of Integrated Cement Project - Clinker (2.0 to 6.0 MTPA), Cement (3.25 to 8.0 MTPA), CTPP (40 MW to 80 MW), D.G. Set (2.0 MW to 7.0 MW) & WHRB (2 x 9 MW)
C	**Project Location**	
1.	Villages	Bhatkotri, Lasravan, Phalwa & Rasulpura Sangaria, Borakheri, Peerkhera and Rasulpura
2.	Tehsil	Nimbahera
3.	District	Chittorgarh
4.	State	Rajasthan
5.	Toposheet No.	45 L/6, 45 L/9 & 45 L/10
6.	Lease area co-ordinates	Latitude - $24^0$39'10.07" N & $24^0$40'23.97" N Longitude - $74^0$35'16.28" E & $74^0$37'48.93" E
E	**Environmental Setting**	
1.	Nearest Village	Bhatkotri

S.No.	Particulars	Details
2.	Nearest Town	Nimbahera (~ 7.0 km in SE)
3.	Nearest National Highway/State Highway	➢ NH-79 (~ 2 km in ENE direction) ➢ NH-113 (~ 7.0 km in SE)
4.	Nearest Railway Station	Gambhiri Road Railway Station (~ 5.0 km in NE)
5.	Nearest Airport	Dabok Airport Udaipur (~75 km in W)
6.	Ecological Sensitive Areas (National Park, Wild Life Sanctuaries, Biosphere Reserves etc.) within 10 km radius	None within 10 km radius of mining lease boundary
7.	Reserved / Protected Forest within 10 km radius	4 Protected Forests and 4 Reserved Forests falls at a distance of 3.0 to 9.0 km from mine site.
8.	Water Bodies within 10 km radius of the mine site.	➢Kadmali River (Seasonal) ~ 9.0 km in ESE, ➢Nimbahera River (Seasonal) ~ 8.0 km in SE, ➢Gambhiri Reservior (Seasonal) ~9.0 km in ENE, ➢Murliya Dam ~2.2 km in NNE, ➢Uncha Talav ~ 8.0 km in South.
9.	Archaeological Important Place	None within 10 km radius of mine site
10.	Seismic Zone	Zone – II as per IS: 1893 (Part-I) : 2002


LOCATION MAP
INDIA

1.2 Requirements for the Project

1.2.1 Raw Material Requirement

The major raw materials required for the cement plant are limestone, gypsum, fly ash. Road transport facilities for the transportation of materials are already present near plant premises and Railway siding is under construction which will be used for the proposed expansion also.

1.2.2 Water Requirement

The existing water requirement for the plant is 2571 KLD. Additional water requirement for the Proposed Expansion Project will be 3673 KLD; therefore total water requirement after the Proposed Expansion Project will be 6244 KLD.

1.2.3 Power Requirement

The existing power requirement is 37.09 MW and additional power required for Proposed Expansion Project will be 56.51 MW. Thus, the total power requirement after proposed expansion project will be 93.6 MW.

Source: Captive Power Plant (2 x 40 MW), WHRB (2 x 9 MW), AVVNL (Ajmer Vidyut Vitran Nigam Ltd.) & D.G. Set (for emergency).

1.2.4 Man Power Requirement

The total manpower engaged in existing plant is 649 persons and additional manpower requirement will be 423 persons. Unskilled/ semi skilled manpower will be sourced from the local area and skilled manpower shall have to be sourced from outside.

1.3 LAND DETAILS

Total Plant area is 191.064 ha and the proposed expansion will be done within the existing plant premises, thus no additional land will be acquired for the proposed expansion project. Mine lease area is 740.93 ha. Plantation has been raised in about 33.40 ha land. It is proposed to develop greenbelt/plantation in 191 ha area of plant, colony and mines (Table 4.7).

1.4 Objective of the Study

1.4.1 Need of Biodiversity Impact Assessment

Present biological study and preparation of conservation plan has been carried out due to the scope in TOR of Environment Impact Assessment study issued by EAC committee of MoEF, New Delhi for environment clearance of cement plant & limestone mines expansion project.

1.4.2 The points prescribed in Terms Of Reference(TOR) for expansion of Cement Plant by MOEF has been described below:-

Detailed description of the flora and fauna (terrestrial and Aquatic) should be given with special reference to rare, endemic and endangered species **(Annexure 2).**

1.4.3 The points prescribed in Terms Of Reference(TOR) for expansion of Limestone Mines by MOEF has been described below:

(i) A detailed biological study for the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease) shall be carried out. Details of flora and fauna, duly authenticated, separately for core and buffer zone should be furnished based on primary field survey clearly indicating the Schedule of the fauna present. In case of any Scheduled-1 fauna found in the study area, the necessary plan for their conservation should be prepared in consultation with state forest and wildlife Department and details furnished. Necessary allocation of fund for implementing the same should be made as part of the project cost.

(ii) A study shall be got done to ascertain the impact of the mining project on wildlife of the area including on the elephant population and details furnished. The vegetation in the RF/PF area with necessary details should be given. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly detailed mitigation measures required should be worked out with cost implication and submitted.

In order to meet the statutory requirements of MOEF, J M EnviroNet Pvt. Ltd. Jaipur was engaged as EIA/EMP consultant for this project. EIA division of J M EnviroNet is approved by National Accreditation Board for Education & Training (NABET). Detailed biological study of flora and fauna in the study area was conducted by experts of J M EnviroNet during Dec 2012 to Feb 2013 and Biological study and conservation plan report was prepared (**Annexure 1).**

In line with TOR prescribed by MOEF, area comprising 10 km radius area of mine lease and cement plant of WCL was considered as study area.

In order to assess the overall status of floral and faunal diversity the following scope of work have been formulated and studied.

1.5 Scope of Study

i) A rapid survey to assess status and distribution of flora and fauna groups within the proposed study area.

ii) Analysis of the field based primary data and results of analysis.

iii) Collection of secondary data

iv) Interview and discussion with experts of forest and wild life department in the field.

v) Based on outcome of the study, prepare the biological study and conservation plan report.

CHAPTER 2

PROJECT LOCATION & LAND USE

2.1 Location

WCL plant and mine site is 5 km north-west of Nimbahera town. The site is 25 km away from Chittorgarh District head quarter in south Rajasthan. It is located on survey of India topo sheet No 45 L-9 & 45 L-10 with following coordinates:

Latitudes N 24°39‘10.7” N & 24°40’ 23.39”

Longitudes E $74^0$35'16.28” E & $74^0$37'48.93”

2.1.1 Approach by Road:

The nearest town Nimbahera is located on Chittorgarh-Neemach highway. National highway 79 is 2 km in ENE direction and NH-113 is 7.0 km in SE direction from the site. The area is approachable by tar road from Udaipur (100km).

2.1.2 Approach by Railways:

Nearest rail station is Gambhiri Road Station about 4.5 km on Ajmer-Ratlam broad gauge line.

2.1.3 Topography and Drainange

The area form flat terrain that gradually slopes down towards the north. The ground level is 446-454 meter above M.S.L. Ground water is mainly recharged by seasonal rainwater nalla (Channel). Number of tube wells were drilled for irrigation & drinking water in the area.

2.1.4 Climate

Temperature generally becomes highest in May and it reaches upto 45°C to 48°C and the minimum is recorded in January going down to 2°C to 9°C.

The average annual rainfall in the past one decade was in the range of 600 to 800 mm with the highest precipitation in August when about 80% of the rainfall is received in the area during the NW Monsoon every year.

Wind direction is from NNE and wind velocity is in the range of 3-15 km/hr.

2.1.5 Soils

The Chittorgarh district and surrounding area forms a part of inter-mountain plateau and consist of dark- lava soils. Major cash crops like cotton and sugarcane are grown in this black soil region. Other food crops are also grown.

The soils of Rajasthan are complex, and highly variable, reflecting a variety of differing parent materials, physiographic land features, range of distribution of rainfall and its effects, etc. However, broadly, the soils can be put in five major groups, based on the basic fabric of soils i.e. soil texture which governs its many other properties. They are, (1) sandy soils or light soils, (2) sandy loam or light medium soils, (3) loam or medium soils, (4) clay loam to clay or heavy soils and (5) skeletal soils or shallow rocky and hilly soils.

Quality of the soil in the area is shown a marked diversity in nature depending upon the parent rock and climatic conditions prevailing in different parts of the district. The soil in the area has a property of swelling to some extent when wetted and foaming cracks, when it dries up subsequently. The soil found in the Chittorgarh district is black cotton soil.

2.2 Land Use Pattern

2.2.1 Land Use Pattern of 10 km radius Buffer Core Zone

Current vintage data of Indian Remote Sensing Satellite RESOURCESAT-2 (L4FMX) digital FCC (False Color Composite) has been used for preparation of Land use/ Land cover thematic map of study area. Satellite image has been procured from National Remote Sensing Centre, Hyderabad. Survey of India toposheet as a reference map on 1:50,000 scale has been used for preparation of base layer data like road, rail network, village and mine site and for geo-referencing of satellite image.

Technical details

- Satellite Image - RESOURCESAT-2 (L4FMX)
- Satellite Data Source - NRSC, Hyderabad
- Date of Data Procurement - 1st February, 2013
- Software Used - Earth Resources Data Analysis System (ERDAS) Imagine 9.2

The whole study area of the buffer zone mainly comprises of crop land which constitutes 46 % of the total area and fallow land includes 14.32 %. North western portion is dominated by forest land which makes up to 5.66%. The third largest area (5014.30 ha) is covered by the class called stony waste, which in this regard is limestone belt. The areas which have been

excavated or where the soil cover is falls under open scrub land having nearly 10.82 % of area. There are few streams/ rivers present in the study area including Gambhiri river. These are seasonal and hence contain very less water. There is a reservoir constructed over Gambhiri River named Gambhiri reservoir & is present in the eastern portion of the study area.

The land use land cover details of 10 km radius area (buffer zone) are given below:

TABLE – 2.1 Land Use / Land Cover Details of Buffer Area

S. No.	Legend	Area (in ha)	% Area
1.	Water Bodies	799.41	1.81
2.	Open Scrub Land	4779.85	10.82
3.	Stony Waste Land	5014.30	11.35
4.	Open Land	1280.09	2.90
5.	Mine Quarry	713.31	1.61
6.	Plantation	742.35	1.68
7.	Forest	2498.91	5.66
8.	Fallow Land	6324.79	14.32
9.	Crop Land	20323.26	46.00
10.	Human Settlement	1383.29	3.13
11.	Industrial Area	264.46	0.60
12.	Seasonal Water bodies	52.38	0.12
Total		**44176.40**	**100.00**

Source: *LU/LC Map for Buffer Zone*

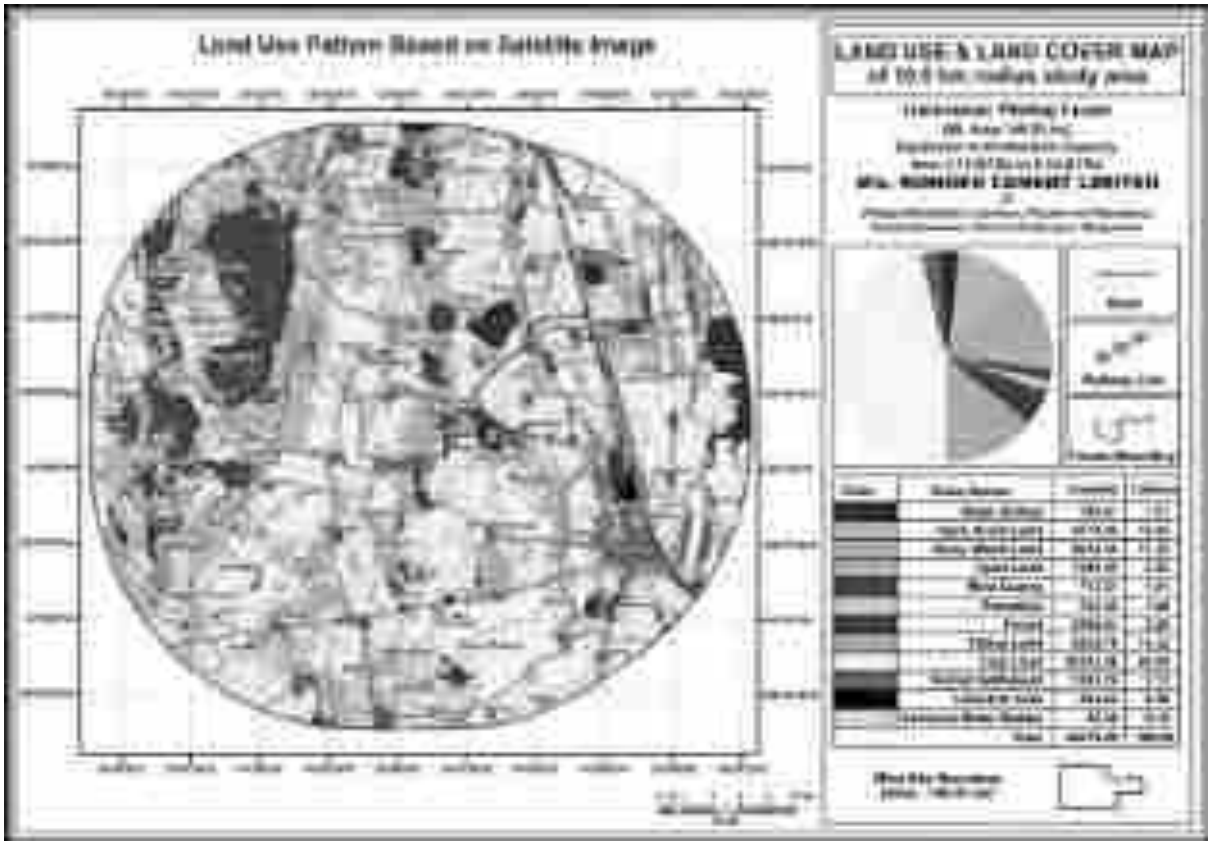


FIGURE 2.1: LAND USE / LAND COVER MAP OF BUFFER ZONE

2.2.2 Land Use Pattern of Core Zone

WCL cement plant and township is located in 191.064 ha of land and mine lease area of limestone mines in 740.93 ha of land. The land use pattern of mines, plant & colony area is given below:

TABLE – 2.2

Land Use / Land Cover Details of Core Zone (Limestone Mines)

S.No.	LANDUSE	AREA (Hectares)	AREA (%)
1.	Open scrub land	43.83	5.92
2.	Stony Waste land	59.95	8.09
3.	Open land	220.62	29.78
4.	Mine quarry	23.96	3.23
5.	Plantation	15.93	2.15
6.	Fallow land	80.82	10.91
7.	Crop Land	277.95	37.51
8.	Human Settlement	8.64	1.17
9.	Industrial area	7.65	1.03
10.	Seasonal water bodies	1.58	0.21
	TOTAL	**740.93**	**100.00**

- ***Source:*** *LU/LC Map for Core Zone*

TABLE 2.3

Land Use / Land Cover Details of Core Zone (Cement Plant)

S. No.	Legend	Area (in ha.)	% Area
1.	Open Land	98.43	51.52
2.	Plantation	23.37	12.23
3.	Colony Area	14.72	7.70
4.	Industrial Area	53.164	27.83
5.	Seasonal Water Bodies	1.38	0.72
Total		**191.064**	**100.00**

Source: *LU/LC Map for Core Zone*

TABLE 2.4

TOTAL MINE LEASE AREA

S. No.	Name of Village	Govt. Waste Land	Pasture (Gochar) land	Private land	Total
		Hect.	Hect.	Hect.	Hect.
1	2	3	4	5	6
1	Phalwa	18.278	17.229	377.000	412.507
2	Bhatkotri	6.455	17.291	113.911	137.66
3	Rasulpura	0.607	0.000	22.481	23.09
4	Lasrawan	4.870	7.619	154.696	167.19
5	Peerkhera	0.000	0.000	0.114	0.11
6	Maliyakheri	0.000	0.000	0.379	0.38
	Total :-	**30.210**	**42.139**	**668.581**	**740.930**

TABLE 2.5

Cement Plant, Colony Land & Approach Road

S.No.	Name of Village	Govt. Waste Land	Pasture (Gochar) land	Private land	Total
		Hect.	Hect.	Hect.	Hect.
1	2	3	4	5	6
1	Rasulpura	5.532	18.443	95.861	119.836
2	Sangriya	1.532	0.000	44.367	45.899
3	Borakheri	1.987	0.000	19.190	21.177
4	Peerkhera	0.000	0.000	4.152	4.152
	Total :-	**9.051**	**18.443**	**163.570**	**191.064**

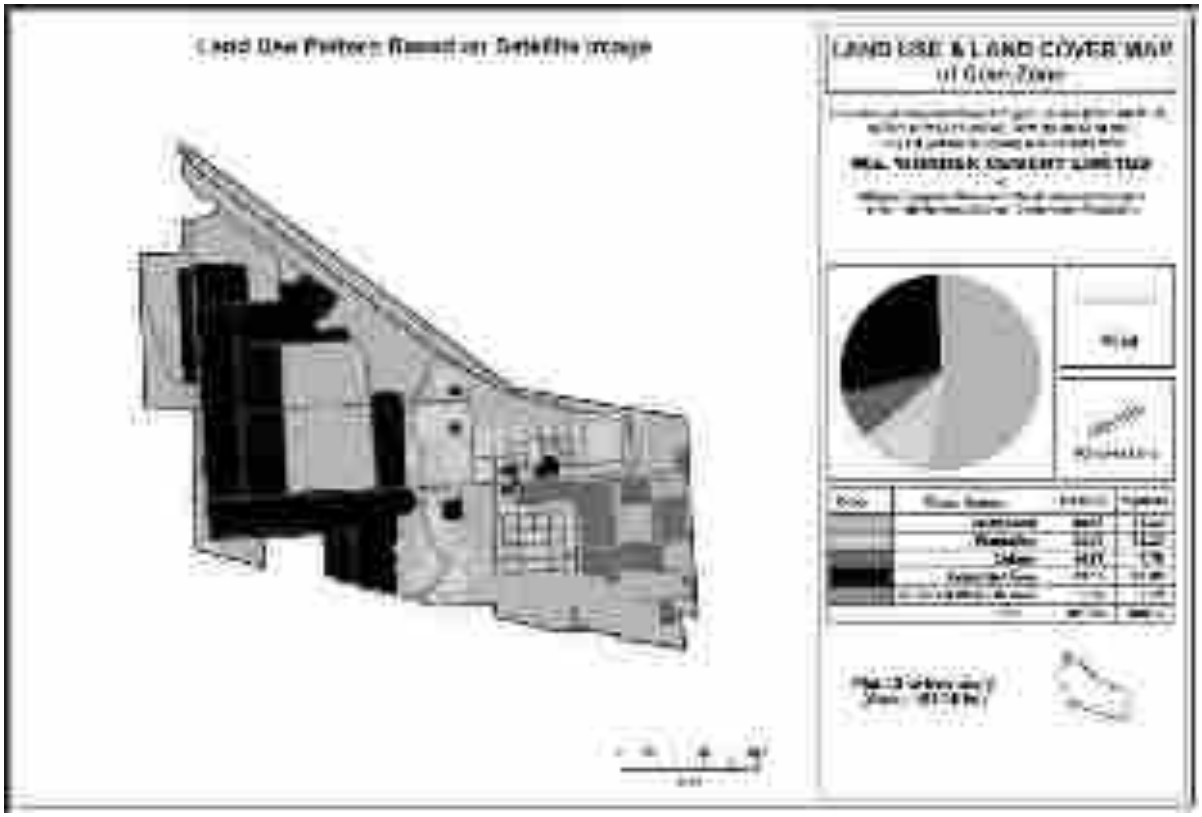


FIGURE: 2.3 :AND USE/ LAND COVER MAP OF CORE ZONE (CEMENT PLANT)

