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BASELINE STATUS OF FLORA AND FAUNA AT TEHSIL NEEM KA THANA DISTRICT SIKAR, RAJASTHAN AND IMPACT DUE TO SAND/BAJRI MINING AT KANTALI RIVER

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Abstract: The study area falls under 3 districts of Rajasthan and 1 district of Hayrana State *viz*. Sikar, Jhunjhunu, Jaipur (Rajasthan) and Mahendragarh (Haryana). The major trees were Khejri *(Prosopis cineraria),* Babool (*Acacia nilotica*) and few shrubs of Bilayati baool *(Prosopis juliflora)* as dominant vegetation. Total 31 species of trees belong to 14 families are enumerated from the study area. Total 21 shrub species belong to 15 families are enumerated from the study area. The dominant shrub community in this area was represented by *Prosopis juliflora*, *Calotropis procera*, *C. gigantea* (Akoda), Kaner (*Thevetia peruviana)*, *Ipomoea fistulosa* and *Abutilon indicum,* etc. Total 24 herbaceous species belongs to 13 family were recorded from the study area. Total 5 species of climbers/ twiners belongs to 3 families are recorded from the area. Among the enumerated flora in the study area, none of them were assigned any threat category by Red data book of Indian Plants. The most commonly spotted bird species of this area were Cattle Egret, Intermediate Egret, Red-wattled Lapwing, Rock Pigeon, Eurasian Collared-Dove, Spotted Dove, Chestnut-headed Bee-eater, Bank Myna and Common Myna. The Indian Peafowl was observed which is listed as schedule –I as per IWPA, 1972 and others listed as schedule IV as per IWPA, 1972. The reptile, Common Garden Lizard, Common Indian Monitor, House Gecko and Fan-Throated Lizard, Rosebelly Worm-eating Snake and Himalayan Wolf Snake were observed; Indian Cobra and Russell's viper were provided protection as per Schedule-II of Wild life Protection Act, (1972). Common Mongoose, Jackal and Monkey were observed which are protected under schedule II and Nilgai is Schedule-II animal as per Wildlife Protection Act 1972. Common Indian monitor is schedule-I as per Indian Wildlife Act and should be protected. Impact on wildlife due to mining activity is assessed along with mitigation measures.

Keywords: Conservation*;* Impact Assessment; Shelter belt; *Varanus bengalensis;* Wildlife Protection.

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INTRODUCTION

Rajasthan is the largest State in India, occupying an area of about 3,42,239 Km^2 nearly about 11 percent of the total geographical area (TGA) of India, and lies between 23º30´ and 30º 12' North latitude and 69º 30' and 78º 17' East longitude. Rajasthan is bordered by Pakistan in the west and northwest, the Indian States of Punjab, Uttar Pradesh and Haryana lie in the north and northeast, Madhya Pradesh in the southeast and Gujarat in the southwest. Administratively, Rajasthan is divided into 33 districts (Ajmer, Alwar, Banswara, Baran, Barmer, Bharatpur, Bhilwara, Bikaner, Bundi, Chittorgarh, Churu, Dausa, Dholpur, Dungarpur, Hanumangarh, Jaipur,Jaisalmer, Jalore, Jhalawar, Jhunjhunu, Jodhpur,Karauli, Kota, Nagaur, Pali, Pratapgarh, Rajsamand, Sawai Madhopur, Sikar, Sirohi, Sri Ganganagar, Tonk and Udaipur). Rajasthan is a unique State which shows great variation from one area to another and is noticeable in respect of climate, altitude

and vegetation. Rajasthan has three major physiographic regions, *viz*. the western desert (Thar Desert), the Aravalli hills and the south-eastern plateau. The most striking geographical feature is the Aravalli range, the oldest folded mountain range in the world, which intersects the State diagonally end to end north-east to south-west into three-fifth north-western desertic zone and two-fifth eastern semi-arid region. The elevation of Aravalli range gradually decreases in north-east direction, as it is 1,772 m at Mt. Abu (Gurushikar),1100 m at Bijapur, 913 m at Harshanath and 792 m at Khetri; the elevation further decreases to 335 m at Delhi beyond the boundaries of the State in north-east direction. The total forest area of the State is 16,036 Km^2, which occupies 4.69% of the total geographical area (FSI, 2009). The vegetation delineation depends on spatial, spectral and temporal resolution of the satellite sensor on one hand and the spatial extent and degree of homogeneity of the species assemblages on the other hand. The forest class is subdivided into mixed species forest types, gregarious species forest types, locale specific types, degraded types based on composition and location specific distribution controlled by physiographic, edaphic and disturbance conditions.

Species extinction caused by human activities continues at an alarming rate. Protecting biodiversity is in our self-interest. Ecological impact assessment (EcIA) is used to predict and evaluate the impacts of development activities on ecosystems and their components, thereby providing the information needed to ensure that ecological issues are given full and proper consideration in development planning. Environmental impact assessment (EIA) has emerged as a key to sustainable development by integrating social, economic and environmental issues in many countries. EcIA has a major part to play as a component of EIA but also has other potential applications in environmental planning and management (Kumar, 2014). Mineral resources of the nation reflect in terms of potential economic growth of the country at large. Our natural mineral wealth has been exploited considerably during the past 50 years. Floristic and Faunistic pattern of the area was studied based on opportunistic survey (personal observation), inquiries from the local people and forest officials and secondary data. The study area falls under 3 districts of Rajasthan and 1 district of Hayrana State *viz*. Sikar, Jhunjhunu, Jaipur (Rajasthan) and Mahendragarh (Haryana). The mining activity will be done at Dry river bed of kantali River, Tehsil Neem Ka Thana District-Sikar. Only rainwater comes during heavy rain. Kind of trees found in this area are Babul, Khejari, Neem, Sheesham, Mango, Pipal, Vad, Mahua, Khajur, Imili, Jungle-jalebi, Ber, etc. There is only protected forest which is mountainous range with *Prosopus juliflora* and *Acacia nilotica* as scrub falling in study area and there is no any wild life sanctuary within 10 Km radius.

EXPERIMENTAL

The baseline study was conducted for the evaluation of the floral and faunal biodiversity of the terrestrial environment of the study area (Figure 1) and it comprises of total 88 villages and its nearby area of District Sikar, Jaipur, Jhunjhunu (Rajasthan) and Mahendragargh (Hayrana). Total 53 villages of District Sikar, 11 villages of District Jaipur, 11 villages of District Jhunjhunu and 13 villages of Mahendragarh (Haryana) were surveyed for the present study. The buffer area comprises of 251334.63 hectares falls in state Rajasthan and Haryana (interstate boundary) and lease mining area is 3150.07 hectares in Teh.-Neem Ka Thana, District-Sikar. The study area comprises of protected forest (rocky terrain) and agricultural land. The village list is given in table 1. The baseline study has been conducted on 20th, 21st and 22nd June, 2015.

