Biodiversity Impact Assessment and Mitigation Measures to Mining and Cement Plants, District: Sirohi (Rajasthan)

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Abstract: Status of biodiversity including both terrestrial and aquatic in study area was studied in year of Jan.2014 to march 2014 in season of winter on the basis of field visit, consulting with Forest Department of sirohi and local people. The study area of biodiversity impact assessment is selected 10 km radius from J K Lakshmi cement plant and mine of Tehsil – Pindwara, District - Sirohi, Rajasthan.

In terrestrial flora, 61 species including trees, shrubs, herbs and grasses species recorded in open field and 46 species of flora ware observed in protected and reserved forest of study area. The 11 species of aquatic vegetation including free floating, merge and submerge plants were recorded in study area.

The 86 species of animals including mammals, reptiles, arthropods and avis were recorded during biodiversity assessment on the basis of field survey, concern with local people, officers of forest department of Sirohi, Rajasthan

Impact on biodiversity had been predicted and quantified through authenticated methodologies due to various activities of mining and cement plant. Mitigation measures are suggested to minimize the negative impact on surrounding biodiversity.

Keywords: Biodiversity, Terrestrial, Aquatic, Impact Assessment, Mammals, Reptiles, Arthropods and Avis, Mitigation Measures

1. INTRODUCTION

Industrialization and mining activities have negative impact on surrounding biodiversity there for it is required to study to identified impact on biodiversity and find out the way to minimize impact as sustainable manner. The study areas have unique diversity of aravali range with dense vegetation cover and animals' species including endangered species.

2. METHODOLOGY

2.1 Floral Study

The floral survey of project area is based on extensive field survey of the area. The seasonal study has been conducted in summer season 2014. The plant species were identified with the help of available literature, concern with forest department and local people of study area.

2.2 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.

2.3 Survey techniques:

The visual encounter survey (VES) technique was used. The VES technique involves walking through the study site systematically searching for animals during a given time period.No Time Constrained Studies (TCS) were utilized and hence a varied amount of time was spent at the sites based on species diversity. Micro-habitats studied included terrestrial, arboreal and aquatic during the study.

Given the elusive nature of animals, VES techniques are very effective to estimate the species richness. However, species counts of animals are very difficult, given the terrain and nocturnal habits of many species.

2.4 Equipment used:

Torches for night searches, measuring tape and vernier calipers for measurements and a Nikon Camera of 25 X Zoom for photography and binocular for assessment of animal to safe distance.

2.5 Baselineinformation & Analysis

The baseline study for the evaluation of the floristic and faunal diversity of the terrestrial and aquatic environment of the study area was conducted.

2.6 Flora within the Study Area

Flora of an area depends on climatic conditions, topography, rainfall, soil type, land use and demography of an area. These factors highly affect the floral cover and quality of an area.

2.7 Flora

A general floral survey was carried out in the study area. The plant species on the area are listed below in the Table.

S. No	Scientific Name	Local Name	Family	Habitat
1	Albizia lebbeck	Siris	Mimosaceae	Т
2	Ailanthus excelsa	Ardu	Simaroubaceae	Т
3	Acacia senegal	Cumta	Fabaceae	Т
4	Acacia leucophloea	Ronjh	Fabaceae	Т
5	Acacia nilotica	Babool	Fabaceae	Т
6	Azadirachta indica	Neem	Meliaceae	Т
7	Butea monosperma	Dhak	Fabaceae	Т
8	Cassia siamea	Kassod	Fabaceae	Т
9	Cassia fistula	Amaltas h	Fabaceae	Т
10	Dalbergia sissoo	Shesham	Fabaceae	Т
11	Delonix regia	Gulmoh ar	Caesalpiniaceae	Т
12	Ficus religiosa	Pipal	Moraceae	Т
13	Ficus benghalensis	Bargad	Moraceae	Т
14	Eucalyptus globulus	Safeda/S ugandha patra	Myrtaceae	Т
15	Ficus racemosa	Gular	Moraceae	Т
16	Mangifera indica	Aam	Anacardiaceae	Т
17	Phoenix sylvestris	Khajoor	Arecaceae	Т
18	Pithecellobium dulce	Jungal jalebi	Fabaceae	Т
19	Pongamia pinnata	Karanj	Fabaceae	Т
20	Polyalthia longifolia	Ashok	Annonaceae	Т
21	Prosopis juliflora	Bilayati Babool	Fabaceae	Т
22	Terminalia arjuna	Arjun	Combretaceae	Т
23	Syzygium cumini	Jamun	Myrtaceae	Т
24	Salvadora persica	Pilu	Salvadoraceae	Т
25	Ziziphus mauritiana	Ber	Rhamnaceae	Т