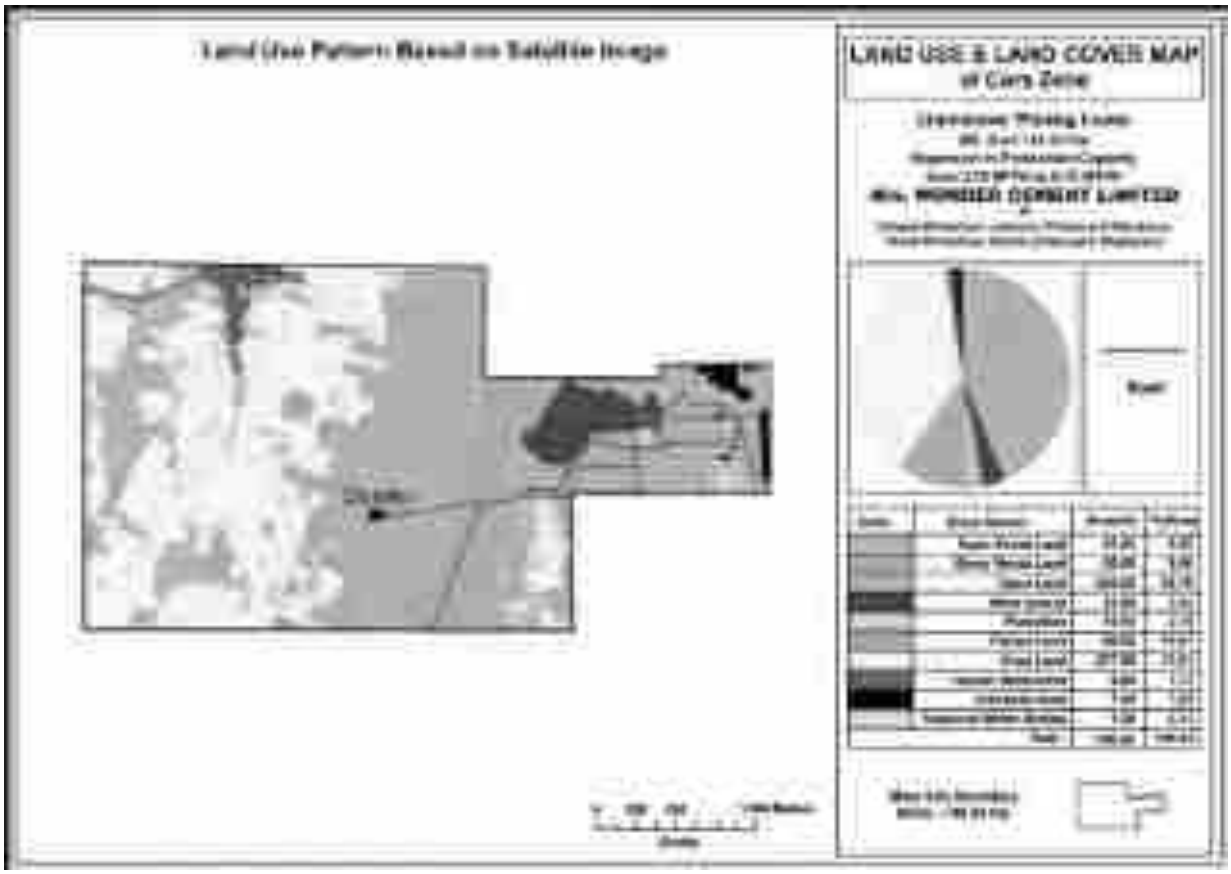


FIGURE: 2.2 :AND USE/ LAND COVER MAP OF CORE ZONE (LIMESTONE MINES)

CHAPTER 3

BIOLOGICAL STUDY OF BUFFER & CORE ZONE

Keeping in view of the unique diversity of the project study area , the project proponent are concerned about the negative impact that the cement plant and Mine development might have on the biodiversity of the area, which might be impact or direct or indirect and/or short-and long-term. Direct and Indirect impacts are explained below in **Table3.1**

Table 3.1 Explanation and examples of direct and Indirect Impacts

Direct Impact	Indirect Impact
Destroy, displace or in some way adversely affect the plants and animals themselves.	Destroy or disrupt patterns, processes or behavior leading to alteration in habitats, ecosystems or other physical or biological factors upon which a species depends.
Example are Habitat loss Habitat fragmentation Increased animal mortality due to collision with road vehicles Aquatic habitat damage	Example are Habitat degradation resulting increased human access to wildlife habitats Ecological disequilibrium Ecosystem simplification

Keeping the above – mentioned context in mind, MOEF TOR conditions and to minimize any of the direct and indirect impact of development project on biodiversity, Biological Impact Assessment study and conservation plan has been prepared out with the following objectives -

- To assess the impacts the project will have on forest, wildlife and wildlife habitat.
- To prepare a multi- purpose mitigation plan that details the strategies and measures to address forestry and wildlife concerns in the project.

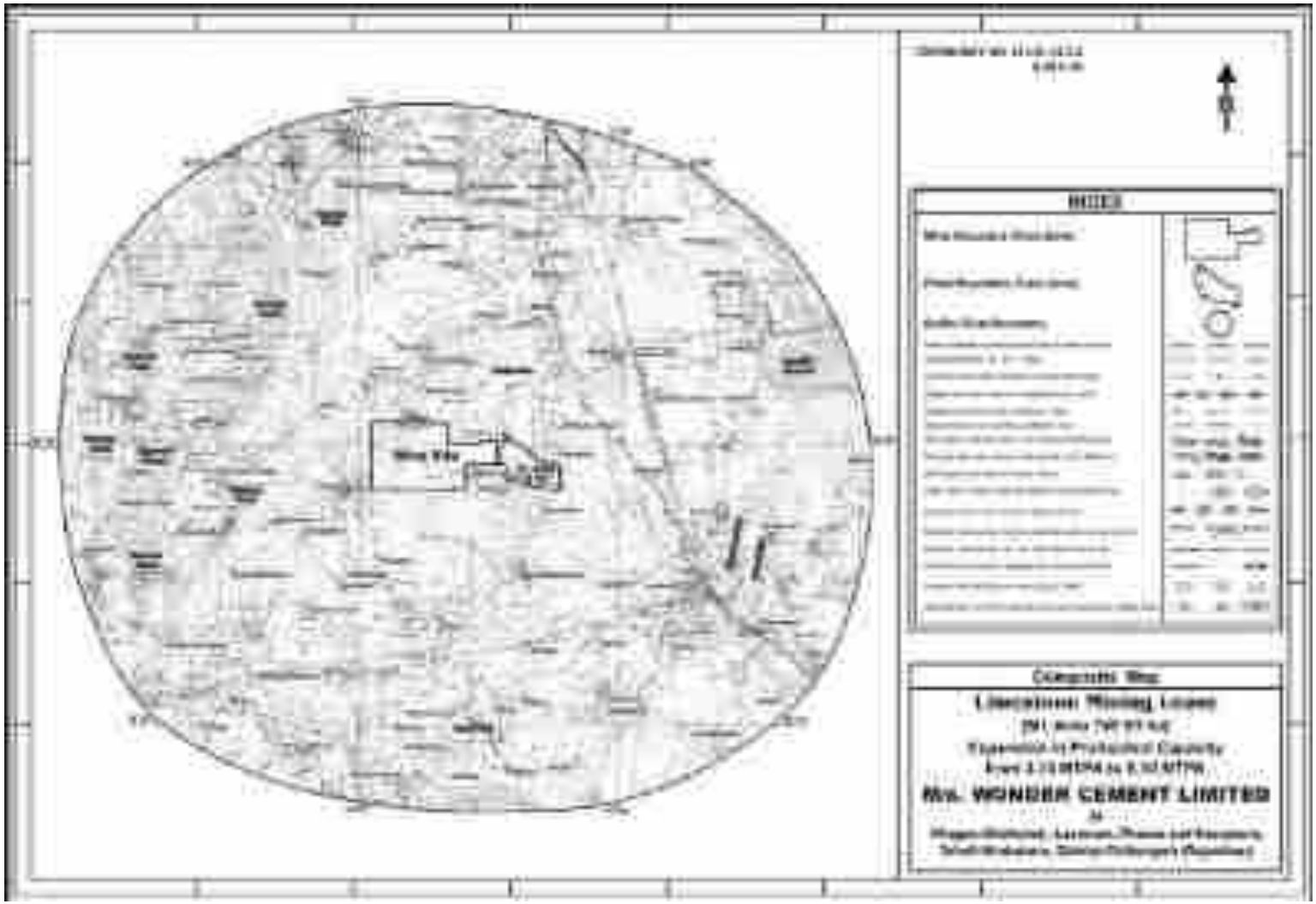


Fig 3.1 Location map of integrated project

3.1 Environment Setting

Environment is critical element for sustaining life. Various environmental parameters (Temperature, humidity, and rainfall besides components of the physical environment like soil) determine the composition of the species within plant communities that, in turn, affect colonization by and movement of animals. Consequently, it is important to take a brief look at the environment setting, particularly of the area within 10 km periphery from project site.

The climate of Chittorgarh is quite dry and parched. The summer season extends from April to June and is quite hot. The average temperature in summers falls between 43.8° C to 23.8° C. The winter season lasts from October to February. Chittorgarh weather in the winters is pretty cool. The temperature averages around 28.37° C to 11.6° C. The monsoon season falls during the months of June to August. As far as climatic conditions of Chittorgarh, Rajasthan in monsoon are concerned, there is only slight rainfall that averages around 60 cm to 80 cm.

3.2 Biodiversity Profile

3.3 Forest Type

The forest found in this biodiversity assessment is classified as II- Dry tropical forests, which is further diversified into group 5- Tropical dry deciduous forest with 5A- Southern tropical dry deciduous forest (including C1-dry teak bearing forest) and 5B- Northern tropical dry deciduous forest (including C2 –northern dry mixed deciduous forest) (Champion and Seth 1968).

Fig.3.2 Forest Type Map of Rajasthan

PHOTO-PLATES 3.1 – Overview of Study area

Photo Plates 3.2

Biodiversity Assessment and Consultation with Forest Department

3.4 Study Approach and Methodology

3.4.1 Study Plan

S.No.	Broad level approach
1	• Interaction with project proponent (WCL) • Collection of project related secondary data from project proponent • Review of scientific literature-publications • Reconnaissance survey
2	Intensive field work & primary data collection covering scope of work of the study proposal.
3	Data analysis, report preparation and submission of final report

This biological Reconnaissance Survey was carried out in the three steps

1. Collection and collation of available area specific secondary information by perusal of literature.
2. Mapping of land cover/forest and other related parameters.
3. The entire Core and buffer was surveyed, both by rapid and intensive protocols.

Biodiversity assessment was carried out using well accepted scientific methods and concern with forest officers and local peoples within study area.

3.4.1.1 Macro level Approach

3.4.1.2 Reconnaissance Survey

Rapid survey of project area was carried out to identify and understand the existing biological environments and different land use/land cover of the project study area covering project site and 10 km radius buffer zone.

Interactions and discussions were held with the project proponents to understand and get the first hand information about the project and associated activities at project site office Nimbahera.

3.4.1.3 Secondary data collection

Project related secondary information from the project proponent(WCL) in the form of project site maps, technical reports were collected.

Project related information specific to project study components (flora,fauna and habitats) were collected from different stack holders.

Scientific information available in the form of published papers,reports,books, was collected from the in house facilities and other institutions.

3.4.1.4 Micro level approach-field data collection

Micro level approach involves mainly the field based primary data collection on different components of the scope of works.faunal diversity was assessed by inventorization and quantifying the major faunal groups like amphibians,reptiles,birds(both aqatic & terrestrial) and mammals.

3.4.2 Biodiversity Monitoring Station : -

We have selected sampling point for assessment of both flora and fauna of study area of project site and we have taken GPS point of major location selected for biodiversity assessment.

Table 3.2: - GPS points have been taken for major location of Biodiversity Assessment

Y	X	Location Name
24°40'52.30"N	74°36'46.32"E	JK cement mine area
24°43'28.22"N	74°34'19.64"E	Forest area
24°44'6.84"N	74°33'3.75"E	Forest area
24°43'9.77"N	74°33'31.61"E	Forest area
24°36'49.24"N	74°42'29.73"E	Kadmali river
24°33'15.88"N	74°42'41.70"E	Adjacent river environment
24°42'4.90"N	74°43'45.78"E	Gambhir reservior
24°42'58.07"N	74°43'14.10"E	Gambhir river
24°42'10.51"N	74°37'53.58"E	Murliya DAM
24°35'3.20"N	74°37'21.09"E	Uncha talab

3.4.2.1 Sample Plots

To assess the status of faunal diversity taxa specific sampling plot of varying sizes were laid at selected sampling location and the details are discussed below;

3.4.3 Floral Study

The present report on the flora of project area is based on extensive field survey of the area. The seasonal study has been conducted from winter season. The plant species were identified with the help of Encyclopedia of flora of Rajasthan (Shetty and Singh).

A nested quadrate technique was used for sampling the vegetation. The size and number of quadrates needed were determined using the species area curve (Mishra,1968) and running mean method (Kershaw ,1973) .Summarization of previously used method and recommendations led to the use of more than often (10*10 m^2) quadrates laid out of sampling the tree stratum at different altitudinal gradients.

Quadrates were lased randomly on sampling site and were analyzed from each quadrate by counting the tillers individually as per the method used was that of Singh and Yadav (1974).

The vegetation data collected for phytosociology information were quantitative analyzed for Density, Frequency and Abundance according to Curtis and Mc-Intosh (1950). The relative value of frequency, density, and dominance of all the species were summed up to represent Importance Value Index (IVI). The following are the formulae to derive frequency, density, dominance, IVI etc.

$$Frequency = \frac{Total\ Number\ of\ quadrants\ in\ which\ species\ occurred}{Total\ number\ of\ quadrants\ studied} * 100$$

$$Abundance = \frac{Total\ number\ of\ Individuals\ of\ species\ in\ all\ quadrants}{Total\ number\ of\ quadrants\ in\ which\ species\ occurred}$$

$$Density = \frac{\text{Total number of individuals of a species}}{\text{Total number of quadrants studied}}$$

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

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

$$\text{Relative Density} = \frac{\text{Density of the species} * 100}{\text{Total density of all species}}$$

$$\text{Relative Dominance} = \frac{\text{Dominance of the species} * 100}{\text{Total dominance of all species}}$$

$$\text{Relative Abundance} = \frac{\text{Abundance of the species} \quad * 100}{\text{Total abundance of all species}}$$

Diversity Index of the Flora

The **Shannon-Weiner Index** was developed from information theory and is based on measuring uncertainty. The degree of uncertainty of predicting the species of a random sample is related to diversity of a community. If a community is dominated by one species (Low diversity), the uncertainty of prediction is low: a randomly – sampled species is most likely going to be the dominant species. However, if diversity is high, uncertainty is high.

$$H' = \frac{N \ln N - \sum(Ni \ln Ni)}{N}$$

Where, N = The total number of individuals of all species

Ni = the number of individuals of species i

The Phytosociology study was carried out for **woody vegetation** on site of protected forest. Quadrates were laid down in area of 10*10 M ^{2} and used randomly in number of three in each study area.