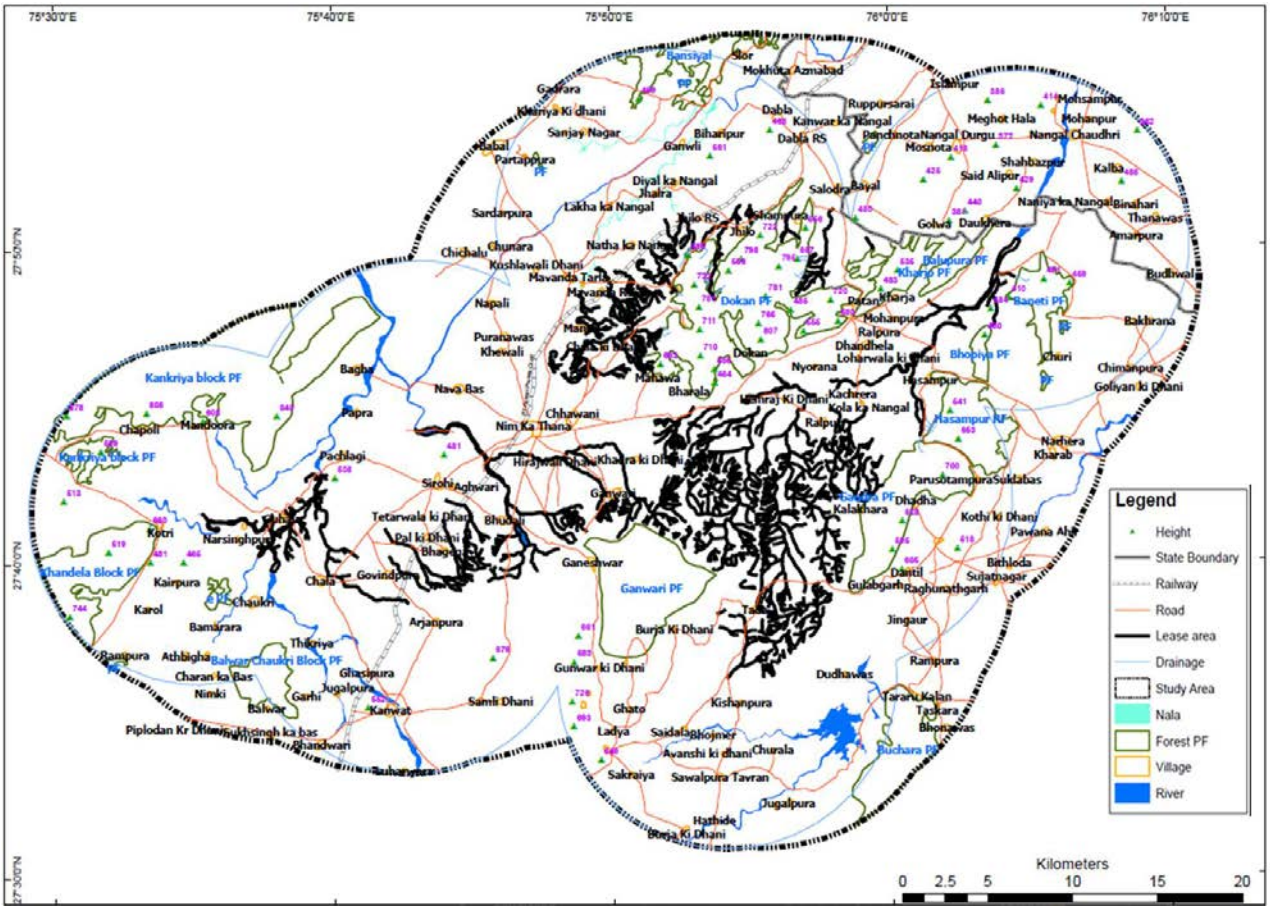

Figure 1a. Study area Map (10 Km Radius)

Methodology for Terrestrial Ecology

The primary objective of survey was to describe the floral and faunal communities within the study area. The sampling plots for floral inventory were selected randomly in the suitable habitats (Anderson, 1867; Jain and Rao, 1983). The methodology adopted for faunal survey involve random survey, opportunistic observations, diurnal bird observation, active search for reptiles, faunal habitat assessment, active search for scats and foot prints, animal call, and review of previous studies. The aim was to set baselines in order to monitor and identify trends after the commissioning of the mining activity. Emphasis has been placed on presence of endemic species, threatened species if any present in the study area. Desktop literature review was conducted to indentify the representative spectrum of threatened species, population and ecological communities listed by IUCN, WCMC, ZSI, BSI and Indian Wild life Protection Act, 1972 (Bentham and Hooker, 1862-1883; Hunter, 1879; Dixit, 1984; Ghosh *et al.,* 2004; Lushington, 1915; Wilson and Reeder, 1993; BirdLife International, 2000; BirdLife International, 2004a, b; Wilson and Reeder, 2005; BirdLife International, 2010; Kumar and Srivastava, 2012; Kumar, 2013; Kumar *et al.,* 2013; Kumar and Aggarwal, 2013a,b). The status of individual species was assessed using the revised IUCN/SSC category system (WCMC, 1988; IUCN, 1994; WCMC, 2000; IUCN, 2001, 2003, 2008, 2010). The villages covered for baseline study are given in the table 1.

Figure 1b. Google Map of Showing Tehsil boundary

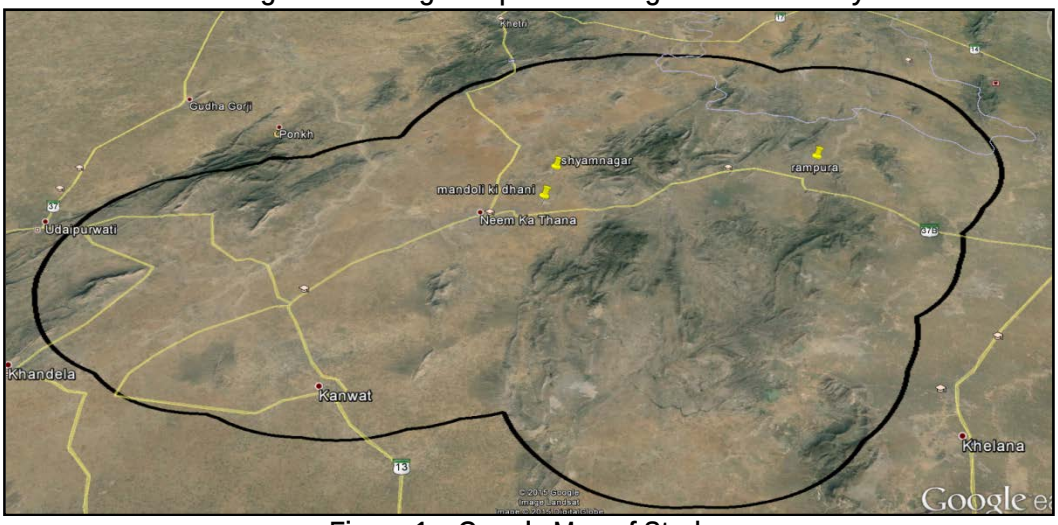

Figure 1c. Google Map of Study area

Table 1. List of Villages for Baseline study

S.No.	Village Name	S.No.	Village Name	S.No.	Village Name
Sikar		31	Kotda	61/8	Narheda
1	Baleshwar	32	Kotdi	62/9	Pabnera
2	Ballupura	33	Kotrak	63/10	Purushottampura
3	Banethi	34	Lakha Ka Nangal	64/11	Shukla ka Bas
4	Bhasudi Khurd	35	Manda	Jhunjhunu	
5	Bhudoli	36	Mavda	65/1	Babai
6	Birhampur	37	Moduka	66/2	Bagholi
7	Bopia	38	Nanagwas	67/3	Dalolpura
8	Chak Mandi	39	Napawali	68/4	Hardia
9	Chala	40	Narsinghpura	69/5	Jahaj
10	Chapar	41	Natha Ka Nangal	70/6	Jhadaya
11	Dabla	42	Naya Bas	71/7	Mandvara
12	Dayal Ka Nangal	43	Neem ka thana	72/8	Mavta
13	Dhandhela 1 & 2	44	Nimu	73/9	Nathuwala
14	Dilpura	45	Patan	74/10	Pachlangi
15	Dhokan	46	Pritampuri	75/11	Tal
16	Fatehpura	47	Puranabas	Mahendragarh	
17	Ganeshwar	48	Ram Singhpura	76/1	Amarpura
18	Ganvadi	49	Rampura	77/2	Bayal
19	Ghursali	50	Sirohi	78/3	Binneri

20	Guhala	51	Syalodra	79/4	Budhwal
21	Hemrajpura	52	Thoi	80/5	Deota
22	Harjanpura	53	Toda	81/6	Amarpura
23	Jhilo	Jaipur		82/7	Lujota
24	Kairwali	54/1	Banaar	83/8	Mushanta
25	Kakad ki Tibara	55/2	Beri	84/9	Nangal Chaudhary
26	Kanwat	56/3	Chhardaha	85/10	Nangal Durg
27	Keetpura	57/4	Dada	86/11	Nangal Nunia
28	Khandela	58/5	Datil	87/12	Pashata
29	Khurdia	59/6	Dwarikapuri	88/13	Rupar Sarai
30	Kola ki Nangal	60/7	Khadeb	-	

RESULTS AND DISCUSSION

The area for the present biological baseline study falls under 88 villages of 4 districts from 2 states. The plantation on road side and domesticated plants in villages were scattered. There is dry deciduous forest falling in the study area. The study area belongs to plain, undulating, fallow land and some grazing land; the thick vegetation cover observed in the south to west with scrub. The major trees were Khejri *(Prosopis cineraria),* Babool (*Acacia nilotica*) and few shrubs of Bilayati baool *(Prosopis juliflora)* as dominant vegetation. The people were engaged in Maize, Peanuts and Pearl millet cultivation during the study period. The crop is depending on rain, as there is no other means of water for irrigation. Some part of the study area has bore/tube wells, but the water table is more than 100 m. The crop may be affected by fugitive emission; hence water sprinkling is required to mitigate the same (Mahender *et al.,* 2015).