S. No	Scientific Name	Local Name	Family	Habitat
26	Holoptelea integrifolia	Papri, Chilbul	Utreaceae	Т
27	Bougainvillea sp.	-	Nyctaginaceae	S
28	Calotropis procera	Aak	Asclepiadaceae	S
29	Capparis decidua	Kair	Capparaceae	S
30	Hibiscus rosa- sinensis	Jasband	Malvaceae	S
31	Euphorbia neriifolia	Dandath or	Euphorbiaceae	S
32	Grewia tenex	White crossber ry	Tiliaceae	S
33	Opuntia elatior	Nag phani	Cactaceae	S
34	Tecoma stans	-	Bignoniaceae	S
35	Nerium oleander	Kaner	Apocynaceae	S
36	Plumeria alba	Champa	Apocynaceae	S
37	Ricinus communis	Arandi	Euphorbiaceae	S
38	Ziziphus nummularia	Jharberi	Rhamnaceae	S
39	Argemone mexicana	Pili Kantili	Papaveraceae	Н
40	Amaranthus spinosus	Jangli chaulai	Amaranthaceae	Н
41	Aerva tomentosa	Bui	Amaranthaceae	Н
42	Acalypha indica	Muktajh uri	Euphorbiaceae	Н
43	Catharanthus roseus	Sadabha r	Apocynaceae	Н
44	Citrullus colocynthis	Chitraa	Cucurbitaceae	Н
45	Cucurbita pepo	Pumpkin	Cucurbitaceae	С
46	Trichosanthes cucumerina	-	Cucurbitaceae	С
47	Datura metel	Dhatura	Solanaceae	Н
48	Helianthus annuus	Sunflow er	Asteraceae	Н
49	Indigofera cordifolia	Gokhru	Fabaceae	Н
50	Lantana camara	Raimuni ya	Verbenaceae	Н

S. No	Scientific Name	Local Name	Family	Habitat
51	Ocimum tenuiflorum	Tulsi	Lamiaceae	Н
52	Tephrosia purpurea	Sarphon k	Fabaceae	Н
53	Pedalium murex	Bada gokhru	Pedaliacae	Н
54	Pentas lanceolata	-	Rubiaceae	Н
55	Ipomoea nil	kaladana	Convolvulaceae	С
56	Aristida depressa	Bristle grass	Poaceae	G
57	Chloris dolichostachys	-	Poaceae	G
58	Cynodon dactylon	Doob ghas	Poaceae	G
59	Cenchrus biflorus	-	Poaceae	G
60	Eragrostis tremula	Chiri Bajra	Poaceae	С
61	Saccharin spontaneum	-	Poaceae	G

TABLE 1.1 LIST OF FLORA FOUND INRESERVED/PROTECTED FOREST

S. No	Scientific Name	Local name	Family	Habita t
1.	Anogeissus pendula	Dhok	Combretaceae	Т
2.	Acacia Senegal	Cumta	Fabaceae	Т
3.	Acacia leucophloea	Ronjh	Fabaceae	Т
4.	Acacia nilotica	Babool	Fabaceae	Т
5	Azadirachta indica	Neem	Meliaceae	Т
6	Butea monosperm a	Dhak	Fabaceae	Т
7	Balanites aegyptiaca	Higot/ Desert date	Zygophyllacea e	Т
8	Boswellia serrata	Salai	Burseraceae	Т
9	Cassia fistula	Amaltash	Fabaceae	Т
10	Dalbergia sissoo	Shesham	Fabaceae	Т
11	Ficus	Pipal	Moraceae	Т