Table 3.3 Results of Phytosociology study of protected forest Environment

Speies	Freq.	Abun	Den.	Domi.	R.Fre.	R.Den.	R.Domi.	IVI	**Index of Diversity**
Anogeissus pendula	66.67	4.00	2.67	2418.26	18.2	44.4	38.6	101.23	1.81
Acacia nilotica	33.33	1.00	0.33	1632.3	9.1	5.6	26.1	40.71	
Prosopis juliflora	33.33	1.00	0.33	824.06	9.1	5.6	13.2	27.80	
Ziziphus nummulari	66.67	1.00	0.67	32.22	18.2	11.1	0.5	29.81	

a									
Caparis decidua	33.33	1.00	0.33	265.77	9.1	5.6	4.2	18.89	
Butea monosperma	33.33	2.00	0.67	677.49	9.1	11.1	10.8	31.02	
Lantana camera	33.33	1.00	0.33	2.01	9.1	5.6	0.03	14.7	
Euphorbia neriifolia	33.33	1.00	0.33	326.69	9.1	5.6	5.2	19.9	
Acacia catechu	33.33	1.00	0.33	84.91	9.1	5.6	1.4	16.0	

Results were indicated that *Anogeissus pendula* was most dominant species in forest environment of study area. The dominant species were shown below in chronological order based on IVI values-*Anogeissus pendula > Acacia nilotica > Butea monosperma > Ziziphus nummularia*

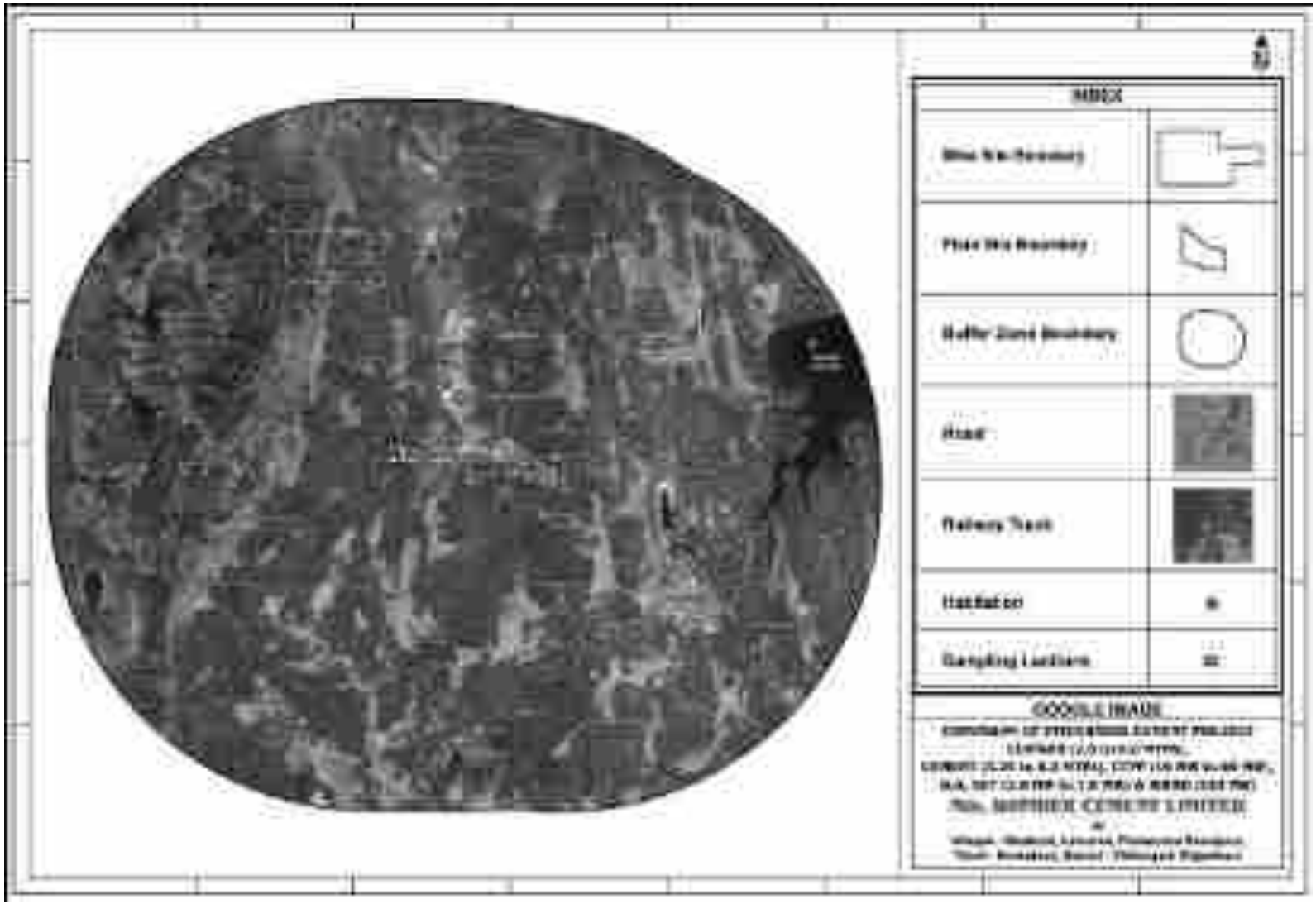


Fig 3.3:- Biodiversity Assessment Sampling Point in Study Area

Table 3.6 Flora of core and buffer zone of project study area

S.No.	Scientific Name	Local name	Family	Habit	Core	Buffer
1				T		
2				T	-	+
3				T	+	+
4				T	-	+
5				T	-	+
6				T	+	+
7				T	+	+
8				T	-	+
9				T	-	+
10				T	+	+
11				T	+	+
12				T	+	+
13				T	-	+
14				T	-	+
15				T	+	+
16				T	+	+
17				T	-	+
18				T	-	+
19				T	+	+

Biological Study & Conservation Plan

93				C	+	+
94				C	+	+
95				H	+	+
96				H	+	+
97				C	+	+
98				C	+	+
99				H	+	+
100				C	+	+
101				C	+	+

Where, T = Tree, S = Shrub, H = Herb, C = Grass and F = Fern, (-) = Absent, and (+) = Present

Table 3.5

Important Value Index (IVI) for Major tree Species of the study area

S.No	Scientific Name	Relative Density	Relative Dominance	Relative Frequency	IVI	RD
	Agricultural Field					
1		23.06	2.52	20.68	47.29	3
2		24.19	1.03	15.29	40.47	4
3		13.79	14.38	20.70	54.86	1
4		1.72	2.66	3.00	6.99	9
5		6.90	18.20	7.39	26.49	6
6		18.39	26.01	15.16	11.46	2
7		5.17	8.41	5.10	18.68	7
8		8.40	8.88	5.00	9.02	12
9		8.46	9.12	2.30	33.07	8
10		5.17	1.104	1.10	25.71	5

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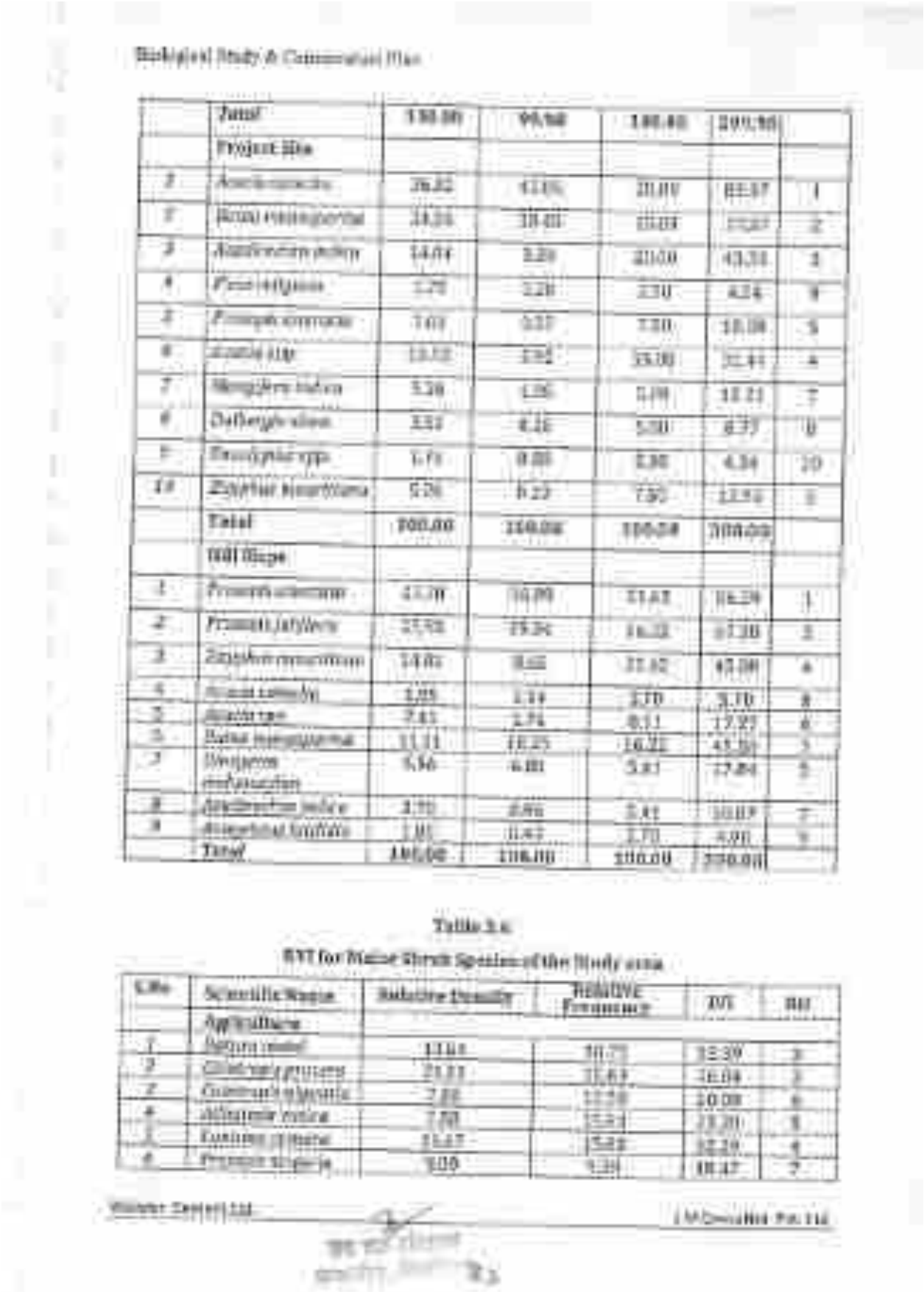


7	*Zizyphus nummularia*	24.24	12.50	36.74	1
	Total	**100.00**	**100.00**	**200.00**	
	Project Site				
1	*Datura metal*	9.09	15.38	24.48	4
2	*Calotropis gigantia*	13.64	11.54	25.17	3
3	*Calotropis procera*	19.70	19.23	38.93	1
4	*Acacia spp*	16.67	7.69	24.36	5
5	*Ipomoea carnea*	18.18	19.23	37.41	2
6	*Lantana camara*	13.64	11.54	25.17	3
7	*Zizyphus nummularia*	9.09	15.38	24.48	4
	Total	**100.00**	**100.00**	**200.00**	
	Hill Slope-Forest				
1	*Prosopis s*ingaria	38.18	24.00	62.18	1
2	*Calotropis procera*	12.73	20.00	32.73	3
3	*Acacia spp*	7.27	8.00	15.27	5
4	*Datura metal*	7.27	16.00	23.27	4
5	*Lantana camara*	5.45	8.00	13.45	6
6	*Zizyphus nummularia*	29.09	24.00	53.09	2
	Total	**100.00**	**100.00**	**200.00**	

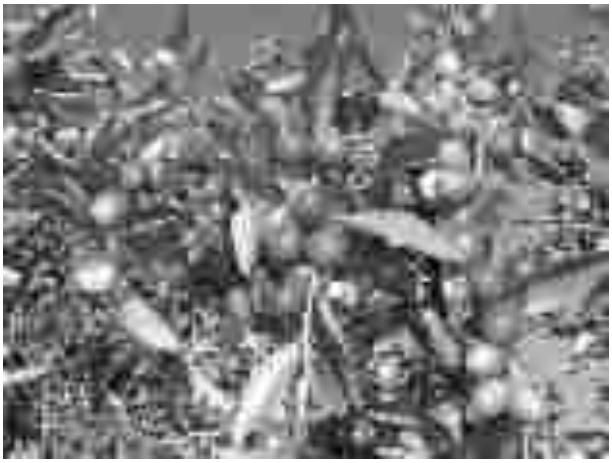
Threat Status of the floristic diversity

Flora was recorded from the study sites during the survey when compared with the available literature revealed that **none of the species recorded from the study area, fall under category of threat status according to Botanical Survey of India**.

PHOTO-PLATES 3.3:- Terrestrial Plant Diversity

1.0 Dichrostachys cinerea

2.0 Sterculia urens



3..0 Ziziphus mauritiana

4.0 Albizia julibrissin

5.0 Mitragyna parvifolia

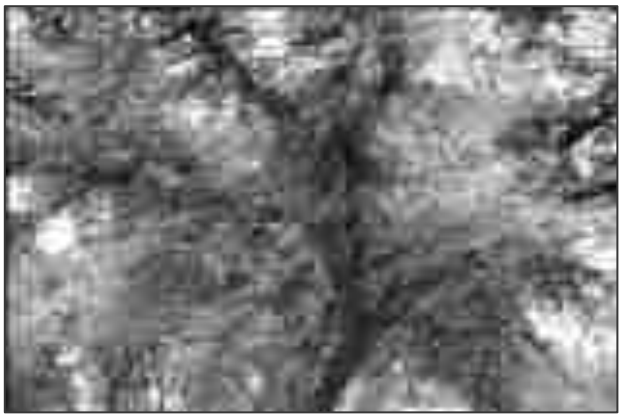
6.0 Terminalia arjuna

7.0 Syzygium cumini

8.0 Phoenix sylvestris

9.0 Ricinus communis

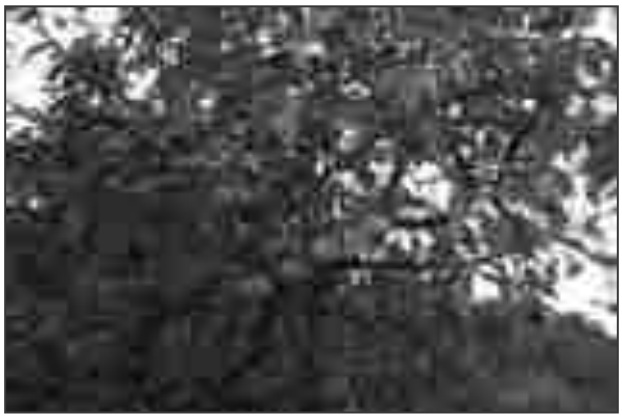
10.0 Ziziphus nummularia



11.0 Prosopis cineraria

12.0 Butea monosperma

13.0Euphorbia neriifolia



14.0 Diospyros melanoxylon

15.0 Acacia leucopholea

16.0 Phyllanthus emblica

17.0 Diospyros melanoxylon

18.0 Mangifera indica

19.0 *Ficus religiosa*

20.0 *Ficus benghalensis*

21.0 Cocos nucifera

22.0 Annona squamosa

23.0 Opuntia elatior

24.0 *Bamboo Species*

25.0 Saccharum munja

26.0 Carica papaya

27.0 *Lantana camera*

28.0 *Tamarindus indica*

29.0 Argemone mexicana

30.0 *Datura metel*

31.0 Solanum nigrum

32.0 *Adiantum Species*

3.4.4 Ethno botanical Study of project study area -

During the study 10 plant species have been recorded and those plants are being used by people of district Chittorgarh to treat their ailments such as injuries, cuts, fever, cough & cold, Blood pressure by using fresh as well as dried plant material. medicinal valuable plant were recorded during field assessment including *Tamarindus indica, Butea monosperma,*

Capparis deciduas, Cassia fistula, Euphorbia hirta, Holoptelea integrifolia, Pongamia pinnata, Terminalia arjuna, Annona squamosa, Syzygium cumini.

3.6 Fauna of Project study area

During the study in the field and concern with local stakeholder, 15 species of Mammals, 10 species of Reptiles, 3 species of Amphibians, 6 species of Butterflies, 15 species of Arthropods and Mollusca and 73 species of Birds were recorded on project study area.

3.6.1 Faunal Study

- Ground survey were carried out by trekking the impact zone for identification of important animal group such as butterflies (Insect), birds, mammals and reptiles etc inhibiting the area**.** The fauna were identified by using standard monograph of birds, butterflies, reptiles, Mammals etc.

3.6.1.1 Faunal status

Herpetofauna

- Intensive search was made along the hedges of all the aquatic habitats open wells located in the villages were checked to identify and list the amphibians.
- Status of reptiles was assessed using intensive time constrained search method covering different micro habitats within core and buffer zones of the study area following Welsh 1987,welsh and Lind 1991.

3.6.1.2 Terrestrial Birds

- Point count (fixed radius circular plot method) and perambulation techniques were used to assess the status of terrestrial birds (Hutto et al. 1986, Bibby et al 1992, Rosenstock et at. 2002).
- Additional effort was made to locate/ identify the presence of any breeding/nesting sites/roosting sites of avifauna.

3.6.1.3 Aquatic Birds

- Total count or flock count method was adopted to assess the status of aquatic birds in selected larger water bodies/ dams and major river systems of the project area (Sridharan 1989, Bhupathy 1991, Thomson 2002 and Steinkamp et al. 2003).

3.6.1.4 Mammals

- Status and distribution of different mammalian fauna was quantified using direct count covering all the terrestrial habitats of the project area following line transect/road count- Burnhem et al. 1980, Sale and Berkmuller 1988, Roadgers 1991.

- In addition circular (25 km radius) plots were laid in each sampling location and searched for indirect evidences (Pellets, dungs, droppings, scats, and other tracks and signs) which would provide relative abundance of presence of mammalian fauna (Thompson ef *al.* 1989, Henke and Knowlton 1995, Allen *etal.* 1996).

3.6.1.5 *Herpetofauna*

A total of 12 and 45 circular plots of 25 m radius were laid in all the micro habitats and intensively searched for Herpetofauna in both the Core and Buffer zones respectively.

3.6.1.6 Birds

To quantify terrestrial birds, 57 x 50 m radius circular plot (point count) was used in the core and buffer zones to assess the status of terrestrial birds. In total two dam sites and five locations along two rivers were surveyed for aquatic birds.

3.6.1.7 Mammals

A total of 57 x 25 m radius plots were intensively searched for indirect evidences of mammalian fauna. In addition, roads crisscrossing the project area were traversed exclusively during early morning and late evenings for the direct sightings of mammalian fauna. In addition dialogue with the local villagers of the project areas with pictorial guides were also carried out to substantiate and establish the presence of some of the mammalian fauna of the study area. Details of number of sample plots laid to assess the faunal diversity status are given in **Table 3.7 & Fig 3.3**

All the nomenclature and scientific names have been referred from standard flora for plants and pictorial guides for fauna (Herpetofauna - Daniel 2002, Birds: Ali, S. 2002, Grimmett *et al.* 2006.