Figure 2. Aquatic Habitat of the Study Area (dry ponds)

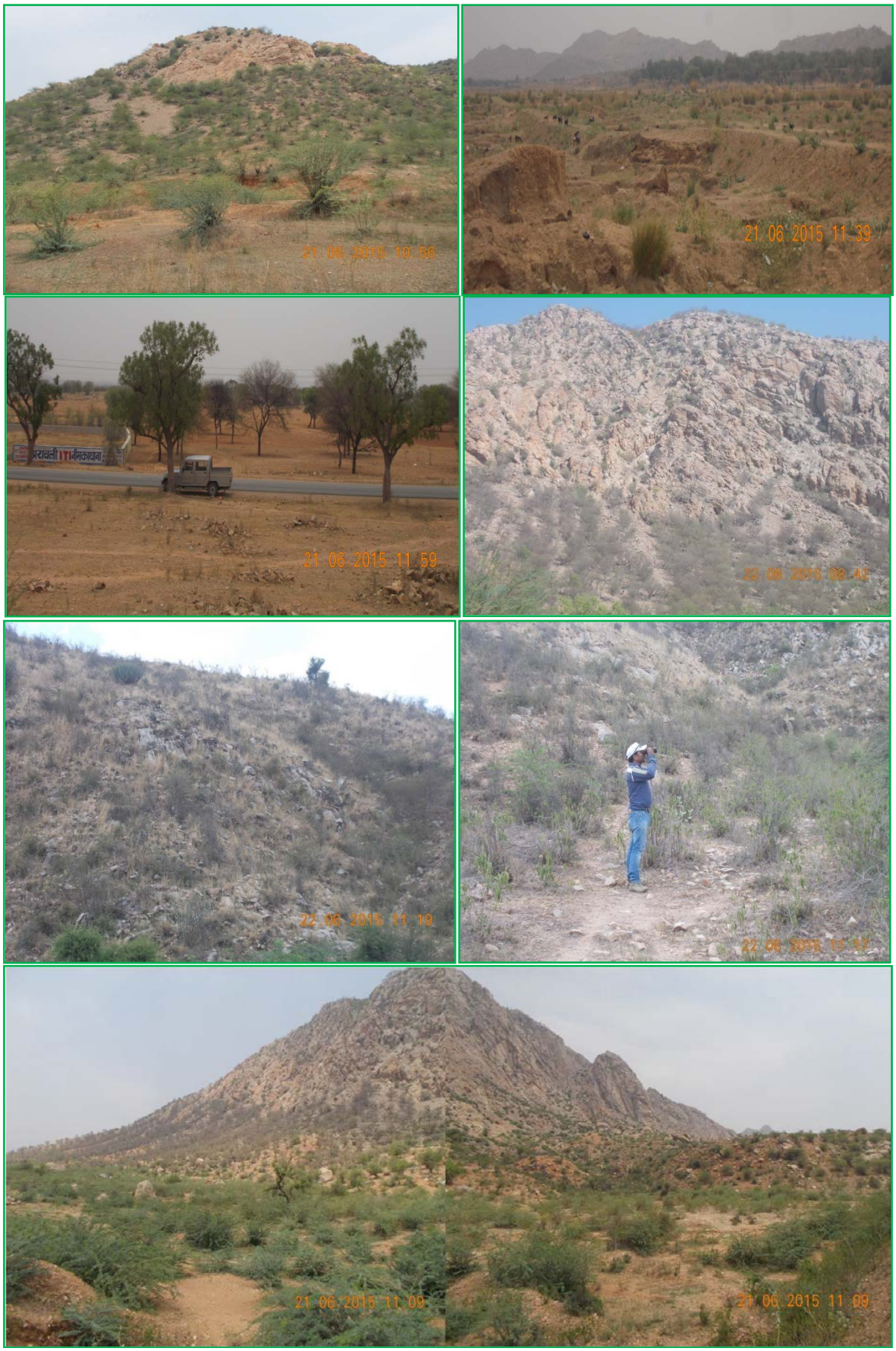

Figure 3. Terrestrial Habitat of the Study area

Figure 4. Agriculture Land of Study Area

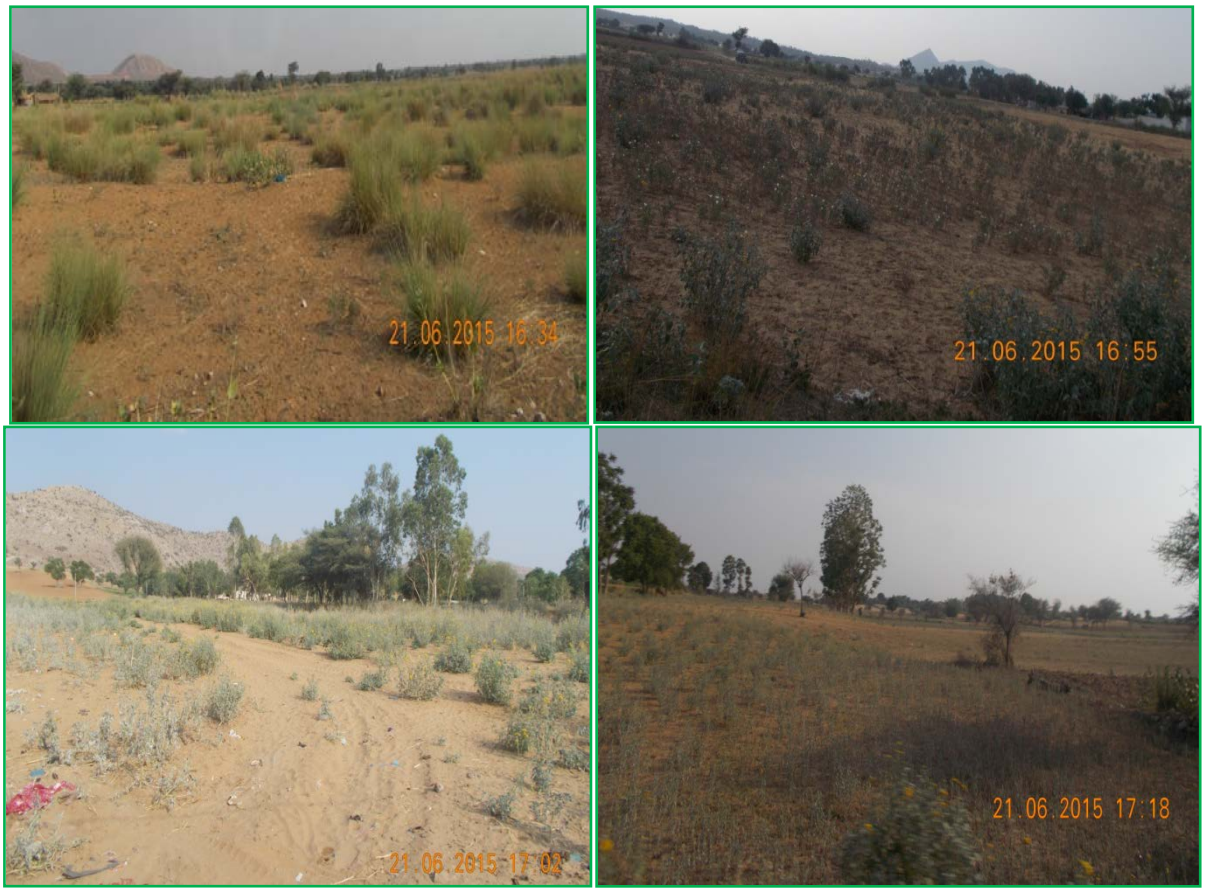

Figure 5. Non agriculture land of study area

Figure 6. River Bed area for sand mining

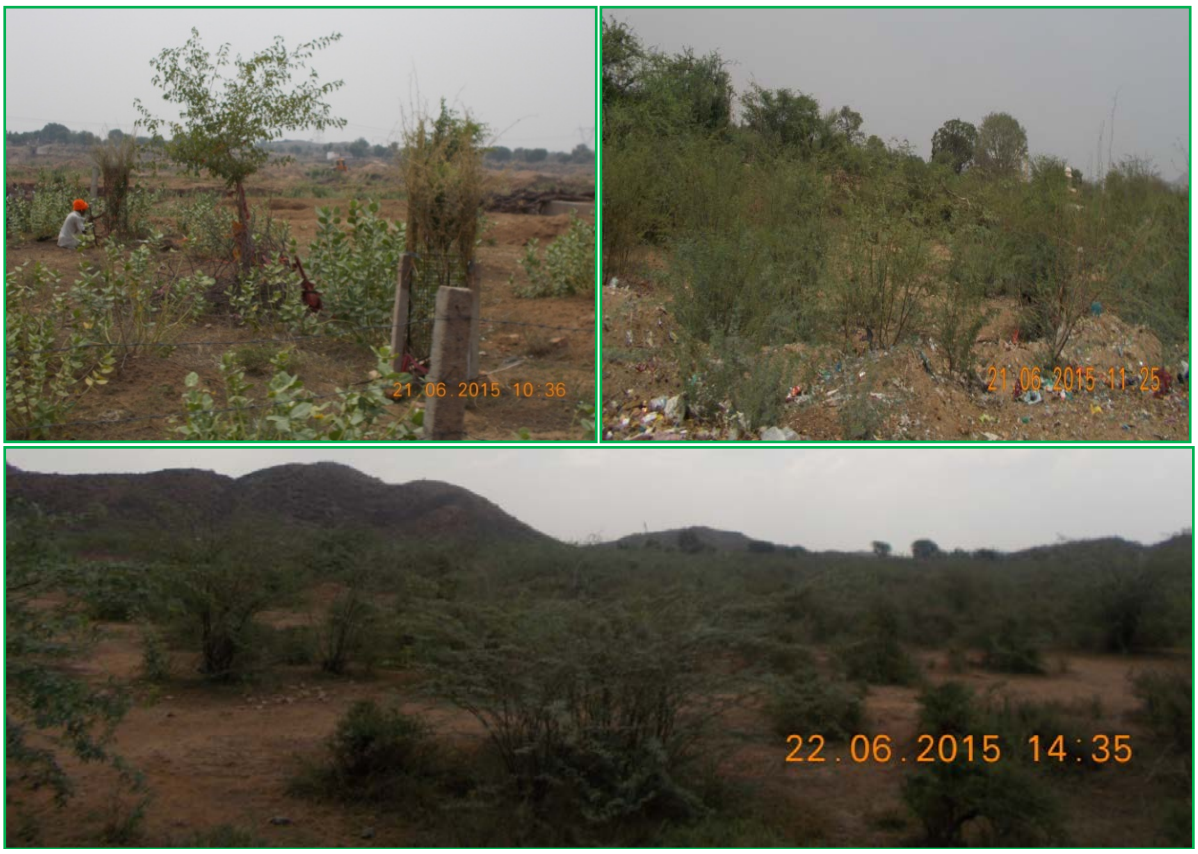

Figure 7. Scrub Area

Figure 8. Grazing Area

Figure 9. Images showing mountainous Range of Protected Forest

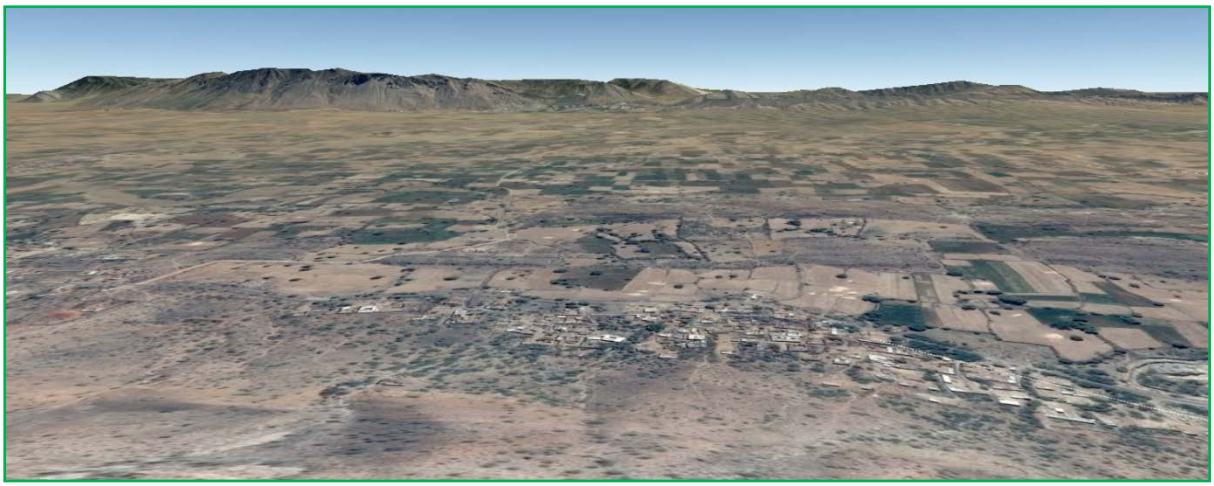

Figure 10. Image showing plain area and Mountainous range at Bhudoli

Villages are small and scattered in between the large patches of agriculture lands and rocky terrain. The tree cover in the study area is scanty restricted only in the habituated areas of the village and few along the boundary of the agricultural fields and road sides. The almost village pond were dry during study period and these village talabs used in rain water harvesting. The water from pond is used by local villagers for various purposes. In some part of South, people were taking water from nearby area/village where other source of water or water tanker available. Some people were engaged in poultry farming in this area. The mining activity will be done at Dry River Kantali and its tributaries in Tehsil Neem Ka Thana. The approx 22% of the study area was occupied by protected forest (rocky terrain), 20% of the area is follow land, 13% is barren, 16% is pasture, approx 2% is settlement, 2% river sand and 25% of the study area is agricultural land. Major agricultural land is in the north while in the west and south, it is occupied by rocky terrain with protected dry deciduous forest. There are patches of small rocks having scrub vegetation. The tree species, herbs and shrubs and major crops, were documented during this base line study. The list of floral species documented in the study area is enlisted in table 2-6.

Floral Diversity of the Study Area

The objective of this floral inventory of the study area is to provide necessary information on floristic structure in the study area for formulating effective management and conservation measures. The climatic, edaphic and biotic variations with their complex interrelationship and composition of species, which are adapted to these variations, have resulted in different vegetation cover, characteristic of each region (Ohasi, 1975). The tree species, herbs, shrubs, climbers and major crops, were documented during this base line study (Jain, 1968; 1991).

Trees: The dominant trees in the study area are Khejari *(Prosopis cineraria),* Babool *(Acacia nilotica), Azadirachta indica* (Neem), *Mangifera indica* (Aam). Total 31 species of trees belong to 14 families are enumerated from the study area.