S.	Scientific	Local name	Family	Habita
No	Name			t
	religiosa			
12	Eucalyptus	Safeda/Sugandhapat	Myrtaceae	Т
	globulus	ra		
13	Ficus	Bargad	Moraceae	Т
	benghalensi			
	S			
14	Phoenix	Khajoor	Arecaceae	Т
	sylvestris			
15	Pithecellobi	Jungal jalebi	Fabaceae	Т
	um dulce			
16	Prosopis	Khejari	Mimosaceae	Т
	cineraria			
17	Prosopis	Bilayati Babool	Fabaceae	Т
	juliflora			
18	Terminalia	Arjun	Combretaceae	Т
	arjuna			
19	Ziziphus	Ber	Rhamnaceae	Т
	mauritiana			
20	Holoptelea	Papri, Chilbul	Utreaceae	Т
	integrifolia			
21	Calotropis	Aak	Asclepiadacea	S
	procera		e	
22	Capparis	Kair	Capparaceae	S
	decidua			
23	Euphorbia	Dandathor	Euphorbiaceae	S
	neriifolia			
24	Grewia	White crossberry	Tiliaceae	S
	tenex			
25	Opuntia	Nag phani	Cactaceae	S
	elatior			
26	Ricinus	Arandi	Euphorbiaceae	S
	communis			
27	Argemone	Pili Kantili	Papaveraceae	Н
	mexicana			
28	Amaranthus	Jangli chaulai	Amaranthacea	Н
	spinosus		e	
29	Aerva	Bui	Amaranthacea	Н
<u> </u>	tomentosa		e	
30	Acalypha	Muktajhuri	Euphorbiaceae	Н
	indica			
31	Citrullus	Chitraa	Cucurbitaceae	Н
	colocynthis			
32	Datura	Dhatura	Solanaceae	Н
	metel			
33	Helianthus	Sunflower	Asteraceae	Н
	annuus	~		
34	Indigofera	Gokhru	Fabaceae	Н
	cordifolia •	.	.	
35	Lantana	Raimuniya	Verbenaceae	Н
	camara			

S. No	Scientific	Local name	Family	Habita
36	Tephrosia purpurea	Sarphonk	Fabaceae	H
37	Pedalium murex	Bada gokhru	Pedaliacae	Н
38	Ipomoea nil	kaladana	Convolvulacea e	С
39	Ipomoea eriocrapa	-	Convolvulacea e	C
40	Cuscuta reflexa	Akashbel	Convolvulacea e	С
41	Aristida depressa	Bristle grass	Poaceae	G
42	Cynodon dactylon	Doob ghas	Poaceae	G
43	Dichanthiu m cardicosum	Badi	Poaceae	G
44	Cenchrus setigerus	Bhurat	Poaceae	G
45	Dendracala mus strictus	Bans	Poaceae	G
46	Eragrostis tremula	Chiri Bajra	Poaceae	G

Table 1.2 Aquatic vegetation recorded in study Area

S. No	Scientific Name	Local name	Family
1	Arundo donax	Arundo	Poaceae
2	Crinum Sp.	lili	Amaryllidaceae
3	Chenopodium album	Bathua	Amaranthaceae
4	Cyperus rotundus	Nutgrass, Coco	Cyperaceae
5	Hydrilla verticillata	Hydrilla	Hydrocharitales
6	Lemna perpusilla	Small Duckweed	Lemnaceae
7	Polygonum species	knotweed	Polygonaceae
8	Phragmites karka	-	Poaceae
9	Scirpus cernuus	-	Cyperaceae
10	Spirodela polyrhiza	Giant Duckweed	Araceae
11	Typha elephantine	Era	Typhaceae

Fauna in the Study Area

A general faunal survey was carried out in the study area. The Fauna found in the area are mentioned below in the table.

Table1.3	Fauna	recorded	in of	Project	Study S	Site
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S.No	Scientific Name	Common Name	Status
1.	Boselaphus	Nilgai	Sch.III
	tragocamelus		
2	Presbytis entellus	Langur	Sch.II
3	Macana mulatta	Bendar	Sch.II
4	Canis aureus	Jackal/Siyar	Sch.II
5	Lepus nigricollis	Hare	Sch.IV
6	Rattus rattus	House Rat	Sch.V
7	Herpestes edwardsii	Common Mongoose	Sch.II
8	Funambulus	Five Striped Palm	Sch.IV
	pennant	Squirrel	
9	Eryx johnii	Red sand Boa	Sch.IV
10	Crocodylus palustris	Mugger crocodile	Sch. I
11	Mabuya carinata	Brahminy Skink/ Bahmani	-
12	Calotes versicolor	Common Garden Lizard/Girgit	-
13	Hemidactylus	House	-
	flaviviridis	Gecko/Chhipkali	
14	Naja naja	Kobra	Sch.II
15	Rana tigerinus	Indian Bull Frog	Sch.IV
16	Rana limnocharis	Indian cricket Frog	Sch.IV
17	Danaus chrysippus	plain Tiger	-
18	Colotis eucharis	Plain Orange-Tip	-
19	Pieris canidia	Indian Cabbage White	-
20	Papilio polytes	Common mormon	-
21	Ixias Marianne	White –orange Tip	-
22	Buthus sp.	Scorpion	-
23	Periplaneta	Cockroach	-
	amercana		
24	Apis indica	Choti Madhumakkhi	-
25	Apis dorsata	Badi Madhumakkhi	-
26	Artema atlenta	Spider	-
27	Argiope arcuata	Spider	-
28	Cyprinus carpio	Common carp	-