Table 3.7

Details of Sample Plots laid to assess Floral and Faunal Status in the Proposed Cement Plant and limestone Mine project WCL, Nimbahera Chittaurgarh, Rajasthan

Components	Plot size	Core Zone	Buffer zone	Study Area
Plants	Necessary information/data obtained from EIA/EMP report			
Herpetofauna	25 m Radius circular plot	12	45	57
Birds	**Terrestrial:** Point count method 100 m radius	12	45	57

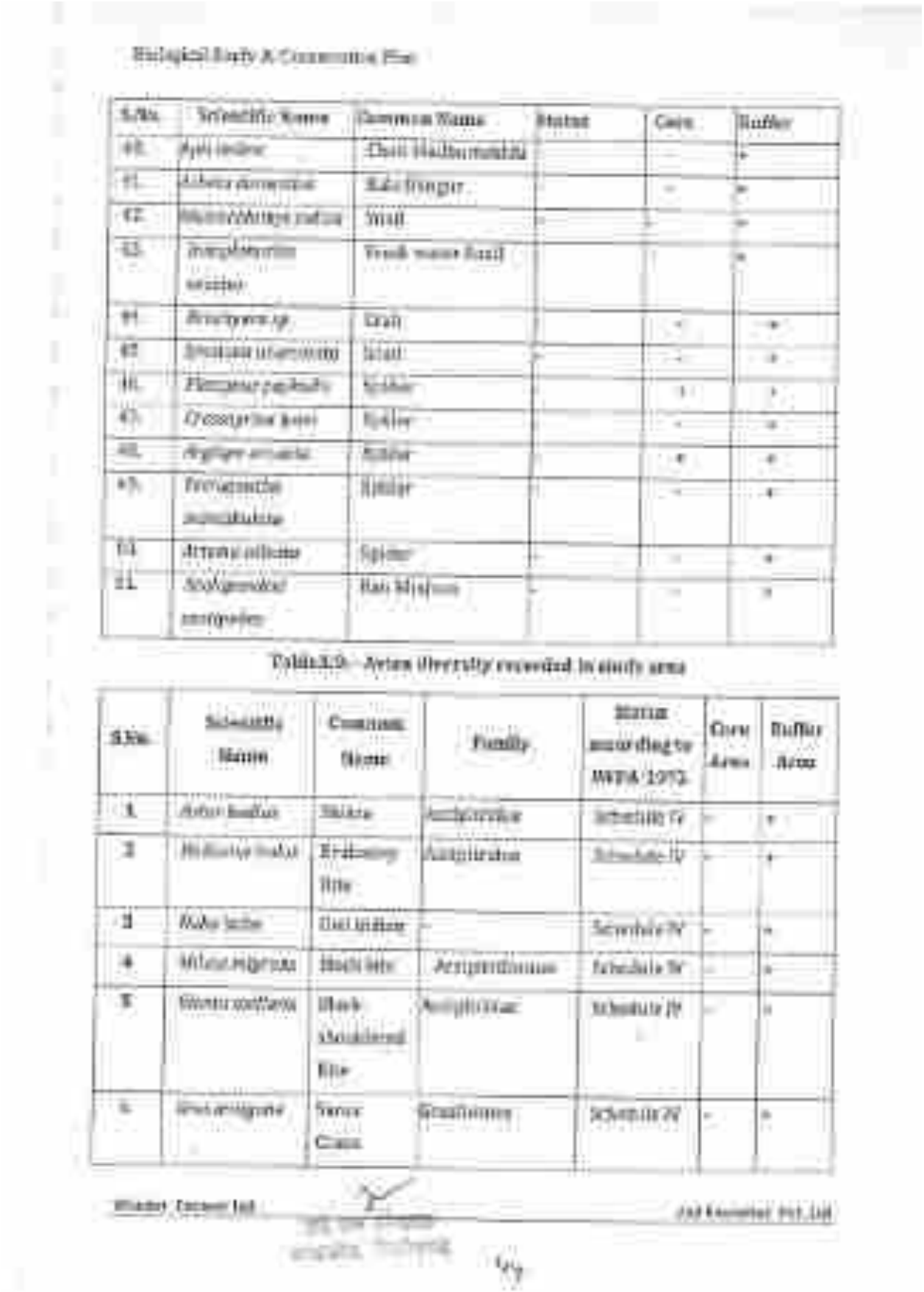
	Aquatic	58	7	7
Mammals -	Indirect evidence	42	45	87

Table 3.8 Fauna were recorded in Core and Buffer Zone of Project Study Site

S.No.	Scientific Name	Common Name	Status	Core	Buffer
Mammals					
1.				-	+
2.				+	+
3.				-	+
4.				+	+
5.				+	+
6.				-	+
7.				+	+
8.				+	+
9.				-	+
10.				-	+
11.				-	+
12.				-	+
13.				-	+
14.				-	+
15.				-	+
16.				-	+
17.				-	+
Reptiles					
18.				-	+

S.No.	Scientific Name	Common Name	Status	Core	Buffer
19.	[illegible]	[illegible]	[illegible]	–	+
20.	[illegible]	[illegible]		+	+
21.	[illegible]	[illegible]	–	–	+
22.	[illegible]	[illegible]	+	+	+
23.	[illegible]	[illegible]	+	+	+
24	[illegible]	[illegible]	[illegible]	–	+
25	[illegible]	[illegible]	[illegible]	–	+
26.	[illegible]	[illegible]	[illegible]	+	+
27.	[illegible]	[illegible]	[illegible]	–	+
Amphibians					
28.	[illegible]	[illegible]	[illegible]	–	+
29.	[illegible]	[illegible]	[illegible]	–	+
30.	[illegible]	[illegible]	[illegible]	–	+
Butterflies					
31.	[illegible]	[illegible]	+	+	+
32.	[illegible]	[illegible]	+		+
33.	[illegible]	[illegible]	+	+	
34.	[illegible]	[illegible]	+	+	
35.	[illegible]	[illegible]		+	+
36.	[illegible]	[illegible]	–	+	+
Arthropods and Molluscs					
37.	[illegible]	[illegible]		+	+
38.	[illegible]	[illegible]		+	
39.	[illegible]	[illegible]		+	+

[illegible] [illegible]



S.No.	Scientific Name	Common Name	Status	Core	Buffer
10.					+
11.				-	+
12.				+	+
13.					+
14.				+	+
15.				-	+
16.				+	+
17.				-	+
18.				+	+
19.				-	+
20.				-	+
21.				-	+

Table 3.9 Avian diversity recorded in study area

S.No.	Scientific Name	Common Name	Family	Status according to IWPA 1972	Core Area	Buffer Area
1.					-	+
2.					-	+
3.					-	+
4.					-	+
5.					-	+
6.					-	+

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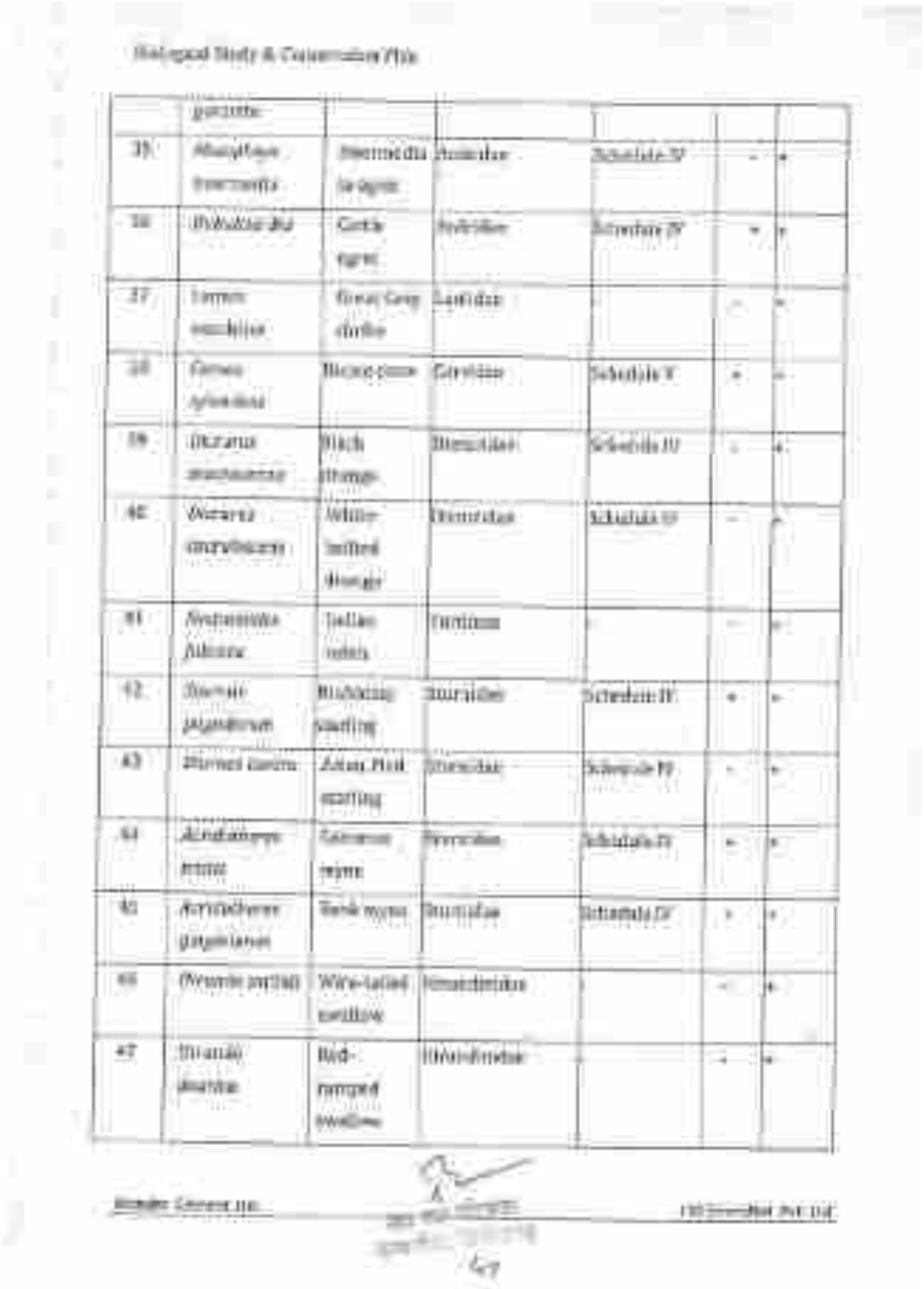


PHOTO-PLATES 3.4:- Animals of buffer zone of Project Site

1.0 Eryx johnii

2.0 Elaphe Helena (Daudin)

3.0 *Boselaphus tragocamelus*

4.0 Presbytis entellus

5.0 Pteropus giganteus

6.0 Rana tigerinus

	
7.0 *Danaus chrysippus*	8.0 *Funambulus pennanti*

3.6.2 Nesting of birds and habitation of animals

Nesting of Birds was recorded in Buffer zone of project area during biodiversity assessment**.** Mostly nests of following **Cattle egret, House crow and Baya Weaver** were recorded in study area. The habitation of Indian fox, reptiles and rodents were also observed in project study area.

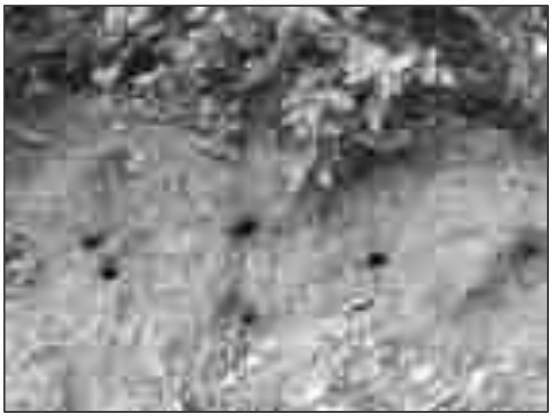
PHOTO-PLATES 3.5: Nesting and Habitation Site of Animals

1.0 Nests of Cattle egret

2.0 Nests of House crow

3.0 Nests of Baya Weaver

4.0 Habitation of Indian Fox



5.0 *Apis dorsata*

6.0 Habitation of Rodents and Reptiles

3.6.3 Aquatic diversity

The study period of biodiversity assessment were Winter Season and the study area having two seasonal river. Three dam are present in study area in which one is big dam constructed on Gambhiri River. The project area rich of aquatic diversity due to presence of Gambhiri river, Kadmali river, Gambhiri Dam, Murliya Dam and Uncha Talab.

Nineteen species of plant including submerge, emergent, Free floating and grasses species were recorded during biodiversity assessment in aquatic environment. The aquatic vegetation of study area was described below in **Table 3.10**. Ten species of fish were also recorded in aquatic Environment which is described in **Table 3.11**. The aquatic diversity were described below –

3.6.4 Aquatic Vegetation in project study area -

Table 3.10: - Aquatic Plant were recorded in Buffer Zone of Project Site

S.No.	Scientific Name	Local name	Family
1	*Alternanthera philoxeroides*	-	Amarenthaceae
2	*Arundo donax*	Arundo	Poaceae
3	*Bacopa monnieri*	Brahmi	Plantaginaceae
4	*Cyperus rotundus*	Nutgrass, Coco	Cyperaceae
5	*Ceratophyllum Demersum*	Water head, pond weed	Ceratophyllales
6	*Chenopodium album*	Bathua	Amaranthaceae
7	*Enhydra fluctuans*	-	Asteraceae

8	*Hydrilla verticillata*	Hydrilla	Hydrocharitales
9	*Euphorbia cyparissias*	Graveyard	Euphorbiaceae
10	*Lemna perpusilla*	Small Duckweed	Lemnaceae
11	*Nymphaea alba*	White water lily	Nymphaeales
12	*Potamogeton diversifolius*	American pond weed	Potamogetonacea
13	*Polygonum species*	Knotweed	Polygonaceae
14	*Phragmites karka*	-	Poaceae
15	*Scirpus cernuus*	-	Cyperaceae
16	*Spirodela polyrhiza*	Giant Duckweed	Araceae
17	*Typha elephantine*	Era	Typhaceae
18	*Vallisneria spiralis*	Tape grass	Hydrocharitaceae
19	*Wolffia Columbiana*	Water meal	Arales

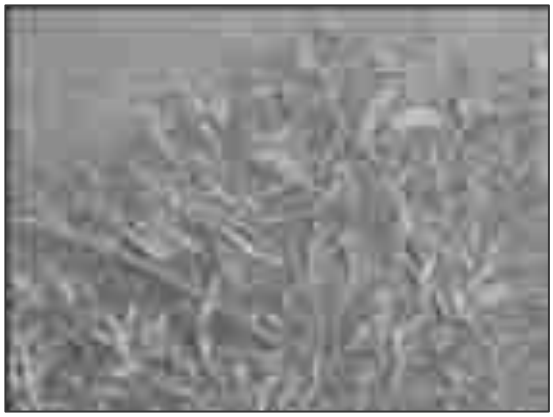
PHOTO-PLATES 3.6:- Aquatic vegetation

1.0 Nymphaea alba

2.0 Spirodela polyrrhiza

3.0 Scirpus cernuus

4.0 *Cyperus rotundus*



5.0 Potamogeton diversifolius

6.0 *Typha elephantina*

Aquatic Fauna in the project area -

Table3.11: - Fish diversity recorded in study area

S.No.	Scientific Name	Common Name	Family
1	*Hypophthalmichthys molitrix*	Silver carp	Cyprinidae
2	*Ctenopharyngodon idella*	Grass Carp	Cyprinidae
3	*Cirrhinus reba*	Reba Carp	Cyprinidae
4	*Channa punctatus*	Snakehead fish	Channidae
5	*Catla catla*	Indian Carp	Cyprinidae
6	*Ctenopharyngodon idella*	Grass carp	Cyprinidae
7	*Cyprinus carpio*	Common carp	Cyprinidae
8	*Gambusia affinis*	Mosqitofish	Poeciliidae
9	*Labeo rohita*	Rohu	Cyprinidae
10	*Macrobrachium malcolmsonii*	Jhinga	Palaemonidae

PHOTO-PLATES 3.7:- Fish Diversity

1.0 Mystus seenghals

2.0 Catla catla

3.0 *Ctenopharyngodon idella*

4.0 Hypophthalmichthys molitrix

PHOTO-PLATES 3.8: - Wetland Accosiated Birds

1. Ardeola grayii

2. Ardea purpurea

3. *Anastomus oscitans*

4. Flock of *Microcarbo niger*

5. Flock of Mycteria leucocephala

6.0 Flock of Phoenicopterus minor

7.0 Flock of Sandpipers, Ruff, Spotted Duck, Eurasian Spoonbill and Painted Storks

8.0 *Grus antigone (Sarus Crane)*

9.0 Ceryle rudis

10.0 Ardea cinerea

11.0 *Anser indicus*

12.0 *Tadorna ferruginea*

13.0 Pelecanus onocrotalus

14.0 Anas poecilorhyncha

3.6.5 Cropping Pattern –

A single crop in kharif is the predominant cropping system in the project area. In the project site practices legume-wheat- based cropping system.

Cropping pattern is pearl – millet - wheat, pearl-millet-mustard, Maize-wheat etc in the project study area. The major kharif crops in the project study area are pulses, maize,

jower, soya been, groundnut and rape seed. While the major Rabi crop in the area are wheat, mustard, barley and gram.

Photo plate 3.9:- Cropping Pattern of Study Area

1.0 *Triticum* sp.

2.0 *Sinapis alba*

3.0 *Papaver somniferum*

4 Cicer Arietinum

3.7. STATUS OF FAUNA

This section includes the discussion of major faunal groups *viz.,* amphibians, reptiles, birds (terrestrial and aquatic) and mammals. Status of Herpetofauna and mammal groups was discussed only at species richness and abundance levels based on actual number of animals and indirect evidences recorded for these groups respectively.

3.7.1. Status of Herpetcfauna

The species richness and abundance status is discussed under the section Herpetofauna with reptile species.

3.7.1.1. Species Richness of Herpetofauna

Buffer Zone: In the buffer zone (10 km radius area from the project site boundary), overall 10 species of Herpetofauna were recorded. Among these 10 species, maximum of 7 species were recorded in agriculture and only 4 in the wetland habitat, which include the dam and river sites. The forest area reported 7 species whereas in the open scrub lands 6 species were reported**. (Table 3.13).**

Study Area: Including the core and buffer zones, overall Herpetofauna richness in the study area, showed the presences of 10 species **(Table 3.13).** Since the core zone did not report any additional species the overall status of the study area was similar to the buffer zone.