Scrub is a vegetation cover predominantly occupied by shrubs or poor tree growth chiefly of small or stunted trees with crown density less than 10%. Desert dune scrub is unique to sandy parts of desert on partially stabilised dunes and on shifting dunes. It is the dominant scrub type of Rajasthan State and of this area. Thorn scrub is generally seen in the fringes of thorn forests, hill tops and nearby settlements. Dry Deciduous scrub has been subjected to more degradation and frequently found in and around dry deciduous forests. Calotropis scrub is specifically found in long fallow areas and bordering crop fields in desert region. Euphorbia (*E. caducifolia* and *E*. *tirucalli*) scrub is unique to rocky and badly eroded areas of rocky terrain of south-east which is part of Ganwari Protected Forest. It is a very open formation in which *Euphorbia caducifolia* predominates. *Prosopis juliflora* and *Lantana*

camara L. are worst invasive alien species and threat to native biodiversity (Reddy, 2008). *Prosopis juliflora* and *Lantana camara* being aggressive colonizers, form dense thickets referred as Prosopis scrub and Lantana scrub, respectively. *Prosopis juliflora* often grows along road sides, canals and degraded thorn forest lands and rapidly spreading in this area. *Lantana camara* prefers openings and fringes of dry deciduous forests and sub-humid tracts of broad leaved hill forests.

Shrubs: Shrubs encountered during the present survey are given in the Table 3. Total 21 shrub species belong to 15 families are enumerated from the study area. The dominant shrub community in this area was represented by *Prosopis juliflora, Calotropis procera*, *C. gigantea* (Akoda), Kaner (*Thevetia peruviana)*, *Ipomoea fistulosa* and *Abutilon indicum,* etc.

Herbs: The herbaceous cover observed in this region is given in the table 4. The most of the undergrowth was dried up, except near water logged regions and along the periphery of the village ponds. Total 24 herbaceous species belongs to 13 family were recorded from the study area.

Climbers and Twiners: The climbers and twiners observed along the agricultural hedges and road side hedges of the study area are given in the table 5. Total 5 species of climbers/ twiners belongs to 3 families are recorded from the area.

Table 2. Trees in the Study area

S.No.	Family and Scientific name	Vernacular Name
1	Anacardiaceae	
1/1	*Mangifera indica* L.	Aam
2	Arecaceae	
2/1	*Phoenix sylvestris*	Kajoor
3	Apocynaceae	
3/1	*Plumeria rubra* L.	Champa
4	Caesalpiniaceae	
4/1	*Delonix regia* (Boj.) Raf.	Gaulmor
5/2	*Cassia siamea* Lam.	Amaltas
6/3	*Peltophorum pterocarpum*	Sonmukhi
7/4	*Tamarindus indica*	Imli
5	Caricaceae	
8/1	*Carica papaya* L.	Papaya
6	Fabaceae	
9/1	*Dalbergia sisoo*	Shisam
10/2	*Acacia catachu*	Khair
7	Malvaceae	
11/1	*Thespesia populnea*	Paras pipal
8	Meliaceae	
12/1	*Azadirachta indica* A.Juss	Neem
13/2	*Melia azadirachta* L.	Bakain
9	Mimosaceae	
14/1	*Acacia nilotica*	Babool
15/2	*Leucaena leucocephala* (Lam.) De	Pardesi Baval
16/3	*Pithecellobium dulce* (Roxb.) Bth.	Jungle jalebi
17/4	*Prosopis cineraria (L.)*	Khejari
18/5	*Acacia senegal* (L.) Willd,	Babool
19/6	*Acacia leucophloea* (Roxb.) Willd.	-
20/7	*Acacia tortilis* (Forssk.) Hyene.	-
10	Moraceae	
21/1	*Ficus benghalensis* L.	Bargad
22/2	*Ficus religiosa* L.	Pipal
23/3	*Ficus glomerulata*	Goolar
24/4	*Morus alba*	Shahtoot
11	Myrtaceae	
25/1	*Eucalyptus sp.*	Nilgari
26/2	*Syzygium cumini (L.) Skeels.*	Jamun

12	Papilionaceae	
27/1	*Pongamia pinnata* (L.) Pierre	Karanj
13	Rhamnaceae	
28/1	*Zizyphus mauritiana*	Ber
29/2	*Zizyphus vulgaris*	Ber
30/3	*Zizyphus xylopyrus*	Jugnle Ber
14	Rutaceae	
31/1	*Aegle marmelos*	Bel

Table 3. List of Shrubs in the Study Area

S.No.	Family and Scientific name	Vernacular name
1	Apocynaceae	
1/1	*Nerium indicum*	Lal Kaner
2/2	*Thevetia peruviana* Merr.	Pili Kaner
2	Asclepiadaceae	
3/1	*Calotropis gigantea* (L.) R. Br	Akoda
4/2	*Calotropis procera* (Ait.) R.Br	Akoda
3	Balanitaceae	
5/1	*Balanites aegyptiaca* (L.) Del.	-
4	Bignoniaceae	
6/1	*Tecoma stans* (L.) H.B. and K.	-
5	Cactaceae	
7/1	*Cereus peruvianus*	Cactus
5	Caesalpiniaceae	
8/1	*Cassia auriculata* L	-
6	Capparaceae	
9/1	*Capparis decidua* (Forsk.) Edgew	-
7	Compositae	
10/1	*Xanthium strumarium* L.	Gokhru
8	Convolvulaceae	
11/1	*Ipomoea fistulosa* Mart.ex Choisy	Besharm
9	Euphorbiaceae	
12/1	*Euphorbia neriifolia L.*	Thor
13/2	*Jatropha curcas L.*	Ratanjot
14/3	*Ricinus communis L.*	Arand
10	Malvaceae	
15/1	*Abelomoschus manihot (L.) Medic.*	Jagali bhindi
16/2	*Abutilon indicum (L.) Sw.*	Khapat
11	Musaceae	
17/1	*Musa paradisiaca L.*	Kela
12	Mimosaceae	
18/1	*Prosopis juliflora* DC	Bilayati babool
13	Nyctaginaceae	
19/1	*Bougainvillea spectabilis* Willd.	Bougainvelia
14	Rhamnaceae	
20/1	*Zizyphus nummularia* (Burm.f.) W. and.	Jharbera
15	Solanaceae	
21/1	*Datura metel* L	Datura

Table 4. List of Herbaceous species observed in the study area

S.No.	Family and Scientific name	Vernacular name
1	Acanthaceae	
1/1	*Hygrophila auriculata (Schum.)*	Kokilaksha
2	Asteraceae	
2/1	*Eclipta prostrata* (L.) L.	Bhangra
3/2	*Echinops echinatus* Roxb	Shulia
4/3	*Tridax procumbens L*	Pardesi bhangra
3	Boraginaceae	

5/1	*Trichodesma indicum l.*	Undha fuli
4	Cyperaceae	
6/1	*Cyperus bulbosus* Vahl.	-
7/2	*Cyperus difformis* L.	-
8/1	*Cyperus stoloniferus* Retz.	-
9/2	*Cyperus rotundus* L.	-
5	Lamiaceae (Labiatae)	
10/1	*Ocimum basilicum* L.	-
11/2	*Ocimum sanctum* L.	Tulsi
6	Nyctaginaceae	
12/1	*Boerhavia diffusa* L.	-
13/2	*Boerhavia chinensis* Druce	-
7	Papaveraceae	
14/1	*Argemone mexicana* L.	Darudi/Katiaya
8	Papilionaceae	-
15/1	Cortalaria medicaginea Lam	Ran methi
16/2	*Indigofera oblongifolia* Forks.	-
9	Poaceae (Gramineae)	
17/1	*Saccharum munja*	Munja
18/3	*Cynodon dactylon* Pers.	-
19/4	*Pennisetum typhoides (Burm.)*	Bajri
10	Poligonaceae	
20/1	*Poligonum sp.*	-
11	Pontederiaceae	
21/1	*Eichhornia crassipes* (Mart.)	Jalkumbhi
12	Solanaceae	
22/1	*Solanum surattense Burm.*	Bhoringini
23/2	*Datura metel*	Dhatura
13	Zygophyllaceae	
24/1	*Tribulus terrestris* L	Gokhru

Table 5. List of Climbers Observed in the Study Area

S.No.	Family and Scientific Name	Vernacular Name
1	Convolvulaceae	
1/1	*Ipomoea obscura* (L.) Ker – Gawl.	Vad fudardi
2	Cucurbitaceae	
2/1	*Citrulus colocynthis (L)*	Indravarna
3/2	*Coccinia grandis* (L.) Voigt	Ghiloda
4/3	*Luffa cylindrica (L.) M.J.Roem*	Galku
3	Cuscutaceae	
5/1	*Cuscuta chinensis* Lam.	Amarval