S.No	Scientific Name	Common Name	Status
29	Cirrhinus reba	Reba Carp	-
30	Channa punctatus	Snakehead fish	-
31	Ctenopharyngodon idella	Grass Carp	-
32	Catla catla	Indian Carp	-
33	Gambusia affinis	Mosqitofish	-
34	Labeo rohita	Rohu	-

Table 1.4 Birds species recorded on project study area

S.No	Scientific Name	Common Name	Status according to IWPA- 1972
1	Anser indicus*	Bar-headed Goose	Sch IV
2	Pelecanus onocrotalus*	Great White Pelican	Sch IV
3	Platalea leucorodia*	Eurasian Spoonbill	Sch I
4	Anas clypeata*	Northern Shoveler	Sch IV
5	Ciconia episcopus*	Woolly-necked Stork	Sch IV
6	Ciconia nigra*	Black Stork	Sch IV
7	Anas platyrhynchos domesticus	Domestic duck	-
8	Mycteria leucocephala*	Painted stork	Sch IV
9	Actitis hypoleucos	Common Sandpiper	Sch IV
10	Ceryle rudis	Pied Kingfisher	Sch IV
11	Ardeola grayii	Indian Pond Heron	Sch IV
12	Fulica atra	Common coot	Sch IV
2913	Ardea cinerea	Grey Heron	Sch IV
3014	Vanellus cinereus	Red-wattled lapwing	-
15	Ploceus philippinus	Baya weaver	Sch IV
16	Francolinus pondicerianus	Grey francolin	Sch IV
17	Milvus migrans	Black kite	Sch IV
18	Upupa epops	Common hoopoe	-
19	Merops orientalis	Green bee-eater	-
20	Centropus bengalensis	Lesser coucal	Sch IV

S.No	Scientific Name	Common Name	Status according to IWPA- 1972	
21	Psittacula krameri	Rose-ringed parakeet	Sch IV	
22	Halcyon smyrnensis	White-throated kingfisher	Sch IV	
23	Apus affinis	House swift	-	
24	Columba livia	Rock pigeon	Sch IV	
25	Streptopelia enegalensis	Laughing dove	Sch IV	
26	Streptopelia decaocto	Eurasian dove	Sch IV	
27	Streptopelia tranquebarica	Red Collared dove	Sch IV	
28	Egretta garzetta	Little egret	Sch IV	
29	Bubulcus ibis	Cattle egret	Sch IV	
30	Corvus splendens	House crow	Sch IV	
31	Dicrurus macrocercus	Black drongo	Sch IV	
32	Saxicoloides fulicata	Indian robin	-	
33	Sturnus pagodarum	Brahminy starling	Sch IV	
34	Sturnus contra	Asian Pied starling	Sch IV	
35	Acridotheres tristis	Common myna	Sch IV	
36	Pycnonotus cafer	Red-vented bulbul	Sch IV	
37	Corvus macrorhynchos	Jungle crow	-	
38	Turdoides striatus	Jungle babbler	Sch IV	
39	Nectarinia asiatica	Purple sunbird	Sch IV	
40	Passer domesticus	House sparrow	Sch IV	
41	Motacilla maderaspatensis	White-browed wagtail	-	
42	Motacilla flava	Yellow wegtail	-	
43	Microcarbo niger	Little cormorant	Sch IV	
44	Pavo cristatus	Peafowl	Sch I	
45	Himantopus himantopus	Black wing Still	Sch IV	
46	Saxicola caprata	Pied Bush chat	Sch IV	
47	Prinia socialis	Ashy Warn- Warbler	Sch IV	
48	Chrysocola ptes festivus	Wood piker	Sch IV	

S.No	Scientific Name	Common Name	Status according to IWPA- 1972
49	Amaurornis phoenicurus	White-breasted waterhen	Sch IV
50	Dendrocitta vagabunda	Rufous tree pie	Sch IV

*Migratory Birds

The fauna were recorded in the study area in which two species of birds *Pavo cristatus*, *Platalea leucorodia* one species of Reptiles (*Crocodylus palustris*,) were recorded in **Sch.-1** according to Wild life protection act 1972.



Fig 1.1 Distance of Ecological Sencitive Area form mine Site



Fig :1.2 Distance of Crocodile Habitation from Plant Site

Impact of Mine and Cement Plant on Ecology & Biodiversity

The native flora and fauna of study area will be affected due mining and cement Plant. The mine and cement plant will be sourced of generating particulate matter and gaseous. Emission of particulate matter in uncontrolled manner may be caused of negative impact on surrounding ecology. During operation phase, fugitive emission from site may be degraded the soil quality of surrounding environment that may be affected the productivity of vegetation of surrounding environment. Aquatic ecosystem including dam and ponds may be fragmented due to mine activities.