3.7.1.2. *Abundance status of Herpetofauna*

Core Zone: In the core zone a total of only 28 individuals were recorded of which Garden Lizard *[Colotes versicolor)* reported maximum of 13 animals followed by six Indian Bull Frog *[Hoplobatrachus tigerinus).* It clearly showed the very poor abundance status of Herpetofauna in the core zone **(Table 3.12).**

Buffer zone: Abundance status of the buffer zone resulted in enumeration of 81 animals of 10 species. Snake species are silent and secretive in nature and were reported based on sightings and were confirmed based on the interviews with local people with pictorial representation./guides. Among the habitats, agriculture area had 36 animals of 7 species followed by forest habitat with 20 animals of 7 species. Though the buffer zone encountered 81 individuals of 10 species, and were found to be low in abundance in buffer zone **(Table 3.12).**

Table 3.12: Abundance Status of Herpetofauna

S.No	Family /Species name	Core Zone	CT	Buffer zone				BT	ST
		AG		**AG**	**FR**	**OS**	**WL**		
	AMPHIBIANS								
1	**Dicroglossidae**								
I	Indian Bull Frog *Hoplobatrac hus tiqerinus*	6	**6**	2			7	9	**15**
ii	Paddyfield or Cricket Frog *Fejervarya limnocharis*	2	**2**	2			2	**4**	***6***
	REPTILES								
2	**Agamidae**								
i	Garden Lizard -*Calotes versicolor*	13	**13**	19	8	6	4	37	50
3	**Gekkonidae**								
i	Northern House Gecko *Hemidactylus flaviviridis*	2	**2**	5	3	2		10	12
4	**Scincidae**								
I	Brahmini grass skink-Mabuya *carinata*	3	**3**	8	4	2		14	17
5	**Elapidae**								
I	Spectacled cobra -*Naja naja*	1	**1**		1	1		2	3
Ii	Common Krait-Bungarus *caeruleus*				*	*		*	*
6	**Colubridae**								
I	Indian rat snake-Pfyas *mucosa*	*		*		*		*	*
Ii	Common Indian Cat Snake *Boiga trigonata*			*	*			*	*
7	**Viperidae**								
i	Viper- *russelli*				2			2	2

	Total species	**7**	**6**	**7**	**7**	**6**	**4**	**10**	**10**
	Total animals	**28**	**28**	**36**	**20**	**13**	**13**	**81**	**107**

AG- Agriculture, CT- Core Total, AG -Agriculture, FR-Forest, OS- Open Scrub , WL-Wetland, BT- Buffer Total, ST- Total, * Species Reported Based on Secondary Sources - Local

3.7.2. **Status of Avifauna - Terrestrial**

3.7.2.1. ***Taxonomical Status, Species Richness and Diversity - Terrestrial birds***

Core zone: Status of terrestrial birds assessed within the core zone, reported presence of total 15 species 15 families. Overall the core zone had a fairly high species diversity of H'=3.2 **(Table 3.13).**

Buffer Zone: The buffer zone that spreads over a larger areas had four different habitats, which together harbored 74 species and 37 families, at a species high diversity of H'=3.7. **(Table 3.13).**

Table: 3.13.Taxonomical Status of Terrestrial Birds

S.No.	Parameters	Core Zone	Buffer Zone
1	Family	15	38
2	Species	15	74
3	Species Diversity (H")	3.2	3.7

Table: 3.14 Taxonomical Status of Fish.

S.No.	Parameters	Core Zone	Buffer Zone
1	Family		4
2	Species		10

Threatened fauna

Terrestrial Birds: During this study, of the total 74 terrestrial bird species of 38 families, reported within the study area, one threatened species such as Indian Peafowl (Povo *cristatus),* a schedule I species under Wildlife Protection Act 1972. Since these species fall under the threatened category, possible conservation measures are suggested.

Mammals: This list included two Schedule I species in the study area. These three schedule I species includes: Indian Wolf *[Canis lupus) and* Common Leopard *(Panthera pardus)* none of these species were reported either in the project site and in the forest habitat of the buffer zone. All the two species were reported in the State Forest Department record .

However, the study area was not having designated Protected Areas (Wildlife Sanctuary and National Parks) within 10km radius, considering the quality/nature of the reserved forest habitats of the study area and contiguity with other forest areas beyond the study area, species specific conservation and management plans for these schedule I species have been suggested in **Chapter 4**

3.8 Ecologically sensitive area -ESA

Based on the coordinates of the proposed project site, Land use map and wildlife sanctuaries placed on Google map, a total of three Ecologically Sensitive Areas- ESA i.e., Wildlife sanctuaries, which are located outside the project 10 km buffer have been identified. The distance measured between the project site and the boundary of the nearest ESA showed that Sitamata Wildlife Sanctuary is the nearest and located 40 km away from the project boundary little towards south-west of the project site, Bassi Wildlife Sanctuary which is in the north-east is 45 km, while Behnsrodgarh Wildlife Sanctuary is located 104 km from the project site. Overall this Mapping study clearly showed that, none of the ESA areas are located in the close vicinity/distance i.e., within 10 km radius of the Cement Plant, CPP and Limestone mine project site of WCL located near Bhattkotri village of Nimbahera Tehsil of Chittaurgarh district, Rajasathan **(Google Map).**.

Table 3.15: Status of ecologically Sensitive areas and distance from the Proposed Cement Plant,

s.no	Wildlife Sanctuary	Distance from the Proposed WCL Project site
1	Sitamata Wildlife Sanctuary	40 km
2	Bassi Wildlife Sanctuary	45 km
3	Behnsrodgarh Wildlife Sanctuary	104 km

3.9 Impact on Ecology and Biodiversity:-

3.9.1 Impacts of Mine development have been described below in tabular form.

Impact of the mine development on Ecology and biodiversity	Mining activities	Exploration and Construction	Exploration drilling	Access road construction	Land clearance (For construction etc.)	Construction related infrastructure	Construction of ancillary infrastructure	Road,rail and export infrastructure	Pipeline for slurries or concentrates	Energy/power & Trasmission line	Water sources, Wastwater treatment	Transport of hazardous material
Potential Impact												
Impacts on terrestrial biodiversity												
Loss of Ecosystem and habitats			•	•	•			•	•	•		•

Effects on migratory species			•	•	•	•		•	•	•		•
Effects of induced development on biodiversity			•	•		•		•	•	•		•
Aquatic biodiversity & impact of discharge												
Increase mineral, heavy metals and pollution			•		•	•		•		•	•	•
Increased turbidity (Suspended solids)			•	•	•	•		•	•	•	•	•
Risk of groundwater contamination			•			•		•				
Social interfaces with biodiversity												
Loss of access medicinal plants					•	•		•	•	•		
Loss of access to fisheries					•			•	•	•		
Loss of Access to forage crops or grazing				•	•	•		•	•	•		
Increased hunting pressures			•	•	•	•		•		•		•
Induced development impacts on biodiversity				•	•	•		•		•		•
Air quality related impacts on biodiversity												
Increased ambient particulate matter			•	•	•	•		•		•		•
Increased ambient sulfur dioxide (SO2)						•				•		•
Increased ambient oxides of nitrogen (NOx)						•				•		•

Increased ambient ~~heavy metal~~ and Minerals											•	

3.10 **Impacts of Mining operation activities on Ecology & Biodiversity** :-

Impact of the mine development on biodiversity at operation phase	**Mining activities**	**Ore processing and plant site**	**Plant site, materials handling etc.**	**Extraction and waste rock storage**	**Rock blasting and ore removal**	**Mine dewatering**	**Ore stockpiling**
Potential Impact							
Impacts on terrestrial biodiversity							
Loss of Ecosystem and habitats			•	•	•	•	•
Effects on migratory species			•	•	•	•	
Effects of induced development on biodiversity							
Aquatic biodiversity & impact of discharge							
Increase mineral, heavy metals and pollution			•	•	•	•	•

Increased turbidity (Suspended solids)			•	•	•	•	•
Risk of groundwater contamination			•	•	•	•	•
Social interfaces with biodiversity							
Loss of access medicinal plants			•	•		•	
Loss of access to fisheries			•	•		•	
Loss of Access to forage crops or grazing				•		•	
Increased hunting pressures			•				
Induced development impacts on biodiversity							
Air quality related impacts on biodiversity							
Increased ambient particulate matter			•	•	•		•
Increased ambient sulfur dioxide (SO2)			•				
Increased ambient oxides of nitrogen (NOx)			•				
Increased ambient heavy metal and Minerals			•	•	•		•

3.11 Impact of Cement plant and mining on Ecology and Biodiversity

The project area is rich of biodiversity. Emission of particulate matter and gaseous like SOx, NOx and CO may affect on both flora and fauna of surrounding environment. These gaseous may deteriorate the chlorophyll content of plant. Some plant specifies are very sensitive for gaseous concentration and cannot survive in particular concentration of these gaseous. These gaseous are cause of health related issue in animals at particular concentration.

Noise pollution creating activities may be caused of habitat destruction of wild animal beside this increase vehicle activities may generate negative impact on Biodiversity. If Hazardous, solid waste and waste water will not disposed and treatment according to CPCB guideline, it will create negative impact on both flora and fauna of study area.

The fugitive emissions, which are expected to be generated during operation, are likely to settle down within a distance of 200-300 m from the plant core. There are no perennial water bodies with in 10 Km radius of the lease which could have been possible impacted by the fugitive emission in term of increased turbidity and TS content. However, the terrestrial flora will be impacted. The settlement of these fugitive particulate emissions on the laminar surface of plants can impede the efficiency of photo transduction and thereby affect productivity of plants. In some of the plant, it may smother the leaf surface blocking stomata, resulting in reduced transpiration.

There are direct or indirect evidences of presence of major wildlife in the buffer of plant as well that of the mines. The area does not form part of any National park or Wild life Sanctuary, through there is four protected and four reserved forest.

During construction and operation phase, a large number of machinery and construction labor will be active in the construction sites. The sittings of construction equipments, stores, labor camps, the operation of various construction equipments and construction work itself is likely to generate significant noise. The noise may scare the wild Fauna of nearby forests patches and force them to migrate to other areas. In the operation phase, the emission of particulate matter and toxic gases in the environment may create toxic impact on terrestrial and aquatic animals due to change in composition of elements.

In running cement plant, hazardous waste is not generated. WCL is having ETP and STP for treatment of waste water and is operating efficiently. No waste water is discharged out side plant premises and after treatment it is using for greenbelt development. WCL is operating

air pollution control devises like ESP etc that have been described in detail in Environment management plan. Beside this WCL is developing greenbelt for control fugitive and gaseous emission as well as controlling noise pollution and light beam impact on surrounding environment. Thus the impact on biodiversity due to cement plant will not significant through effective environment management plan.

3.12 Impact of emissions from project site to Reserve/protected Forest

As per results of air pollutant dispersion modeling, ground level concentrtation of SPM a major emission from cement plant will be neglissible beyond a distance of 3 km from site. As reserve forest and protected forest are located at a distance of 3 to 9 km from project site, the effect of emission on flora & fauna in forest area will not be there. During field study in the forest zone, no impacts were recorded on effects on flora and fauna by the emission from existing cement plant operation.

3.13 Biodiversity Impact Mitigation Measures –

During construction and operation phase of cement plant and mine following mitigation measure to reduce biodiversity impact on surrounding environment are given below:

1. Water sprinkler should be used on connecting road for transportation of construction material during construction phase and raw material and product in operation phase to control fugitive emission in surrounding environment.
2. Paved road should be use for transportation of construction material and product to minimize fugitive emission**.**
3. Transported material and store of raw material should also be well covered.
4. Transport vehicles and machinery should be properly maintained and periodically check pollution level to reduce noise level and gases emission surrounding environment.
5. Blasting should be carried out in deep hole to minimize impact on vibration and noise on Ecology and biodiversity.
6. Emission of particulate matter and gaseous during operation phase should be controlled at source by using particulate matter control and gaseous emission control devises as per CPCB guidelines.
7. Thick Green Belt should be developed in 33 % area around of project site. The plant specifies selection for greenbelt should be according to guideline of CPCB. These species should be drought resistance and can be control gaseous emission. The green belt is also beneficial for controlling noise pollution of surrounding environment.

8. Do not use exotic species that may be fast growing.
9. Maintain the ecology of the preferred routes of animal's movement.
10. Use flasher to prevent animals from crossing busy interaction.
11. Transportation of raw material and construction material should be preferred in day time. If any circumstance for transportation at night time should be use night readable signboard cautioning the drivers to watch for animal. Use fluorescent ink to make them readable after darkness.
12. Built a clause in contract document for the contractor that would not permit the labors, worker, supervisors, contractors and other employees to collect and utilize forest produce, including firewood. Frequent visitation to the forest habitats for collection of resources could scare the wildlife and may also result in human –wildlife conflict.
13. Create a live hedge of sturdy woody shrubs along the mine that would restrict the wildlife to enter into mine site that is good practice to save animal to fall in mine pit. Closely packed *Euphorbia neriifolia*, *Opuntia elatior* could be used about 100 meter width around mine site boundary.
14. Undertaken an educational and awareness drive in labor camps to ensure that traps are not laid by the labors for trapping small animals.
15. The removal or picking of any protected or unprotected plants shall not be permitted.
16. The grass mix should consist of indigenous grasses adapted to the local environment conditions.
17. In the event that animals are present that may pose a risk to human safety, a suitable animal handler must be requested to removed the animal in an environmentally responsible manner. This specifically refers to snake and scorpions.

CHAPTER 4
CONSERVATION PLAN

4.0 Introduction

The project proponent shall take all precautionary measures during plant and mining operation for conservation and protection of flora and fauna. Action Plan for conservation of flora and fauna shall be implemented in consultation with the State Forest and Wildlife Department. Necessary allocation of funds for implementation of the conservation plan shall be made and the funds so allocated shall be included in the project cost. In this regard as per field study we hereby states that no endangered fauna falls within the 10 km radius of the study area. Management Plan for the Conservation of Flora & Fauna was prepared in consultation with the State Forest and Wildlife Department and an amount of about Rs. 140 lacs will be spent towards Conservation Measures.

A pragmatic Action Plan has been evolved for the **Schedule-I** fauna particularly in the buffer area and shall be adhered to in letter and spirit for implementation by the project proponent. The plan shall be implemented in consultation and collaboration with the forest department, besides entrusting the responsibility to an exclusive 'in-house' expertise.

(i) The matter of supporting management strategies for conservation of wildlife through organizational and administrative infrastructure is often taken to be straightforward and it is planned by rote. In the present case the project proponent recognizes the values of wildlife and the need to balance the proposed industrial activity with conservation. Therefore professionals of appropriate expertise and experience shall be roped in from outside to complement the execution of the conservation action plan. Endorsement shall be sought to the extent possible for every proposed action of relevance to conservation of wildlife, from the regional forest authorities.

(ii) It is the budget that translates operation of strategies into reality. The project proponent has prepared a realistic budget considering every operational aspect and the various schemes of the Govt. of India and those available within the state upto the district level, to override the budgetary constraints.

(iii) The budget is intended to be annualized by indicating operational costs under all strategies and their relevant financial implications.

(iv) There shall be a critical monitoring and auditing of the progress of management activities and costs incurred on an annual basis. The project proponent shall maintain a record of achievements, postponements, and circumstances under which some components of the action plan had to be deleted or deferred indefinitely.

(v) For effective and informed application of action plan prescriptions, the project proponent shall prepare a 'hand book' containing information on ground situation, all technical strategy details with modalities of application. The managerial cadre shall monitor the response of the users of this 'Hand Book' with the objective of smooth implementation of plan strategies.

(vi) There shall be a hierarchical control in implementation of the action plan without exemption to any cadres, to ensure complete participation and accountability of all within the enterprise.

4.1 Indian Peafowl

The Indian Peafowl *(Pava cristatus)* is an omnivore. The Indian Peafowl *(Pavo cristatus)* has been an integral part of the people of the India and their culture for centuries. From religion and mythology to civilization and socio-culture, the Indian Peafowl occupies an important place in the lives of the people. In addition to this, the Indian Peafowl is well recognized for its ecological and aesthetical values, and hence aptly declared as the 'National Bird' of India in the year 1963. Although the Indian peafowl is widely distributed and locally abundant or fairly common in some areas, the present population status of this species is only speculative and many of its former contiguous range has become fragmented and discontinuous (Choudhury and Sathyakumar 2009).

Status: - This bird recognized under **Schedule I species** of Wild Life Protection Act 1972 in India.

Classification:-

Kingdom	Animala
Phylum	Chordata
Class	Aves
Order	Galliformes
Family	Phasianidae
Subfamily	Phasianidae
Genus	Pavo
Species	*Pavo cristatus*

Habitat: It is a bird of scrub jungles and forest edges, showing affinity to moist and dry deciduous and semiarid biomes. It is also found in the agriculture fields, along streams with good vegetation and close to human habitations in a semi-feral condition (Johnsgard 1986). It generally prefers a habitat mosaic of scrub and open areas, with adequate sites for dust bathing. Dust bathing is important as this bird has to condition its feathers and remove feather-degrading bacteria and other external parasites (Choudhury and Sathyakumar 2007). It roosts on trees and also uses tall buildings where trees are scarce (Birdlife International 2000). Also forages farmland, particularly dense, tall crops such as sugar cane, maize. Travels in small parties of males and 3 to 5 females when nesting, but sexes segregate after breeding. Feeds and drinks in open early and late, prefaced by crowing; also stimulated by thunder. Roosts in tall trees.

The natural range of Indian Peafowl is essentially the Indian Subcontinent, with India covering a vast majority of its range from the outer Himalaya (up to 2000m) through much of the country including the peninsula. Other countries where the species still survives in good numbers are Nepal and Sri Lanka, while there are only two populations in Pakistan, it is rare in Bhutan and possible extinct in Bangladesh. It has been introduced in Andaman Island (Ali & Ripley 1980).

Male peacock is 78.34 to 90 inches (200 to 229cm) and known for its long train consisting of elongated upper tail coverts that can be spread into dazzling fan by raising tail beneath. Neck and breast deep bright blue, lower back bronze-

green with scallops and upper tail coverts bronze-green with purplish and black in centre, rump black. Copper-coloured eyes, face white and black, fan-shaped crest of wiry feathers.

Female 34 inches (86cm). Head crested as male and nape Rufus brown, upperparts brown, mottled paler; primaries brown; lower neck metallic green, breast buff glossed green, belly buffy white. Legs and bill grey, eyes brown. Immature male resembles female, but primaries chestnut.

Reproduction : Peafowl normally reach breeding age at two years. Peahens will sometimes lay fertile eggs as yearlings. They will lay these eggs late in the summer after they have turned one year old. The best chance for a yearling hen to lay eggs is when she is in the same pen as a mature male. A mature male is a peacock which is at least three years old. The peacock will molt the tail in late summer and this is when the breeding season will end. A two year old peacock that has a one to two foot long tail train will be a better breeder at this age than a peacock of the same age that doesn't have a tail train of any size.

A mature peacock in prime condition can be mated to as many as five peahens. The eggs are light brown in color and are similar in size to turkey eggs. If the eggs are collected from the nest for artificial incubation, a peahen may lay as many as thirty eggs. Peahens which are allowed to roam freely about a farm will hide their nests in tall grass, around shrubs, and in brush piles. The nest is a depression scratched out in the ground and lined with grass. Nests in such locations are many times destroyed by possums, raccoons, and skunks which will eat the eggs.