Cultivated Plants in the Study Area

The prevalent cropping systems of this area are the cumulative results of past and present decisions by individuals; these decisions are usually based on experience, tradition, expected profit, personal preferences and resources, and so on. The crop occupying the highest percentage of the sown area of this region is taken as the major crop and all other possible alternative crops which are sown in this region either as substitutes of the base crop in the same season or as the crops which fit in the rotation in the subsequent season, are considered as minor crop.

a. Major Crops: Mainly people of this area was dependent on rain to cultivate the corps. Major crops in the study area are Wheat (*Triticum aestivum*), Maize (*Zea mays*), Bajra *(Pennisetum glaucum)* and Peanuts (*Arachis hypogaea*).

b. Minor crops: The minor crops of this region are Mustard (*Brassica campestris* var.), Green gram (*Vigna radiate*), Pigeon Pea (*Punica granatum*) and Black Gram (*Vigna mungo).*

c. Major horticultural crops: Aam (*Mangifera indica* L.), Papaya (*Carica papaya* L.), Banana (*Musa Paradisiaca* L.), Lime (*Citrus aurantifolia*), Guava (*Psidium guajava*), Jack-

fruit (*Artocarpus heterophyllus*) and Jujube (*Ziziphus mauritiana*).

d. Major Vegetable corps: The major vegetables grown in the study area were:

1. Bottle gourd: *Lagenaria siceraria.*
2. Brinjal: *Solanum melongena.*
3. Carrot: *Daucus carota.*
4. Chilli: *Capsicum annum.*
5. Coriander: *Coriandrum sativum*
6. Cucumber: *Cucumis sativus*
7. Lady's finger: *Abelmoschus esculentus.*
8. Potato: *Solanum tuberosum.*
9. Pumpkin: *Cucurbita moschata.*
10. Radish: *Raphanus sativus.*
11. Bean: *Dolichos lablab.*
12. Sponge gourd: *Luffa cylindrica.*
13. Tomato: *Lycopersicum esculantum*

e. Major Ornamental Plants: Following is the list of ornamental plants in the study area.

1. Marigold: *Tagates erecta.*
2. China rose: *Hibiscus rosasinensis.*
3. Sunflower: *Helianthus annuus.*
4. Rose: *Rosa indica.*
5. Jasmin: *Jasminum sambac.*

Rare and Endangered Flora in the Study Area: The IUCN Red List is the world's most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. With its strong scientific base, the IUCN Red List is recognized as the most authoritative guide to the status of biological diversity. Out of 17000 species of higher plants known to occur in India, nearly 614 higher plant species were evaluated by IUCN. Among them 247 species are under threatened category (IUCN, 2008). Among the enumerated flora in the study area, none of them were assigned any threat category by Red data book of Indian Plants (Jain and Sastry, 1984; Nayar and Sastry, 1987; 1988; 1990; Oldfield *et al.,* 1998; Kholia and Bhakuni, 2009) and Red list of threatened Vascular plants (IUCN, 2010).

Endemic Plants of the Study Area: De Candolle (1855), Swiss botanist, first used the concept of Endemic, which is defined as an area of a taxonomic unit, especially a species which has a restricted distribution or habitat, isolated from its surrounding region through geographical, ecological or temporal barriers. Out of 17000 species of known flowering plants of India nearly 5000 species are said to be endemic. Nearly 58 genera and 1932 taxa are found to be endemic to peninsular India (Nayar, 1980; Ahmedullah and Nayar, 1986; 1987; Jain 1992; Nayar, 1996; Vijaya Shankar *et al.,* 2005; Nautiyal *et al.,* 2009a,b; Shendage *et al.,* 2010). Among recorded plant species none can be assigned the status of endemic plant of this region.

Status of the Forest, Their Category in Study Area: No any reserve forest was observed in the study area except protected forest of Dry Deciduous forest, Thorn forest (*Prosopis cineraria* (L.) Druce., *Acacia senegal* (L.) Willd, *Acacia nilotica* (L.) Willd. ex Del, *Acacia leucophloea* (Roxb.) Willd., *Acacia tortilis* (Forssk.) Hyene and *Zizyphus mauritiana* Lam) and *Prosopis cineraria* (L.) Druce forest with few other scrub species and grazing lands with thin vegetation cover.

Faunal Biodiversity of Study Area

For the documentation of the faunal biodiversity of the study area with respect to birds, reptiles, amphibians, and butterfly species, a baseline survey had been conducted. The study area falls under two states Rajasthan and Haryana (interstate boundary).

Birds: The sighting of bird species was very lass during the study period during June 2015. The most commonly spotted bird species of this area were; Cattle Egret, Intermediate Egret, Red-wattled Lapwing, Rock Pigeon, Eurasian Collared-Dove, Spotted Dove, Chestnut-headed Bee-eater, Bank Myna and Common Myna. The Indian Peafowl was observed which is listed as schedule –I as per IWPA, 1972 and others listed as schedule IV as per IWPA, 1972. List of schedule -1 as per Wild life Protection Act 1972, species is given in the table 6. Systematic account of the birds in the study area with the status of occurrence is given in the table 7.

Table 6. Schedule –I Bird(s) of Study Area

Species	As IWPA 1972	IUCN	CITES
Indian Peafowl *(Pavo cristatus)*	Schedule I	Least Concern ver 3.1	Not listed

Table 7. Systematic Lists of Birds in the Study Area with Its Distribution and Migratory Status

Old Common name	New Common Name	Scientific Name	Dist.
I. ORDER: APODIFORMES			
Family: Apodidae (swifts)			
Common Swift	Common Swift	*Apus apus*	R
House swift	Little Swift	*Apus affinis*	R
II. ORDER: BUCEROTIFORMES			
Family: Upupidae			
Hoopoe	Hoopoe	*Upupa epops*	R
III. ORDER: FALCONIFORMES			
Family: Accipitridae (Vulture, Sparrow Hawk, Eagle, Harrier, Kite and Vulture)			
Shikra	Shikra	*Accipiter badius*	R
Black-winged Kite	Black-winged Kite	*Elanus caeruleus*	R
IV. ORDER: CICONIIFORMES			
Family: Ardeidae (Heron, Egret, Bittern)			
Cattle Egret	Cattle Egret	*Bubulcus ibis*	R
Median or Smaller Egret	Intermediate Egret	*Mesophoyx intermedia* *Egretta intermedia*	R
Little Egret	Little Egret	*Egretta garzetta*	R
Pond Heron	Indian Pond-Heron	*Ardeola grayii*	R
Family: Charadriidae (Plover, Stilt, Oystercatcher, Lapwing, Avocet)			
Red-wattled Lapwing	Red-wattled Lapwing	*Vanellus indicus*	R
V. ORDER: COLUMBIFORMES			
Family: Columbidae (Pigeon, Dove)			
Blue Rock Pigeon	Rock Pigeon	*Columba livia*	R
Ring Dove	Eurasian Collared-Dove	*Streptopelia decaocto*	R
Rufous Turtle Dove	Oriental Turtle-Dove	*Streptopelia orientalis*	R
Spotted Dove	Spotted Dove	*Streptopelia chinensis*	R
VI. ORDER: CORACIFORMES			
Family: Dacelonidae (Kingfishers)			
White breasted Kingfisher	White-throated Kingfisher	*Halcyon smyrnensis*	R
Family: Coraciidae (Roller)			
BlueJay or Roller	Indian Roller	*Coracias benghalensis*	R
Family: Meropidae (Bee Eater)			
Chestnut-headed Bee-eater	Chestnut-headed Bee-eater	*Merops leschenaulti*	R
Blue-cheeked Bee-eater	Blue-cheeked Bee-eater	*Merops persicus*	R
VII. ORDER: CUCULIFORMES			
Family: Centropodidae (Cocucal)			
Crow-Pheasant or Coucal	Greater Coucal	*Centropus sinensis*	R
Family: Cuculidae (Cuckoo, Koel)			
Koel	Asian Koel`	*Eudynamys scolopacea*	R
Indian Drongo Cuckoo	Drongo Cuckoo	*Surniculus lugubris*	R
VIII. ORDER: GALLIFORMES			
Family: Phasianidae (Peafowl, Partridge, Quail, Spur fowl, Jungle fowl, Monal)			
Common Peafowl	Indian Peafowl	*Pavo cristatus*	R
Grey Partridge	Grey Francolin	*Francolinus pondicerianus*	R
Common Quail	Common Quail	*Coturnix coturnix*	R
Red jungle fowl	Red jungle fowl	*Gallus domesticus*	R
IX. ORDER: GRUIFORMES			
Family: Rallidae (Waterhen, Coot, Crake water cock, Moorhen)			
White-breasted Water hen	White-breasted Water hen	*Amaurornis phoenicurus*	R
Indian Moorhen	Common Moorhen	*Gallinula chloropus*	R