Noise pollution creation activities like blasting may be caused of habitat destruction of wild animal along with increase vehicle activities may be generated negative impact on wild animals. Nocturnal animals will be affected through light beam of mine lease area and vehicles. Animals' mortality may be increase through increasing vehicles moments from plant and mine site specially refer to reptiles and rodents.

Leopold matrix:- Leopold matrix showing magnitude and intensity on scale of I to 10.



Leopold Matrix, M = Magnitude, I = Importance

This method was developed by Leopold et al. (1971) and it has been used for the identification of mpacts.

Where an impact is anticipated, the matrix is marked with diagonal line in the interaction box. The second step in using the Leopold matrix is to describe the interaction in terms of its magnitude (M) in the upper section and Importance (I) in the lower section of each box.

Project Activities Resources	Exploration drilling, Rock blasting and ore removal	Land clearance	mine site, materials handling etc.	Extraction and waste rock storage	Leopold Method (Total)
Loss of terrestrial Ecosystem and habitats	5 7	7 8	2 3	5 7	19 25
Effects of induced development on biodiversity	3 4	4 7			7 11
Loss of aquatic biodiversity	2 4	3 4			5 8
Loss of access medicinal plants	3 5	4 7		2 5	9 17
Loss of access to fisheries	2 5	2 4			4 9
Loss of Access to forage crops or grazing	4 6	3 5		3 7	10 18

Increased hunting and poaching pressures	3 5	4 5		2 3	9 13
Effect Migration route of wildlife	4 8	3 4	2 4	5 7	14 23
Effect on Nocturnal activities of animals	3 5	2 4		2 4	7 13
Effect on Productivity of plant	4 5	5 7	2 5	3 6	14 23
Loss of fodder and fuel wood	2 4	2 3		2 5	6 12
Loss of forest resource	4 5	4 6	3 4	3 6	14 21
Effect on Nesting and breeding of animals	4 6	5 7	2 5	5 8	¹⁸ 26
Leopold Method (Total)	43 69	48 71	11 21	32 58	

Mitigation Measures:-

During operation phase of mine would be followed mitigation measure to reduce impact on surrounding ecology and biodiversity which have been given below –

- Blasting would be carried out in deep hole and using latest technology for blasting to minimize impact on vibration and noise on Ecology and biodiversity.
- Transported material and store of raw material would also be well covered.
- Water sprinkler would be used on connecting road for transportation of mine ore material in operation phase to control fugitive emission in surrounding environment.
- Transport vehicles and machinery would be properly maintained and periodically check pollution level to reduce noise level and gases emission surrounding environment.
- The three tier greenbelt would be developed on periphery of mine pit, around water bodies, village with in mine lease. The plant specifies selection for greenbelt would be according to guideline of CPCB. These species should be drought resistance and can be control gaseous emission and fugitive emission. The green belt is also beneficial for controlling noise pollution of surrounding environment.

- Overburden dump site would be covered through grasses mixed vegetation to stabilize it. The vegetation of Leguminosae family would be grown on overburden dump site. Proper drainage system would be operated to control gully erosion on overburden site. .
- Transportation of raw material should be preferred in day time. If transported 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.
- Create a live hedge of sturdy woody shrubs along the road on either side that would restrict the wildlife to cross road connected to project site. Closely packed bamboo and tail grasses could be used.
- Undertaken an educational and awareness drive in labor camps to ensure that traps are not laid by the labors for trapping small animals.
- The removal or picking of any protected or unprotected plants would not be permitted.
- Awareness programmes will be organized for the local people to strengthen protection and conservation of biodiversity and wildlife.
- Green Belt Development Plan
- Green belts can help in reducing the impact of fugitive emissions and pollutants released at ground levels.
- The selection of plant species for greenbelt development should be according to 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, Alstonia scholaris, Albizzia lebbeck, Ficus benghalensis, Lucena leucocephala, Ficus religiosa, Dalbergia sissoo, Peltophorum pterocarpum, Mangifera indica, Delonix regia, Albizia lebbeck, Cassia fistula, Azardirachta indica, Polyalthia longifolia, Hibiscus rosa sinensis, Bougainvillea sp. Nerium indicum, Thevetia peruviana, Rosa indica, Cestrum nocturnum, Helianthus annuus etc.