Threats:

- The Indian peafowl is under threat from various quarters that include the demand for feathers and wild meat, conflict with farmers during cropping season, increased use of chemical fertilizers and pesticides, and habitat degradation
- Habitat degradation and loss -more significantly from conversion of their habitat to agriculture, habitation and industrial growth, poisoning to counter crop damage, consumption of eggs and fat extracts for alleged medicinal values, and killing for wild meat.

Action plan for Conservation of peafowl: -

- Time series analysis of habitat change to quantify the rate of change and identify high risk areas and potential sites for further affirmative action.
- Estimation population size by established count method such as line transect, call counts and roost counts.
- Intensive ecological investigation in reprehensive sites in major biogeography zone with focus on the effects of threats in relation to breeding success and survival probability.
- Encourage Afforestation activities around close to peafowl habitation. The selection of plant species should be based on requirements of peafowl roosting, food, shelter.
- Organized seminar, conferences, poster presentation at school and Gram Panchyat level around peafowl habituation area with discussed on aware local people about not to kill this bird for meat, feathers. Protect it birds to wild dog and his eggs to predators.
- Peafowl have culture value in India with associated to god of Krishana, Kartikaya. It feathers are used to various festivals like dipawali. Encourage the local people to give his contribution in protection of peafowl. It is necessary to aware local people to his cultural value.
- Small water tank should be constructed in habitation zone of Peafowl and its water quality should be maintained.
- Fruit and shade plant should be planted nearby peafowl habitation like mango, Anvala, Amrud, Emli, Bargad, Neem, Pipal etc.
- Small sacred grove should be constructed on wasteland in each peafowl habitation area. Sacred grove is small patches of vegetation that are protected by traditional manner. This sacred grove should constructed boundary about 7-10 ft height and one temple should construct in sacred grove. One person should be monitor to wild dog, monkey and give organic farming food like maze, Pulls, wheat, rice for Peafowl.
- Encourage local farmer to use biopesticide, biofertilizer and vermicomposting in agriculture practices.

Budget for conservation of Peafowl -

The total budget for Peafowl conservation will be 10 **Lakh** that will be expenditures in Construction of small scared groove, Plantation of fruits, shady and grasses species, Construction of small water tank and Training and awareness program.

Table: 4.1 Budget for Conservation of Peafowl

S.No	Activities	Expenditures in Lakh
1.	Construction of small scared groove in each habitation area.	4.0
2.	Plantation of fruits, shady and grasses species in habitation of Peafowl.	2.0
3.	Construction of small water hole in each scared groove and forest area.	2.0
4.	Awareness program for protection of peafowl.	1.0
5.	Monitoring and counting of Peafowl in Core and Buffer Zone of project area.	1.0
	Total	10

4.2. Leopard

The leopard *(Panthera pardes),* a vulnerable (IUCN 2010) and Schedule-I species of the Wildlife Protect Act 1972, is the most adaptable and widely distributed among the big cats (Nowell and Jackson 1996). This species is known for the use of habitat edges and its ability to live close to human habitation (Seidensticker *et al.* 1990). Leopard feed on a broad spectrum of prey, ranging from smallest rodent to a young buffalo (Qureshi and Advait 2006, Ahmed and Khan 2008 and Ramesh *et al.* 2009). Studies on feeding of leopard have shown that chital, sambar and common langur forms their major diet (Karanth and Sunquist 1995, Sankar and Johnsingh 2002, Ramesh ef *al.* 2009 and Mondal ef *al.* 2011).

However, Leopard presences was not established during this survey (field survey and interviews with locals), considering the contiguity of the forest patches with forest beyond the 10 km study area and there are possibilities of this carnivore, which is the top predator

to be present there. This is because leopards are adaptable to any type of habitat in and around wilderness areas. So it is important that sufficient prey or food is available in the forest. Though the study area supports fair number of Nilgai and Wild pig which can be prey for leopard, as part of conservation plan for this predator, habitat protection and improvement, especially the food availability for both the leopard and the prey species, along with availability of water and salt licks are of priority. The langur, which is an important prey species for leopard in this region, was sighted (four individuals) at one location, thus showing that its population was very low.

However, many of the tree species used as food by the langurs and the ungulates were available, most of the regeneration and recruitment was low or stunted due to grazing and occasional fire (in some forest areas), that has led to heavy degradation of the area that has resulted in low availability of fodder species in the area. So the nearby forest areas must be protected from fire in addition to improving the fodder availability in and around the high forest dependent villages so as to reduce the grazing pressure and its impact in the forest.

4.2.1. Habitat improvement - Gap plantation with woody shrubs

Gap plantation can be done in 15 locations in the degraded reserve forest areas, mainly in the patches that are heavily degraded and lack natural regeneration, covering at least one ha area in each plantation site. The species suggested for gap plantation as part of habitat improvement

Table 4.2: List of woody shrub species suggested under habitat improvement program.

S.No	*Species Name*	Local Name	Technique Codes*	
			Nursery	Planting
1	*Carissa spinarum*	Karonda	3	1
2	*Carissa congesta*		3	1
3	*Grewia hirsute*	Gudshariya	2	2
4	*Grewia tenox*	Gangor	2	2
5	*Grewia villosa*	Dolkan	2	2
6	*Capparis separia*	Kanter	8	1/2
7	*Capparis spinosa*	Kalvariya	8	1/2

	[zeylanica)			
8	*Securinega laucopyrus*	Kelspariva	8/9	1/2
9	*Helicteres isora*	Marodphli	2/9	1/2
10	*Tamarix dioica*	Zau	10	1/4
11	*Clerodendron visconsum*	Arnia	2/9	1/2/4
12	*Zizyphus xyiopyrus*		7	1/2
13	*Zizyphus nummularia*		7	1/2
14	*Coccuius hirsufus*		2/9	2
15	*Coccuius pendulus*		2/9	2

A total of 15 shrub and woody shrub species have been suggested under gap plantation to improve the habitat quality:

- Improve vegetation cover and provide shelter for small mammals such as rats, gerbils, mouse, hare, jackal and wild pig.
- Control soil erosion and retain the soil moisture and thereby improve the overall regeneration potential of other tree species of the forest habitat.
- Provide food for Jackal, Wild pig, Common langur and Nilgai which are main prey species for leopard which is top carnivore of the study area.
- The nursery and planting techniques are given in the table **(Table 4.3).**

Table 4.3: Techniques and codes for Germinating Seeds in the Nursery and Planting of Sapling in the forest.

Nursery Technique		**Planting Technique**	
Code	**Method**	**Code**	**Method**
1	Seed must be treated with H2SO4 for 10 mins and then washed and sowed into bags	1	Pit Planting
2	Seed must be Soaked in Water for 24 hrs and then sowing into bags	2	Dried Seed Sowing directly
3	Seed needs no treatment and should be sowed directly into bags	3	Suckering
4	Pot Method: Seeds must be sowed into pot and kept in shade with partial sunlight and after germinating to about 4 cm then transplant into bags.	4	Stump Planting
5	Bed Method: Prepare bed of 50 cm long with small pit of 5-10cm on both end of the bed, where water should be poured. Seed should be		

	spread with sieve (single layer) on which fine soil to the height of the seeds must be spread using sieve and the bed must be cover with transparent polythene sheet. Once seeds germinate to 4 cm it should transplanted into bags		
6	Winged Seed : Small cut on top and towards sideways should be made in such a way that it does not damage the embryo / alternatively seed must be soaked for 15-20 days and then dried for three days, this must be repeated twice and then the seed can be sowed into bags / alternatively sow the seed directly into the bags after tearing the wings the seed would germinate late after 20-30 days.		
7	Seeds need to be cracked by beating using stick		
	either putting them into a cloth bag or spreading them on hard surface and then can be put into the bags / alternatively the seed can be directly sowed but germination would be late.		
8	Seeds need to be depulped and then sowed into the bag		
9	Wildling : geminated saplings should be collected from the wild during rainy season and that can be planted		
10	Cutting : Pencil sized branches can be cut and then planted directly		

4.2.2. Development of Grasslands/patches for prey species of leopard.

In order to improve the prey species, including the rodent (rats, gerbils, mouse & hare) population that are also eaten regularly by leopard where prey especially ungulates population is low, the habitat improvement should involve developing grass patches in the areas that are open. List of some grass species reported in the study area are suggested for grassland development **(Table 4.4).** A minimum of 25ha plots, and at least four such plots, mainly in the degraded patches in the RFs away from the villages in different directions should be developed.

The good viable grass seeds, 4-5 kgs (if half degraded site) or 7-8 kgs (fully degraded site) needs to be mixed with one part of soil, one part of farm yard manure, one part of clay and water and made into pellets round if the site is flat and slightly flat or disc shaped if the area is slopy and sowed. Alternatively, bed of 10m long and 1m wide with mixure of soil, clay and farm yard manure is to be prepared in the nursery and grass seed sowed on it. Once the grass seeds germinate and grow to 4-5 cm it can be pulled out carefully with roots and plant the slips. Third means is by collecting wild slips from the wild grass before they

seed and fruit and then plant the slips which have some leaf blade and also root. All these should be done during the monsoon season. However the first method is more quicker and easier.

Table 4.4: List of Grass species suggested for developing grassland/patches

S.No	Grass Species
1	*Apluda mutica*
2	*Cenchrus ciliaris*
3	*Cynodon dactylon*
4	*Desmostachya bipinnata*
5	*Dichanthium onnulatum*
6	*Eragrostis ciliaris*
7	*Eragrostis Sp.*
8	*Heteropogon confortus*
9	*Sporobolus coromandelianus*
10	*Sporobolus* Sp.

4.2.3. Population status assessment

As of now except for the Nilgai and wild pig, in addition to very few Common Langur, no direct sightings and indirect evidences of any other ungulate species were reported during the study in these forest areas.

- Therefore, along with habitat protection and improvement, it is highly essential to re-assess the status of leopard population and other major prey species especially ungulates within 10 km radius of the project site.
- Regular monitoring of the leopard and its prey population using comparable ecological methods is essential and is one of the other most important actions for leopard conservation.
- This survey need to be carried out with the wildlife experts and the state forest department to identify the areas or forest that needs all the conservation and management interventions which are highly crucial.

4.3. Indian Wolf

It a large canid that looks like a slim Alsatian with big head. The Indian wolf is smaller than the sub-species found in Europe and America. The wolf readily adapts to a variety of food including domestic livestock bringing them into direct conflict with villagers. They live in small packs in dry open country, desert and barren upland (Menon 2003).

The study area does not have a suitable habitat for wolf, which is substantiated with no sightings of this species in the field and also no report based on interviews with local villagers during this study. The list based on secondary source showed occurrence of this species in the forests of Chittaurgarh District, which covers very large extent of area. However, the above management plans for threatened ungulate are likely to increase the populations and prey (lesser mammals) base for wolf. Added development of grass plots will support, other lesser mammals specifically gerbils and rats that serve as food resources for this threatened wolf.

Awareness and education of local on the importance of the grasslands, the protection and improvement of wild prey species and consen/ation significance of Wolf is also equally imperative. Another important action that needs to be taken up is monitor the population of the Wolf for medium to long term with trained forest guards/temporary guards.

4.4 Conservation of other species

A brief idea about the nature and habitat of all species listed under schedule II of the Wild Life Protection Act, 1972 including the possibilities of threat to their existence.

4.4.1 Jungle Cat : Zoological name : *Felis chaus*

Jungle cat has long legs and a thin body. Its feathers are mostly straw yellow brown, reddish grey and aside from the lines on its legs there is not a specific pattern available (Pocock, 1951,Heptner and Sludskii, 1972, Harrison and Bates, 1991). Under captivity, compared to females, males perform a more protective attitude towards the kittens. Sexual dimorphism can be attributed to this behavior (Schauenberg, 1979; Mendelssohn, 1989). It is observed that in nature jungle cat family walk in groups (Schaller, 1967; Mendelssohn, 1989). Additionally, these animals are good swimmers. In order to catch fish (Mendelssohn 1989) or run away from dogs or humans, they dive into water (Heptner and Sludskii, 1972). In search of their food, Jungle cats do not merely use their sight; at the same time they

employ their sharp hearing and smelling senses (Ognev, 1962). Mainly they eat gnawers (Allayarov, 1964; Schaller, 1967; Heptner and Sludskii, 1972; Roberts, 1977; Khan and Beg, 1986). Besides jungle cats are fed by hares, birds, reptiles, amphibian, bugs and even the juvenile of big animals such as wild boar .

Habitat: The place where Jungle cat lives is surrounded by bushes, small hills covered by maquis vegetation near lake, fruit gardens, plains, rocks and willow groups where at times floods resultant of lake have occurred. The observations revealed that population used meadow and lake shore to feed and rock cracks covered by maquis to shelter. Around the irrigation channel in plain, many traces and slops have been detected and it became obvious that the species used under bridge as a shelter. Alongside the irrigation channel here, many nests which are acknowledged to be of the species have been found.

Diet: Jungle cats, which move to the lake-shore after sunset, mainly feed on fish. It is reported that almost every night they eat the fish leftovers of the fishermen and restaurants' garbage. Additionally, it is detected that they sneak into fish depots. However, it is noted in this study that they also feed on fresh dead animals. It is observed that mostly in winter months jungle cats feed on water birds which are killed and left to the shore which are died in fish nets. Additionally the cat found dead had inside its stomach flakes, bird legs and plant grains like wheat.

Behavior: Although the members of this population act timidly, still basically in order to feed, they approach close to the places where people live. During the observation it was detected that after sunset they got more active, but it is possible to allege that the cats move around during daytime as well.

Conservation: The jungle cat would also benefit from improved protection of natural wetlands and reedbeds, particularly in the more arid parts of its range, and improved legislation prohibiting fur trade. Jungle cats can do well in cultivated landscapes (especially those that lead to increased numbers of rodents) and artificial wetlands.

Developing Check dams

There are two dams (Gambheeri Reservoir & Murliya dam) located in and around the study area, and though rivers and streams are cutting across the study area from north to south, they are highly seasonal. Added these rivers are far away from the forest and is fully surrounded by agriculture land use. The water availability in most of the forest habitats/blocks are totally nil during summer and other seasons. Hence, it is suggested that a check dams need to be constructed across the streams/rivers passing through the

Reserved Forests located in the study area. Fish and other aquatic species will be developed in the dam which will provide food to Jungle cat.

4.4.2 Jackal : Zoological name – *Canis aureus*

It is smaller than common dog with height 38-43 cm. it can live anywhere easily but hunts in packs. Usually nocturnal and carnivore but feeds on dead carcass too. It can even taste fruits like berries etc.

Medium-sized canid, considered the most typical representative of the genus Canis (Clutton-Brock et al. 1976). There is approximately 12% difference in body weight between sexes (Moehlman and Hofer 1997). Basic coat colour is golden but varies from pale creamy yellow to a dark tawny hue on a seasonal basis. The pelage on the back is often a mixture of black, brown, and white hairs, such that they can appear to have a dark saddle similar to the black-backed jackal (Canis mesomelas). Jackals inhabiting rocky, mountainous terrain may have a greyer coat shade (Sheldon 1992). The belly and underparts are a lighter pale ginger to cream. Unique lighter markings on the throat and chest make it possible to differentiate individuals in a population (Macdonald 1979a; Moehlman 1983). Melanistic and piebald forms are sometimes reported (Jerdon 1874; Muller-Using 1975). The tail is bushy with a tan to black tip. Legs relatively long, and feet slender with small pads. Females have four pairs of mammae (Sheldon 1992). The skull of the golden jackal is more similar to that of the coyote (C. latrans) and the grey wolf (C. lupus), than that of the black-backed jackal, side-striped jackal (C. adustus), and Ethiopian wolf (C. simensis) (Clutton-Brock et al. 1976). The dental formula is 3/3-1/1-4/4-2/3=42. Moehlman and Hofer (1997) give mean body mass for females as 5.8kg, and for males 6.6kg.

Habitat : Due to their tolerance of dry habitats and their omnivorous diet, the jackal can live in a wide variety of habitats. These range from the Sahel Desert to the evergreen forests of Myanmar and Thailand. They occupy semi-desert, short to medium grasslands and savannahs in Africa; and forested, mangrove, agricultural, rural and semi-urban habitats in India and Bangladesh (Clutton-Brock et al.1976; Poche et al. 1987; Y. Jhala pers. obs.). Golden jackals are opportunistic and will venture into human habitation at night to feed on garbage. Jackals have been recorded at elevations of 3,800m in the Bale Mountains of Ethiopia (Sillero-Zubiri 1996) and are well established around hill stations at 2,000m in India (Prater 1980).

Food : Jackals are omnivorous and opportunistic foragers, and their diet varies according to season and habitat. They consume invertebrates and fruit, over 60% of their diet comprises rodents, lizards, snakes, birds (from quail to flamingos), hares, and Thomson's gazelle (Gazella thomsoni) (Wyman 1967; Moehlman 1983, 1986, 1989). In Bharatpur, India, over 60% of the diet comprised rodents, birds and fruit (Sankar 1988), while in Kanha, Schaller (1967) found that over 80% of the diet consisted of rodents, reptiles and fruit. In Sariska Tiger Reserve, India, scat analysis (n=136) revealed that their diet comprised mainly mammals (45% occurrence, of which 36% was rodents), vegetable matter (20%), birds (19%), and reptiles and invertebrates (8% each) (Mukherjee 1998). Great quantities of vegetable matter occur in the diet of jackals and, during the fruiting season in India, they feed intensively on the fruits of Ziziphus sp., Carissa carvanda, Syzigium cuminii, and pods of Prosopis juliflora and Cassia fistula (Kotwal et al. 1991; Y. Jhala pers. obs.)

Reproduction : Reproduction and denning behavior Reproductive activity commences from February to March. As with other canids, mating results in a copulatory tie that lasts for several minutes (Golani and Mendelssohn 1971; Golani and Keller 1975). Timing of births coincides with abundance of food supply; for example, the beginning of the monsoon season in northern and central India. Gestation lasts about 63 days(Sheldon 1992). Moehlman and Hofer (1997) give mean litter size as 5.7 (range=1–8) in Tanzania, while in the Bhal area in India, average litter size was 3.6 (range=2–5; n=11) (Y. Jhala unpubl.). Lactation usually lasts for 8–10 week.

Conservation: Development of Grasslands/patches for prey species Jackal.