X. ORDER: PASSERIFORMES			
Family: Paridae (Tit)			
Grey Tit	Great Tit	*Parus major*	R
Family: Corvidae			
Raven	Common Raven	*Corvus corax*	R
House Crow	House Crow	*Corvus splendens*	R
Black drongo- King Crow	Black Drongo	*Dicrurus macrocercus*	R
Tree Pie	Rufous Treepie	*Dendrocitta vagabunda*	R
Family: Muscicapidae (Short wing, Chat, Robin, Shama)			
Indian Robin	Indian Robin	*Saxicoloides fulicata*	R
Pied Bushchat	Pied Bushchat	*Saxicola caprata*	R
Family: Nectariniidae (Sun Birds, Flower pecker, Spider hunter)			
Purple Sunbird	Purple Sunbird	*Nectarinia asiatica*	R
Small Sunbird	Crimson-backed Sunbird	*Nectarinia minima*	R
Family: Passeridae (Avadavat, Pipit, Wagtail, Munia, Snowfinch, Sparrow, Accentor)			
House Sparrow	House Sparrow	*Passer domesticus*	R
Family: Pycnonotidae (Bulbul)			
Red-whiskered Bulbul	Red-whiskered Bulbul	*Pycnonotus jocosus*	R
Red-vented Bulbul	Red-vented Bulbul	*Pycnonotus cafer*	R
Family: Sturnidae (Myna, Starling)			
Bank Myna	Bank Myna	*Acridotheres ginginianus*	R
Indian Myna	Common Myna	*Acridotheres tristis*	R
Family: Sylviidae (Warbler, Browning, Fulvetta, Babbler, Laughing thrash, Tailor birds)			
Common Babbler	Common Babbler	*Turdoides caudatus*	R
Jungle Babbler	Jungle Babbler	*Turdoides striatus*	R
XI. ORDER: PSITTACIFORMES			
Family: Psittacidae (Parrot and Parakeet)			
Rose-ringed Parakeet	Rose-ringed Parakeet	*Psittacula krameri*	R
Family: Ploceidae			
Baya	Baya weaver	*Ploceus philippinus*	R
XII. ORDER: STRIGIFORMES			
Family: Strigidae (Owl and Owlet)			
Owlet	Spotted owlet	*Athene brama*	R

Note: R = Widespread Resident, r = Very Local Resident, W = Widespread Winter Visitor, w = Sparse Winter Visitor, RW =Resident and winter visitor as per the Distribution (Dist.) given in WCMC, Check list of Indian Birds

Butterflies from the study area: Butterflies from three families observed during the present study are documented in the Table 8.

Herpetofauna: In amphibian group, the toads were sighted during the study period. The reptile, Common Garden Lizard, Common Indian Monitor, House Gecko and Fan-Throated Lizard, Rosebelly Worm-eating Snake and Himalayan Wolf Snake were observed in the region is given in the table 9.

Mammals: Common Mongoose (*Herpestes edwardsii*), Jackal (*Canis aureus*) and Monkey (*Macaca mulatta*) were observed which are protected under schedule II and Nilgai (*Boselaphus tragocamelus*) is Schedule-II animal as per Wildlife Protection Act 1972. Bat (*Rousettus leschenaulti*) and Common House Rat (*Rattus rattus)* are protected under schedule V.

Fishes: During the study period (summer), there were no any major pond or river (aquatic body) was observed. The small fishes observed in one village pond along with tadpoles.

Domestic Animals: The domestic animals viz. Dog, cow, buffalo, goat, sheep and chicken observed in the study area are listed in the table below. Some people of this area practising poultry farming and some are sheep and goat farming.

Table 8. Butterflies in the Study Area

Scientific Name and Family	Common Name	Relative Abundance
Family Papilionidae		
Papilio polytes	Common Mormon	Common
Family Pieridae		

Eurema hecabe	Common Grass yellow	Very Common
Ixias Marianne	White orange tip	Common
Family: Nymphalidae		
Danaus chrysippus	Plain Tiger	Common
Phalantha phalantha	Common Leopard	Fairy Common
Hypolimanas misippus	Danaid egg fly	Common
Mycalesis perseus	Common bush brown	Uncommon

Table 9. Reptiles and Amphibian in the Study Area

S.No.	Common Name	Scientific name	Schedule as IWPA, 1972
1.	Toad	*Bufo bufo*	Not listed
2.	Common Indian Monitor	*Varanus bengalensis*	Schedule I
3.	Common Garden Lizard	*Calotes versicolor*	Not listed
4.	Fan-Throated Lizard	*Sitana ponticeriana*	Not listed
5.	House Gecko	*Hemidactylus flaviviridis*	Not listed
6.	Rose belly Worm-eating Snake	*Trachischium guentheri*	Not listed
7.	Himalayan Wolf Snake	*Lycodon mackinnon*	Not listed
8.	Indian Cobra	*Naja naja* (L)	Schedule II
9.	*Russell's Viper	*Daboia russelii*	Schedule II

*Not sighted but included as per the secondary information from the villagers.

Table 10. Mammals in Study Area

S.No.	Common Name	Scientific name	Status as per IWPA 1972
1.	Bat	*Rousettus leschenaulti*	Schedule V
2.	Common House Rat	*Rattus rattus*	Schedule V
3.	Common Mongoose	*Herpestes edwardsii*	Schedule II
4.	Five striped Palm Squirrel	*Funambulus pennanii*	Schedule IV
5.	Hare	*Lepus nigrigolis dayanus*	Schedule IV
6.	Jackal	*Canis aureus*	Schedule II
7.	Monkey	*Macaca mulatta*	Schedule II
8.	Nilgai (Blue Bull)	*Boselaphus tragocamelus*	Schedule-III

Table 11. Domestic Animals in Study area

S.No.	English/Hindi Name	Scientific Name
1.	Buffalo/ Bhains	*Bulbalus bulbalis*
2.	Chicken/Murga	*Gallus gallus domesticus*
3.	Cow/Gai	*Bos primigenius*
4.	Dog/Kutta	*Canis lupus familiaris*
5.	Goat/Bakri	*Capra aegagrus hircus*
6.	Sheep/Bhed	*Ovis aries*

Rare and Endangered Fauna of Study Area: The IUCN Red List is the world's most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. With its strong scientific base, the IUCN Red List is recognized as the most authoritative guide to the status of biological diversity. IUCN, (2008) has evaluated 1976 animal species from India, among them 313 have in recognized as threatened species. Among them one species is considered as extinct, while 44 species are in critically endangered (CR) category, 88 is in endangered category (EN), while 181 is considered as vulnerable (VU). Wild Life (Protection) Act, 1972, amended on 17th January 2003, is an Act to provide for the protection of wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto with a view to ensuring the ecological and environmental security of the country. Some of the sighted fauna was given protection by the Indian Wild Life (Protection) Act, 1972 by including them in different schedules. Among the birds in the study area, Pea fowl (*Pavo cristatus)* is included in schedule I of Wild life protection Act (1972), while many other birds are included in schedule IV. Among the reptiles, Indian Cobra (*Naja*

naja) and Russell's viper were provided protection as per Schedule-II of Wild life Protection Act, (1972). Among mammals; Common Indian monitor (*Varanus bengalensis*) is schedule-I and Common Mongoose (*Herpestes edwardsi)*, Jackal (*Canis aureus* (Linnaeus) and Monkey (*Rhesus macaque*) are a schedule –II animals. Nilgai (*Boselaphus tragocamelus*) is protected as Schedule-III animal and hares and five stripped squirrels are included in schedule IV of Wild Life Protection act 1972. The conservation plan should be prepared for schedule-I and II fauna (Kumar 2015a & b; Rathoure, 2016).