In order to improve the prey species, including the rodent (rats, gerbils, mouse & hare) population that are also eaten regularly by Jackal where prey especially ungulates population is low, the habitat improvement should involve developing grass patches in the areas that are open. List of some grass species reported in the study area are suggested for grassland development **(Table 4.4).** A minimum of 25 ha plots, and at least four such plots, mainly in the degraded patches in the RFs away from the villages in different directions should be developed.

The good viable grass seeds, 4-5 kgs (if half degraded site) or 7-8 kgs (fully degraded site) needs to be mixed with one part of soil, one part of farm yard manure, one part of clay and water and made into pellets round if the site is flat and slightly flat or disc shaped if the area is slopy and sowed. Alternatively, bed of 10 m long and l m wide with mixture of soil, clay and farm yard manure is to be prepared in the nursery and grass seed sowed on it. Once the

grass seeds germinate and grow to 4-5 cm it can be pulled out carefully with roots and plant the slips. Third means is by collecting wild slips from the wild grass before they seed and fruit and then plant the slips which have some leaf blade and also root. All these should be done during the monsoon season. However the first method is more quicker and easier.

4.4.3 **Russell's Viper** : Zoological name – *Vipera russelli*

It is identified by similar small spots on head. Rounded, heavy body with flat head. Golden eyes and brown spots with black and white lining. Rarely spotted in the area due to presence of workers.

Russell Viper has a light brown body with three rows of dark brown or black spots edged with white or yellow extending its entire length. Toxic Snake Range 5: Russell's viperpoisonous snake is the world leader 5. It is highly venomous snake too.

Characteristics of snake: Russell viper is a dangerous species is abundant throughout its range. Is responsible for more human deaths than any other venomous snake. It is irritable. When threatened, it coils tightly, hisses and punches with such speed that its victim has little chance of escape. Its venom is a powerful haemotoxic coagulant, damaging tissue and blood cells.

Habitat: The habitat varies from farmland Russell's viper in the tropical forest. It is commonly found around human settlements. Length of the snake: the average length of Russell's viper is 1 meter and a maximum of 1.5 meters. Russell's vipers are found in Sri Lanka, southern China, India, Malaya,Java, Sumatra, Borneo and surrounding islands.

Behavior : This snake is terrestrial and active primarily as a nocturnal forager. However, during cool weather it will alter its behavior and become more active during the day.

Adults are reported to be persistently slow and sluggish unless pushed beyond a certain limit, after which they become aggressive. Juveniles, on the other hand, are generally more nervous.

When threatened they form a series of S-loops, raise the first third of the body and produce a hiss that is supposedly louder than that of any other snake. When striking from this position,

they can exert so much force that even a large individual can lift most of its body off the ground in the process. These snakes are strong and may react violently to being picked up. The bite may be a snap, or they may hang on for many seconds.

Although this genus does not have the heat-sensitive pit organs common to the Crotalinae, it is one of a number of viperines that are apparently able to react to thermal cues, further supporting the notion that they too possess a heat-sensitive organ. The identity of this sensor is not certain, but the nerve endings in the supranasal sac of these snakes resemble those found in other heat-sensitive organs.

Reproduction : This species is ovoviviparous. Mating generally occurs early in the year, although gravid females may be found at any time. The gestation period is more than six months. Young are produced from May to November, but mostly in June and July. It is a prolific breeder. Litters of 20–40 are common, although there may be fewer offspring and as little as one. The reported maximum is 65 in a single litter. At birth, juveniles are 215–260 mm in length. The minimum length for a gravid female is about 100 cm. It seems that sexual maturity is achieved in 2–3 years. In one case, it took a specimen nearly 4.5 hours to produce 11 young.

Food : It feeds primarily on rodents, especially murid species. However, they will eat just about anything, including rats, mice, shrews, squirrels, land crabs, scorpions and other arthropods. Juveniles are crepuscular, feeding on lizards and foraging actively. As they grow and become adults, they begin to specialize in rodents. Indeed, the presence of rodents is the main reason they are attracted to human habitation.

Conservation: Because of its poisonous effect, people fear a lot and try to kill snake. Snake catcher is a useful tool to catch the snake and leave it in to remote place outide the village. On complaint, forest department send persons to catch snake in major town in Chittorgarh. But due to limitation of manpower and vehicles, it is not possible to send person to remote villages. Wonder Cement has purchased snake catchers and regularly providing training through experts of forest department to people in surrounding villages to use snake catchers.

Plate 4.1 : WCL provides regular training to catch snakes in surrounding villages through Chittorgarh Forest Department Experts.

4.4.4 Wild Pig (*Sus scrofa*),

Wild pig, is a species of the pig genus *Sus*, part of the biological family Suidae. The species includes many subspecies. It is the wild ancestor of the domestic pig, an animal with which it freely hybridises Wild boar are native across much of Northern and Central Europe, the Mediterranean Region (including North Africa's Atlas Mountains) and much of Asia, including Japan and as far south as Indonesia. Populations have also been artificially introduced in some parts of the world, most notably the Americas and Australasia. Elsewhere, populations have also become established after escapes of wild boar from captivity.

The body of the wild pig compact; the head is large, the legs relatively short. The fur consists of stiff bristles and usually finer fur. The colour usually varies from dark grey to black or brown, but there are great regional differences in colour; even whitish animals are known from central Asia. During winter the fur is much denser.

The Wild pig is quite a variably sized mammal. In exceptionally large specimens, the species can rival the size of the Giant forest hog, the largest extant species of wild suid Adult boars

can measure from 90 to 200 cm (35 to 79 in) in length, not counting a tail of 15 to 40 cm (5.9 to 16 in), and have a shoulder height of 55 to 110 cm (22 to 43 in). As a whole, their average weight is 50–90 kg (110–200 pounds), though boars show a great deal of weight variation within their geographical ranges. Generally speaking, native Eurasian boars follow Bergmann's rule, with smaller boars nearer the tropics and larger, smaller-eared boars in the North of their range. Mature sows from Southeast Asia and southern India may weigh as little as 44 kg (97 lb).The Manchurian Wild Boar (*S. s. ussuricus*), the largest subspecies typically weighs between 70 and 180 kg (150 and 400 lb). In central Italy, their weight usually ranges from 80 to 100 kg (180 to 220 lb) while boars shot in Tuscany have been recorded to weigh up to 150 kg (331 lb). An unusually large French specimen shot in Negremont forest in Ardenne in 1999 weighed 227 kg (550 lb). Carpathian boars have been recorded to reach weights of 200 kg (441 lb). Romanian and Russian boars can reach weights of 300 kg (661 lb), while unconfirmed giants reported in early Russian hunting journals have reportedly weighed up to 320 kg (710 lb).

Adult males develop tusks, continuously growing teeth that protrude from the mouth, from their upper and lower canine teeth. These serve as weapons and tools. The upper tusks are bent upwards in males, and are regularly ground against the lower ones to produce sharp edges. The tusks normally measure about 6 cm (2.4 in), in exceptional cases even 12 cm (4.7 in). Females also have sharp canines, but they are smaller, and not protruding like the males' tusks. Tigers hunt boars, but avoid tackling mature male boars. In many cases, boars have gored tigers to death in self-defense.[15] Wild boars can be dangerous to humans, especially when they have piglets.

Wild pig piglets are coloured differently from adults, having marbled chocolate and cream stripes lengthwise over their bodies. The stripes fade by the time the piglet is about 6 months old, when the animal takes on the adult's grizzled grey or brown colour.

Behavior: Adult males are usually solitary outside of the breeding season, but females and their offspring (both sub-adult males and females) live in groups called *sounders*. Sounders typically number around 20 animals, although groups of over 50 have been seen, and will consist of 2 to 3 sows; one of which will be the dominant female. Group structure changes with the coming and going of farrowing females, the migration of maturing males (usually when they reach around 20 months) and the arrival of unrelated sexually active males.

Food : Wild boar are situationally crepuscular or nocturnal, foraging in early morning and late afternoon or at night, but resting for periods during both night and day. They

are omnivorous scavengers, eating almost anything they come across, including grass, nuts, berries, carrion, nests of ground nesting birds, roots, tuberss, refuse insects and small reptiles.

Reproduction : If surprised or cornered, a boar (particularly a sow with piglets) can and will defend itself and its young with intense vigour. The male lowers its head, charges, and then slashes upward with its tusks. The female, whose tusks are not visible, charges with head up, mouth wide, and bites.

Sexual activity and testosterone production in males is triggered by decreasing day length, reaching a peak in mid-autumn. The normally solitary males then move into female groups, and rival males fight for dominance, whereupon the largest and most dominant males achieve the most mating. Mating may last over 45 minutes, and is accompanied by pelvic thrusting.

The age of puberty for sows ranges from 8 to 24 months of age depending on environmental and nutritional factors. Pregnancy lasts approximately 115 days and a sow will leave the group to construct a mound-like nest out of vegetation and dirt, 1–3 days before giving birth (farrowing).

The process of giving birth to a litter lasts between 2 and 3 hours, and the sow and piglets remain in, or close to, the nest for 4–6 days. Sows rejoin the group after 4–5 days, and the piglets will cross suckle between other lactating sows.

Litter size is typically four to six piglets but may be smaller for first litter, usually two to three. The largest litters can be up to fourteen piglets. The sex ratio at birth is 1:1. Litter size of wild boars may vary depending on their location. A study in the Great Smoky Mountains National Park in the US reported a mean litter size of 3.3. A similar study on Santa Catalina Island, California reported a mean litter size of 5. Larger litter sizes have been reported in the Middle East. Piglets weigh 750–1,000 g (1.7–2.2 lb) at birth. Rooting behaviour develops in piglets as early as the first few days of life, and piglets are fully weaned after three to four months. They will begin to eat solid foods such as worms and grubs after about two weeks.

4.5 General conservation Plan Methods

4.5.1 Food tree plantation

The fruits, which is one of the prime diet of most of the animals was found to be low in this forest and as these forests are contiguous with other forest areas outside the study area,

where possibly the same situation of low fruit availability prevails, Improving the fruit availability is suggested.

- The specific conservation action needed is improving the habitat through restoration and planting of fruiting trees that are eaten by animals in the forest that would enhance the food availability for this species. Some of the fruit tree species have been suggested to be grown in the degraded forest areas to increase the food resources for animals **(Table 4.5).**
- Though this list includes 30 tree species, of that 17 species would improve the availability food resources for animals and also support some of the ungulate species reported/said to occur in the forest areas.
- In addition some of the shrub species suggested are *Zizyphus nummularia, Flacourfia indica , Carissa spinarum* and *Carissa congesta,* which also form as food species of animals and other ungulate of the project area **(**Table 4.5).
- The techniques for germinating the seed in the nursery and planting in the forest are detailed in the table **(**Table 4.3**).**

Table 4.5: List of tree species suggested under habitat improvement program

S.No	Scientific name	Habit	Local Name	Techniques Code+		Faunal Species		
				Nursery	Planting	SB	CL	NL
1	*Acacia cathechu*	Tree	Khair	1	1/2		*	*
2	*Acacia nilotica*	Tree		1	1/2			*
3	*Acacia leucophloea*	Tree	Khejda	1	1/2			*
4	*Aegle marmelos*	Tree		2	1/3	*		
5	*Albizia lebbeck*	Tree	Shiras (Kala	1	1		*	
6	*Albizzia odoratissima*	Tree	Chinva	1	1/2			
7	*Butea monosperma*	Tree		3	1/2			*
8	*Carissa congesta*	Shrub		3	1			
9	*Carissa spinarum*	Shrub		3	1	*		

10	*Cassia fistula*	Tree	Amaltash	1	1	*		
11	*Dalbergia sissoo*	Tree	Shisam	3	1		*	
12	*Diospyros melanoxylon*	Tree	Tendu	2	1/3	*		
13	*Emblica officinalis*	Tree		2	1	*	*	
14	*Ficus benghalensis*	Tree	Peepal	4/5	1	*	*	
15	*Ficus virens*	Tree		4/5	1	*		
16	*Ficus racemosa*	Tree		4/5	1	*	*	
17	*Ficus religiosa*	Tree		4/5	1	*	*	
18	*Flacourfia indica*	Shrub		2	1	*		
19	*Holoptelea integrifolia*	Tree	Churel	3	1/2		*	
20	*Lannea coromandelica*	Tree	Gurjan	2	1/2		*	
21	*Madhuca indica*	Tree		3	1/2	*	*	*
22	*Mangifera indica*			3	1/2	*	*	
23	*Pongamina Pinnata*	Tree	Karanj	3	1		*	
24	*Prosopis cineraria*	Tree	Khejdi	1	1			*
25	*Syzygium cumini*	Tree		3	1/2	*	*	
26	*Syzygium heyneanum*	Tree		3	1/2	*	*	
27	*Terminalia arjuna*	Tree		6	1/2		*	
28	*Zizyphus mauritiana*	Tree		7	1/2	*	*	*
29	*Zizyphus nummularia*	Shrub		7	1/2			
30	*Wrightia tinctoria.*	Tree	Revarna	3	1		*	
	Total					16	17	7

Codes for nursery and planting techniques are given in the Table 4.4; SB-Animals, CL-Common Langur, NL -

4.5.3 Food tree plantation for Common Langur and Nilgai

- The above given tree species list also includes 17 tree species likely to provide food resource and roosting trees (mainly large trees) for the common langurs one of the favored prey species of carnivore. **(Table 4.5)**
- A total of seven tree species are identified as food tree for the Nilgai which is presently one of the promising prey species (mainly young animals-yearlings) for Carnivore.
- It is suggested to plant the tree species mostly close to river and stream beds to improve the survival rate and ensure fast growth. Since all the tree species suggested are local species the survival rate would be better.

4.5.4 Developing Water holes:

- It is very essential to develop small water holes and wells with ramps where sightings and evidences of more mammalian fauna was reported.
- Development of additional water resources likely to improve some of the other faunal groups like: amphibians, other reptilian fauna; and fresh water turtles.
- These should be filled with water through tankers frequently during summer and other periods of unavailability of water. So while choosing sites care should be taken that the site selected should have approach for filling water with tankers.

4.5.5 Salt Licks

Requirement of salt is very important for most wildlife, which they often meet from natural salt licks available in the forests, but during the survey there were no such salt licks present in the forest area. So artificial salt licks should be preferably made in the forest near the water holes, where watch and ward is possible to prevent poaching, as these are most vulnerable sites to poaching. This will help these animals and other wildlife to confine to the forest away from the villages.

4.5.6 Protection

It is very important to protect the forest from biotic interference (cutting, lopping, encroachments, expansion of agriculture lands, and other negative influence) caused mainly by the local population. However the forest department is well equipped and with full-fledged protection strategy in place. Provision of communicating equipment for this

purpose would also be very important. Capacity building program on protection would be of high significance.

4.5.6 Forest Fire Protection Plan

This being a tropical forest with dry deciduous and thorn forest type, it is prone to fire each year between mid February to June (until onset of rains). Fire lines are to be cleared around the forest boundaries, in addition to clearing along the roads, footpaths and nullahs that passes through the forest to prevent fire.

The forests, which are prone to frequent fire, should be identified with the help of the local forest department and the above said management plans need to be implemented in those areas

4.5.7 Antl-Poaching Plan

Poaching being one of the causes for depletion of wildlife in general, it is necessary to improve enforcement and create awareness among the people for eliminating poaching /hunting, which is presently almost nil or very low, and help in improving the status of the wildlife and its habitat.

4.5.8 Development of Wetland habitat

4.5.9 *General management for Spoonbills and Painted stork*

Among the two dam sites, the larger one Gambheeri reservoir, where more aquatic bird species were present, seems to be a potential wetland habitat of the study area.. The reservoir covers large extent of area it can support diverse wetland species with good population **.**

Hence it is not possible to suggest any habitat specific management plan. However, since these species were observed in Gambheeri reservoir it has been suggested to develop this dam site as potential wetland habitat of the area. The forest department should have stake to implement the following suggestion with the joint venture of the Irrigation department:

- The peripheral area of the dam site need to be planted with larger tree species *Ficus benghalensis, Ficus religiosa. Syzygium cumini, Mangifera indica, Holoptelea integrifolia,*

Albizia lebbeck, Derris indica, Azadirachta indica that can provide habitat for perching and nesting site for some of the aquatic birds species.

- The forest department can develop interpretation centre close to dam site with the information and visuals (photos) of the common birds found in the wetland, breeding birds, migratory birds and species of conservation significance.

4.5.10 Management of Forest Resources dependency

Development of Energy Resources

With the concept being that conservation of RET species and management of the forest resource around the highly dependent villages would serve a larger ecological system and landscape, the conservation and management of the resources would provide safety to all other biodiversity or flora & fauna surviving within it.

4.5.11 Development of Fodder Resources

- Local villagers lop trees from the forest areas for fodder and also graze their livestock in the forest, which would reduce the food availability for the wildlife and impact overall biodiversity of the local forest areas. Therefore it is suggested to grow fodder trees in the close vicinity of the villages which depend on the forest resources to meet their fodder requirement.

- It is also suggested to develop immediately fodder grass plots within the village Gaucher land (land allotted for grazing) to reduce the grazing pressure in the forests.
- These grass plots should be developed with the grass species which are highly nutritive and locally available with the consultation of local villagers especially livestock keepers.
- The techniques for seed germination in nursery and planting in the forest are given in the table **(Table 4.4)**

Table 4.6: List of tree species suggested to grow under fodder plantation

S.No	Scientific Name	Local Name	Fodder value*	Growth rate+	Fuel value*	Technique Code*	
						Nursery	Planting
1	*Acacia cathechu*	Khair	5	5	6	1	1/2

2	*Acacia nilotica*	Babul	7	6	10	1	1/2
3	*Azadirachto indica*	Neem	6	6	6	3	1/2
4	*Balanites aegyptiaca*	Hingu. Hingot	6	6	4	7	1/2/3
5	*Boswellia serrata*		5	4	6	3	1/2
6	*Derris indica*		6	6	7	3	1
7	*Ficus benghalensis*	Bargad	6	7	4	4/5	1
8	*Ficus religiosa*	Pipal	7	8	4	4/5	1
9	*Pithecellobium dulce*	Vilayati iimli	8	8	5	2/3	1
10	*Syzygium cumini*	Jamun	7	6	7	3	1/2
11	*Tamarindus indica*	Imli	8	2	8	2	1
12	*Wrightia tinctoria*	Mitha indrajau	5	5	4	3	1
13	*Zizyphus mauritiana*	Baer	6	6	8	7	1/2
14	*Zizyphus nummularia*	Jhadiabar	8	7	3	7	1/2

4.5.12 Education of all stack holders

Positive action is always a sequel to positive information. The project proponent has envisioned identifying all the stakeholders within the settlements of the buffer area, and sensitizing them to the issue of wildlife conservation through a participatory mode. Appropriate modes of awareness creation shall be used to evolve a consensus and solicit participation of the communities in the periphery of the lease site.

Mobile exhibitions on the wildlife spectrum of the state with focus on local wildlife shall be held in all villages to heighten interest in wildlife conservation and seek synergistic inputs from the villagers.

Informal portals of communicating importance of wildlife such as street plays, folk songs, folk art, shall be availed of.

Particularly children and youth will be encouraged to celebrate and observe events of relevance to wildlife such as Vanamahotsava and wildlife week etc. the necessary funds shall be provided by the project proponent for the purpose. Thematic competitions in drawing, singing, painting and quiz shall be supported by the project proponent to foster interest and respect for wildlife.

The project proponent shall provide literature on wildlife *gratis to* all the school children in the area. Popular talks shall be organized for the employees as well as the villagers.

Hoardings with messages on importance of wildlife and the need to conserve it shall be sponsored by the project proponent for display in buffer area.

4.5.13 Establishing a centralized collated user friendly database on wild life

All the relevant information on the existing wildlife diversity and range and the cross cutting themes shall be gathered, and collated. The database will be useful in monitoring the populations of wildlife and evolving practical management protocols.

A sizeable body of information on the local biodiversity lies in the informal domain of folk lore and traditional knowledge bases; and will be lost unless formalized by authentication and chronicling. Thus documenting ethnic literature, folk lore, folk art that makes obvious and subtle references to the biodiversity of this place will be taken up on priority basis.

People's Biodiversity Registers will be introduced to the locals, through the Panchayati Raj Institutions. The villagers will be encouraged to maintain these registers. All the biodiversity based livelihood options will e identified and evaluated for the impact. Viable alternatives will be suggested wherever feasible.

4.5.14 Resolution of human –wildlife conflicts in the buffer zone

People are at the center-stage of any viable wildlife conservation program and hence need to be taken into confidence through resolution of conflicts. A realistic assessment of the threat perception and the losses inflicted by wildlife is a prerequisite to resolving the crisis. Services of qualified wildlife biologists shall be requisitioned in this regard. Components of conflict identified and suitably resolved keeping in mind the vulnerability of both the sides.

In the buffer area of the proposed project where agriculture is a prime occupation, crop raiding by ungulates like Nilgai is a serious menace and evokes a strong negative sentiment for the species. Similarly, in many villages where snake bites are common, conflict situations are likely to arise. Such incidents have to be reported, recorded and resolved through a scientific mitigation approach. For instance crop raiding shall be mitigated 'Live Fencing'. The utility of the conventional methods such as wire fencing, trenching, lighting fire

crackers, and using dogs to chase away the animals can also be put to test for efficacy and cost effectiveness.

The project proponent shall assist in assessing damages and grievance redressal and seeking compensation. Efforts will be put in by the project proponent to avail of insurance schemes against damages caused by wildlife such as crop raiding by herbivores and cattle lifting by wild cats.

Services of veterinary Experts shall be requisitioned to assess the risk of Zoonotic disease transmissions from domesticated animals to wildlife & vive versa.

There shall be 'Wildlife Rescue Squad' established by the project proponent in consultation with the Forest authorities to tackle cases of wildlife intrusion and accidents. Simple gadgets such as the snake hooks shall be procured and placed in strategic locations within the core zone.

Primary Health Centers / OPD shall be established and equipped with snake anti-venoms to treat snake bites which are rampant in the buffer zone and are currently treated by the village 'Bhopas' and 'Vaids' resulting in higher mortality.

4.5.15 Habitat management of wildlife in the buffer zone

The project proponent shall entrust the task of monitoring the wildlife diversity and evaluating the conservation status periodically to the Environmental Management Cell (EMC). The constitution of the EMC as agreed upon by the project proponent shall necessarily include an expert in the field of Biodiversity, besides the technical and managerial expertise.

The EMC shall work towards sensitizing all the stakeholders, within and outside the enterprise, to the importance of biodiversity and formulate an action plan to conserve the same.

The EMC shall establish a Biodiversity Documentation Centre (BDC) well stocked with literature relevant to the cause of Wildlife Management and Biodiversity. The (BDC) shall entrust upon itself the task of generating locale specific database on the wildlife and domesticated biodiversity of the buffer zone, generating locale specific information and disseminating the same in local languages, serve as liaison between the Project proponent and the population in the buffer area in formalizing the Traditional Ecological Knowledge

Bases. The BDC shall facilitate all such proposals that are aimed at updating the inventory and give requisite managerial inputs for long term conservation of the local flora and fauna.

The project proponent shall provide for 'Habitat Manipulations' that commensurate with the requirements of the wildlife recorded in the buffer zone and the same will be practiced with the concurrence of the state wildlife authorities. Orchards shall be established for encouraging frugivorous birds and mammals (bats). Similarly 'Butterfly Gardens' shall be raised to encourage lepidopteron diversity even in the core area.

Browse management is a vital component of the managerial interventions in this area which is raided by the herbivores, and shall be practiced.

In recognition of the presence of the Five Striped Palm Squirrel in the core area, Squirrel Nest Boxes shall be installed such as to minimize damage due to accidents, natural calamities and human vandalism.

The project proponent shall actively consider structural improvements such as 'Live Fences' for livestock and wildlife.

A strict vigil and monitoring of spring burning of dry grasses and hedges shall be mandated by the project proponent to minimize destruction of soil humus, wildlife food cover, nests and sometimes even young of the wild.

Feasibility of 'Guzzler Installation' shall be evaluated to provide for the water requirements of wetland birds and small animals.

The project proponent shall also undertake 'Cover Improvement' in the buffer area with an objective of fulfilling the varied needs of the total wildlife in the area.

4.5.16 Recognition and incentives for green conduct

'Green Ethics' shall be practiced at all levels and institutionalized. Every employee of the unit shall be encouraged to abide by the spirit of conservation and direct and indirect actions favouring conservation of biodiversity shall be recognized and acknowledged by the management with monitory incentives. The employee's children will also be supported for green initiatives within the buffer area. Exemplary cases will be given publicity in the annual reports and official news letter of the company. Employees shall be encouraged to plant and adopt saplings within plant core area.

Participation by the local community in Wildlife Conservation has been on the top of the agenda for the project proponent. Commendable efforts by the community will be rewarded by way installation of company sponsored civic amenities such as library, sanitary toilets, public water taps / hand pumps, community halls etc. Health camps will be organized by the company periodically and free medicines will be dispensed.

The women from the settlements in the buffer area in particular shall be trained in establishing 'Seed Banks' of local cultivars of cereals, pulses, vegetables and fruits. The locals shall be empowered to manage of such indigenous 'germplasm repositories' funded by the project proponent.

4.5.17 Restoration of mine land

The mined land shall be restored to the original land-use and ecosystem by the project proponent at its own cost; following ecological principles, by the use of indigenous species to the full benefit of the local communities

4.5.18 Resolution of inter-sectoral conflicts

Crop raiding by herbivores is a major area of conflict and has attributed a strong negative value to wildlife. In the buffer area of the present lease the Nilgai is a major 'Crop Raider' species.

Crop raiding is indulged in by herbivores prompted by alimental instincts and therefore has largely to do with the food value of crops. Certain crops invite greater raids than others. Changing crop patterns in areas immediately around the forests can alleviate the menace of raiding.

It is envisioned to carry out a study of crop preferences by the wild herbivores and accordingly in certain highly prone locations grow crops that animals find undesirable. Pilot studies shall be carried out in the adjacent crop lands in consultations with the farmers.

Also, use of 'Live Hedge Fencing' has great potential for reducing crop raiding. The practice of agro-forestry can be successfully integrated in this concern. Live Fences are a multi-utility resource because besides discouraging crop raiding, they support growth of medicinal plants, offer micro-habitat for herpetofauna and avifauna that act as biological control over insect and rodent pests. The existing government schemes for fencing shall be identified and the farmers shall be assisted in availing of these.

The agricultural plots in the buffer areas shall be surveyed and in areas of intense raids, trenches shall be put in place to prevent raids by Wild Boar and Nilgai.

4.5.19 Strengthening cultural linkages of biodiversity

Rural communities in India have the ancient tradition of conserving natural ecosystems and species. Conservation of natural resources has been an integral part of the cultural ethos for the people of the state of Rajasthan. Traditionally the eco-centric communities of this state have set an example for the world by sacrificing their lives and building whole religio-cultural faiths around the themes of conservation and compassion for living beings. Ethnic rituals and festivals supportive of wildlife shall be identified and encouraged. All such eco-theological expressions will be documented.

4.5.20 Medicinal Plants

- **Training and Education of persons /group engaged in collection of medicinal plants from wild sources:-**This should be undertaken with the involvement of NGOs and other social/environmental development organizations active in the area. The package of as well as additional high value medicinal plants available in the region as well as additional high value medicinal plants identified in future. The same organization should also be involved in preparing scientific documentation- agronomical practices for each medicinal plant and other medicinal properties of the specific plants.

One such organization should be identified for project area under the Project proponent, for developing and imparting customized training specific to medicinal plant varieties found in

- **Plantation of Medicinal plants: The forest Department** of the state government should be entrusted with this very important task for conservation of medicinal plants**.** Based on earlier experience, about one thousand plants per year should be made available to the forest Dept. For this purpose. The Fund for this purpose should be provided by project proponent to Forest Dept.

Wild Plant

- Afforestation programme should be conducted in the project area with association of forest department. The selection of plant species should be based on the local people and wild animal requirements like shelter, food. The native plant species should be grown in the project area environment**.**
- Nursery center should be set up to develop native plants.

- Continuous monitoring should be essential for known the status of rising and pertaining of plants in the project area.
- Vegetation should be protected by any disease through using bio-pesticides. Plants of Bio-pesticides should be encouraged growing in project area.
- Following Instruction write on Signboard should be set up on the project area-

a. Do not through solid waste in the forest area.
b. Do not uses fire generation material in forest area.
c. Do not pick and cut of any wild plant in the project area.

Wild Animals

- Organized workshop for conservation awareness –

A series of conservation awareness workshops for village and school children should be conducted in the different villages. Interactive discussion will be carried out participants. The major trust of the discussion will the conservation importance of wild animal species and possible solution to crop raiding issues.

During workshop education material Viz. Poster and stickers will be distributed among the local community. T- Shirt will be distributed to some enthusiantion local volunteers and to school children who participated in the school level competitions on drawing and assay writing about conservation of wild animals.

- Fencing should be provided around to forest boundary to prevent of migration of wild animals in nearby farming field.
- Provision of water tank for drinking of wild animals and birds should be preferred in wild life habitation area to reduce the migration of wild animals in to nearby villages and agriculture field that practice also beneficial to prevention disease from domestic animals to wild animals.
- Local farmer in the project area are giving poisonous food generally for protection his crop to wild animals and birds at night time mostly that should be stopped with the help of forest department officers and local people awareness programme.
- Health center should be established for treatment of wild animal and birds injuries and disease.

4.5.21 Greenbelt development Plan

Green belts can help in reducing the impact of fugitive emissions and pollutants released at ground levels.

Stage wise greenbelt development plan has been described in **Table 4.7** for Mine development.

TABLE 4.7: - Stage wise Green Belt Development

Year	Limestone Mines		Cement Plant		Total	
	Area (Ha.)	No. of trees	Area (Ha.)	No. of trees	Area (Ha.)	No. of trees
Developed up to 2012	10.03	11120	23.37	23352	33.40	34472
2013-14	0.5	500	3	3000	3.5	3500
2014-15	0.5	500	3	3000	3.5	3500
2015-16	0.5	500	3	3000	3.5	3500
2016-17	0.5	500	4	4000	4.5	4500
2017-18	0.5	500	4	4000	4.5	4500
VI th year onwards	107.47	106380	30.63	30648	138.1	137028
Total	120	120000	71	710000	191	191000

Source: *EIA & Scheme of Mining and Progressive Mine Closure Plan*

The selection of plant species for greenbelt development should be based on CPCB guideline for greenbelt development and on the basic of climatic condition, soil fertility status etc of region. The plant species for greenbelt described below in Table which can be sustained in local climatic condition.

Plants Species for greenbelt development
Acacia nilotica, Ficus benghalensis, Lucena leucocephala, Ficus religiosa, Dalbergia sissoo, Delonix regia, Albizia lebbeck, M*oringa oleifera, Cassia fistula, Butea monosperma, Azardirachta indica,*

Polyalthia longifolia, Phoenix dactylifera, Hibiscus rosa sinensis, Bougainvillea sp. Tabernaemontana divaricata, Nerium indicum, Thevetia peruviana, Rosa indica, Cestrum nocturnum, Helianthus annuus.

4.6 Biodiversity Monitoring Plan

During construction and operation phase, it would be necessary to monitor the mitigation measures compliance scenario to ensure that the concern for minimizing the impacts on biodiversity. For monitoring purposes, a monitoring cell should be established and a compliance officer should be appointed.

Table 4.8 Biodiversity Monitoring Plan

Key Indicator Responsibility	Sub Indicator	Monitoring Frequency	Responsibility
Afforestation	Area brought under plantation	Six Month	Compliance Officer Of Wonder Cement Limited, Chittorgarh, Rajasthan
	Number of tree planted, survived and established		
Soil erosion	Run off measurement / Storage structures	Six Month	Compliance Officer of project
Bird nests	Prepare a baseline along project study and monitor the increase/decrease in nests	Three months	Compliance office of project

4.7 Conservation measures being practiced by WCL:

- The inner and outer fencing of the lease area has been done by the mine authorities.
- Green belt along the periphery of mine has been developed and also on the waste land. Plantation of tree species, fruits and flower plants have also been taken in the area which will support the growth of Aves, Reptiles and herbivores.

- It is proposed to plant total 1,91,000 trees in mines, plant and colony. 34472 trees have been planted up to Sept 2012.
- WCL organizes wild life awareness program in surrounding villages (Plate 4.3).
- WCL has provided drinking water pan for birds in surrounding villages (Plate 4.2).
- WCL has made hoardings on wild life education in the villages (Plate 4.2).
- WCL provides snake catching training to villagers in association with forest department (plate 4.1).
- Management has constructed water-harvesting structures in and around the lease area to facilitate wild life for drinking water. Tree species already planted should provide feed to Furgivorous species.
- Management has provided barriers at the entry of the mines to prevent unauthorized entry in to the area so that poaching and illegal hunting can be prevented.
- No cattle's grazing is allowed in the core zone to take care of existing plant species.
- Fauna reported in the core zone area is not of any rare or endangered species but of common category.

Plate 4.2 : Drinking water pan for birds distributed by Wonder Cement and Wild Life Awareness slogans painted in surrounding villages

Plate 4.3 Wild Life Conservation awareness program organized by Wonder Cement in surrounding villages in consultation with Forest & Wild Life Department Chittorgarh.

Plate 4.4 : Green Belt Developed inside the WCL Plant & Mines in 33 ha area

4.8 Budget for conservation of Biodiversity

The total budget for biodiversity conservation will be 140 **Lakh** per year that will be expenditures in Afforestation activities including medicinal plant, Nursery center, Wildlife monitoring and Training and awareness programme.

Table: 4.9 Financial Forecast (in lakhs) for the Wildlife Conservation

No	Activity	Year wise fund Requirement (in lakhs)										TOTAL
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
1	**Protection**											
1a	**Conservation of Peafowl**											
		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10
1b	**Anti-poaching & Protection**											
A	Survey & Inspection	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6.0
B	Training & Drill	2.0	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	03.3
	Sub Total *(la)*	**3.2**	**1.3**	**1.3**	**1.3**	**1.3**	**1.7**	**1.3**	**1.3**	**1.3**	**1.3**	**9.3**
1c	**Fire Protection**											
A	Survey work	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0

B	Communication Network	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.0
C	Cost of Fire Fighting Equipment	0.5	-	-	0.5	-	-	0.5	-	-	0.5	2.0
D	Training & Drill	0.3	-	-	0.3	-	-	0.3	-	-	0.3	1.2
	Sub Total (lb)	**1.9**	**1.1**	**1.1**	**1.9**	**1.1**	**1.1**	**1.9**	**1.1**	**1.1**	**1.9**	**14.2**
	Total (la+lb)	**5.1**	**2.4**	**2.4**	**3.2**	**2.4**	**2.8**	**3.2**	**2.4**	**2.4**	**3.2**	**29.5**
2	**Habitat Improvement**											
2a	**Nursery**											
	Development & Maintenance of Nursery	0.5	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	7.25
	Sub *Total*	4.5	*0.75*	0.75	0.75	0.75	0.75	0.75	*0.75*	0.75	0.75	7.25
2b	**Removal / Eradication of Exotic Plant species**											
A	*Lantana camara* removal in the forest Blocks	1.5	0.75		0.75			0.75			0.75	4.5
	Sub Total	1.5	*0.75*		0.75			*0.75*			0.75	4.5
2c	**Water Conservation**											
A	Check- Dams & Maintenance; Game tank / water holes & Maintenance; Wells with Ramps - & Guzzlers	12.2	0.3	0.3	1.8	0.3	1.3	1.8	0.3	0.3	1.8	20.4
	Sub *Total*	12.2	*0.3*	0.3	1.8	0.3	1.3	1.8	0.3	0.3	1.8	30.4
2d	**Food Availability**											
A	Improvement of vegetation - habitat & Food by RDF method with gap plantation	7.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	12.5
B	Creation & Maintenance of Meadows (Grassland)	4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	7.6
	Fencing	4.0	0.5	0.5	0.25		0.25		0.25		0.15	5.9
	Sub Total	15.5	*1.9*	1.4	*1.15*	0.9	*1.15*	0.9	1.15	0.9	1.05	26.0
2e	**Salt Licks**											
A	Creation of artificial Salt Lick near meadows & water holes	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.8
	Sub Total	**1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**2.8**
	Total (2a+2b+2c+2d+2e)	**44.45**	**3.9**	***2.65***	**4.65**	**2.15**	**3.4**	**4.4**	**2.4**	**2.15**	**4.0**	***75.15***
3	**Livelihood Development, Monitoring and Capacity Building**											
A	Eco-development Support - Livelihood development -fuel & fodder plots	5	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	12