Endemic Fauna of the Study Area: None of the sighted animal species can be assigned endemic species category of the study area.

Table 12. List of Schedule –I and II Fauna Observed During the Study

S.No.	Scientific Name	Local Name	Schedule as per WPA, 1972	IUCN Category	CITES Listing
1.	*Pavo cristatus*	Indian Peafowl	Schedule I	Least Concern ver 3.1	Not listed
2.	*Varanus bengalensis*	Common Indian monitor	Schedule I	Least Concern ver 3.1	Appendix I
3.	*Canis aureus*	Jackal	Schedule II	Least Concern ver 3.1	Appendix II
4.	*Herpestes edwardsi*	Common Mongoose	Schedule II	Least Concern ver 3.1	Appendix III
5.	*Macaca mulatta*	Monkey	Schedule II	Least Concern ver 3.1	Not listed
6.	*Naja naja*	Indian Cobra	Schedule II	Least Concern ver 3.1	Appendix II
7.	*Vipera/Daboia russelli*	Russell's Viper	Schedule II	Least Concern ver 3.1	Appendix III

Major Impact on Ecological Environment

i. As it is a river bed mining project, mine activities may be confined to core zone only. Thus, no direct impact is foreseen on the flora of the forested area because of mining, whereas activities related to mining as transportation of minerals and passage of workers to and fro from mining area will have an adverse impact on the road side flora.
ii. The mining activity at River bed should not disturb the aquatic life and avifauna.
iii. Loud sounds generated by human activities and transportation may have an adverse impact on terrestrial fauna and avifauna.
iv. Transportation of Sand in the trucks/dumper may disturb the movement of Wild animals like jungle cat, jackal, and other reptiles. Fugitive emission from vehicle movement may form a layer in leaves thus reducing the gaseous exchange process. This ultimately affects the growth of plants. Chances of vehicle collisions with wildlife attempting to cross roads are possible.
v. Any human settlement in the mining area may disturb the vegetation cover.
vi. Indiscriminate mining from active channels of rivers causes many adverse effects on the benthic fauna, which inhabits the bottom sandy substratum. Excessive sand extraction from rivers affects the eco-biology of many terrestrial insects whose initial life history begins in aquatic environments.
vii. The Indian peafowl movement is very common in the area; the noise from sand mining may hinder the same.
viii. Some scheduled fauna was observed in the study area, the mining activity can hinder their movement.

Proposed Mitigation Measures

i. Transportation of sand should be minimise in the morning and evening and cannot be done in night. Access roads should not encroach into the riparian zones.
ii. The mining should be restricted to dry bed.
iii. All equipment should have sound-control devices no less effective than those provided on the original equipment. Motorized equipment used should be adequately muffled and maintained.
iv. No human settlement should be permitted in the lease mining or nearby area. No mining should be carried out during the

rainy season to minimize impact on aquatic life.

v. Shelter belt and community forestry should be encouraged to mitigate the noise level. Plantation should be carried out on approach roads and nearby vicinity at river banks areas.

vi. The latest equipment with sound-control devices should be used for sand excavation and loading/unloading, etc. Use of exhaust silencers and optimized acoustical pipe lagging (acoustical wrapping) to minimize compressor noise.

vii. No mining should be carried out during the rainy season to minimize impact on aquatic life.

viii. Annual bio-monitoring of roadside plants exposed to vehicular pollution should be done to check the dust load and Air Pollution Tolerance Index (APTI).

ix. The conservation plan should be prepared along with budgetary provision to implement effectively and should be supervised by Forest Officials.

Shelter Belt Development (SBD)

A shelter belt should be developed along the boundary/periphery of the mining lease area. The area for shelter belt plantation consists of undisturbed soil; hence plantation could be made as in any garden or road side plantation. Shelter belt should erect not from biodiversity conservation point of view but is basically developed as a screen to check the spread of dust pollution. A shelter belt, 7.5m in width should be developed around the core zone. Shelter belt plantation should be started with the beginning of the mining and should be completed within five years from the beginning. Following precaution should be taken:

- To raise seedlings for plantation in the shelter belt a nursery should be developed.
- Seedlings of only local species, suitable for shelter belt plantation should be raised in this nursery.
- All the representative plant species of the region were found to grow in and around the study site.
- Care should be provided against grazing and browsing.
- Timely watering during the initial stages of survival and provision should be made for the allocation of funds as well.
- During the running of mine, flora should be regenerated in different stages and the area having matured. Afforestation should be properly fenced so as to avoid cutting, browsing and hacking of branches and pruning of trees
- Creating awareness among villagers residing on the periphery of the mines regarding the use of plantations.
- Plantation of indigenous species, fodder and fruit bearing tree species which can also act as habitats for wild life.
- Plantation of fruits bearing trees like Karonda, Zizyphus, Awala, Gular, Aam and other Ficus species will attract birds.
- For increasing hare population turfing on the ground on both sides of nallahs by grasses should provide a suitable habitat which is most sought food for hares.

Afforestation Plan

Under the afforestation plan, plantation in nearby villages and connecting roads should be undertaken. The implementation for development of shelter belt should be of paramount importance as it will not only add up as an aesthetic feature but will also act as a pollution sink. The species to be grown in the areas should be dust tolerant and fast growing species so that a permanent shelter belt is created. Plantation in the barrier zone and roads is necessary as these areas will contain fine particulates resulting from mining operation and vehicle movement. Mining activities should not cause any harm to riparian vegetation cover as the working should not extend beyond the offset left against the banks in the river. Land on both sides is the private agriculture land. Link road from the active zone pass through the areas. It is proposed to have plantation on both sides of the roads as shelter belt to provide cover against dust dissemination. River banks should be strengthened by way of plantation on the banks. Plantation should also be carried out as social forestry programme in villages, school and the areas allocated by the Panchayat/State

authorities. Native plants like Neem, Mango and other native species should be planted. A suitable combination of trees that can grow fast and also have good leaf cover shall be adopted to develop the shelterbelt (Kumar and Eledath, 2015).

Table 13. List of Species for Plantation

S.No.	Scientific Name	Common Name	Type	Effective in Control
1.	*Azadirachta indica*	Neem	Tree	Dust, Air Pollution, Noise pollution
2.	*Bauhinia variegata*	Kachnar	Tree	Dust
3.	*Tamarindus indica*	Imli	Tree	Air Pollution
4.	*Zizyphus mauritiana*	Ber	Tree	Air Pollution
5.	*Aegle marmelos*	Bel	Tree	Air Pollution, Noise Pollution
6.	*Polyalthia longifolia*	Ashok	Tree	Dust, Air Pollution
7.	*Ficus glomerata*	Gular	Tree	Dust, Air Pollution, Noise Pollution
8.	*Acacia nilotica*	Babool	Tree	Air Pollution
9.	*Mangifera indica*	Mango	Tree	Dust, Air Pollution, Noise Pollution

Source: Guidelines for Greenbelt Development, CPCB, March, 2000.

CONCLUSION

The sand mining area having some protected forest within 10 Km radius. Total 53 villages of District Sikar, 11 villages of District Jaipur, 11 villages of District Jhunjhunu and 13 villages of Mahendragarh (Haryana) were surveyed for presence of wildlife around the mining area. Peacock and Indian monitor are protected under schedule –I of Indian Wildlife Protection Act 1972. The schedule –I fauna should be protected *in situ*. Afforestation is the major activity by which wildlife can be protected. Some other activities such as development of shelterbelt, establishing tree grooves, strategic water holes and regular filling of water, pasture land development, awareness among local people for importance of wildlife, etc. can be milestone to protect the wildlife *in situ.*

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