

Biodiversity & Livelihood:

A case study of *Prosopis juliflora* in Ajmer

**Society for Promotion of Wastelands
Development**

Report Submitted by

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Biodiversity & Livelihood- a case study of *Prosopis juliflora* in Ajmer

***Siyale Khatu bhalo, Unale Ajmer,
Nageeno nit hi bhalo, Sawan Bikaner.***

(Winter is enjoyable at Khatu and the summer at Ajmer; it is pleasant in Nagaur almost throughout the year; while the rains look lovelier at Bikaner)

Introduction

The Aravalli range stretches about 615 km from south-west Gujarat through Rajasthan, Haryana and Delhi. Due to its unique location vis-a-vis the South-West monsoon, the Aravalli acts as a rainfall divide. In the East, the rainfall is above 500 mm while in the West it is below 500 mm (SPWD, map attached). It covers an area of about 50,000 sq km and acts as a barrier against advancement of desert to the east, thereby protecting the Indo-Gangetic plains. Due to its geographical location, the range harbours a mix of Saharian, Ethiopian, peninsular, oriental and even Malayan elements of flora and fauna. In the early part of this century, the Aravallis were well wooded. Due to deforestation and subsequent afforestation with *Prosopis* there have been significant changes in the ecological system of Ajmer which are the objectives of the the present study.

The present study was conducted in Ajmer district, which is part of Central Aravallis in Rajasthan. The Central Aravalli range may further be subdivided into two geomorphic units: (1) the Sambhar basin or Shekahwati low hills: the landscape of this region is marked by sand hills and low depressions with inland drainage. (2) The Merwara hills: appear in the parallel succession of hills in the vicinity of Ajmer city which itself is situated on a plateau (625-800 m) marking the highest point on the northern plain from Kukra, a succession of hills and valleys where they imperceptibly merge into the Mewar hills (R.L.Singh, 1971).



This report also presents an assessment of the livelihood effects and local perceptions of the invasive tree species, *Prosopis juliflora*. In 2004 it was rated one of the world's top 100 least wanted species (Invasive Species Specialist Group of the IUCN, 2004). The study began with two presumptions: first, that the invasion resulted in clear winners and losers among the local population (vegetation); and second, how the local community is currently adapting to the invasion and whether it can be turned into a significant resource for the local population. The primary study and field work is being done by Vishnu Sharma and Dr. Ramkumar Rbendapudi. This study is in conjunction as a parallel biodiversity study (including ecological study of the *P.juliflora* invasion and its impacts). The study documents the history of that introduction, establishes how *P.juliflora* affects the livelihoods in the area, and how these affects are distributed across different categories in society. The Singhadiya case provides significant details related to introduction of this species, its benefits and negative impacts. Ajmer district falls in two agro-ecological zones of Rajasthan, 2.3 and 4.2. Zone 2.3 covers around 25-30 % area and zone 4.2 covers around 70% area of the district.

Most of the area of Ajmer district under study comes under the semi-arid and arid climate (Salemad). The climate of Ajmer district varies from arid to sub-humid. The district is largely a semi-arid and the climate is characterized by:

- Low rainfall with limited rainy days and erratic distribution (Kharwa has no experience of good rain for last 10 years,
- High level of diurnal and annual temperatures,
- High wind velocity leading to rapid loss of soil moisture and thus soil erosion (images)

The forest area in Ajmer is distributed across different landscape types, which in turn have shaped the ecological diversity of the region. Several major types of ecosystems and distinct transitional eco-tones are evident in the district. Grassland, thorn forest and scrublands are the major productive terrestrial ecosystems, while wetlands, rivers and tanks (village ponds) are providing habitat for aquatic vegetation and dependant fauna.

Based on the vegetation assessment and forest types, Champion and Seth (1968) have identified about 11 different forest types from Ajmer district as shown in Table 1.

Table 1: Forest types in Ajmer district	
No.	Forest types
1	5A/C ₃ - Southern Dry Mixed Deciduous Forest
2	5B/E ₃ - Babul Forest
3	5B/E _{8b} - Babul Savannah

4	5A/E8 _c - <i>Salvadora-Tamarix</i> Scrub
5	6B/C ₁ - Desert Thorn Forest
6	6B/DS ₁ - <i>Zizyphus</i> Scrub
7	6B/DS ₂ - Tropical <i>Euphorbia</i> Scrub
8	6B/E ₁ - <i>Euphorbia</i> Scrub
9	6B/E ₂ - <i>Acacia senegal</i> Forest
10	6B/E ₄ - <i>Salvadora</i> Scrub
11	6B/DS ₁ - <i>Cassia auriculata</i> Scrub

As shown in the above table district Ajmer supports a wide range of habitats, which in turn harbour good assemblage of the faunal diversity, including rare and endangered animals, birds and plant species. Some of the plants, avi-faunal and mammal species are habitat specific and recorded in certain pockets of the district (observation as well as from local people). To ensure the conservation of the floral and faunal species, few protected/reserved areas have been notified in the region. Todgarh-Raoli Sanctuary, is created for the protection of the only remaining mix deciduous forest ecosystem in the southern part of the district. Total forest area of the sanctuary is 495.27 sq km. The geographical area of the sanctuary is spread in three revenue districts of Rajsamand, Pali and Ajmer. Adding more to its significance it forms a dividing line between two major watersheds of the country. The water of rains of the western side falls into Arabian Sea through river Luni. Water which is falling on eastern slopes is carried by various tributaries of Banas River and the Banas ultimately joins river Chambal and Chambal drain outs water into Bay of Bengal after joining the River Ganges. The site is a junction of three cultures of Mewar, Marwar and Merwara.

Nagpahad, in Pushkar, is approximately 10 km long and as its name suggest is a serpent like ridge. The local flora on the ridge includes large beds of ferns and bryophytes, supporting wild animals like, Common langur, Rhesus macaque, Sambhar, rodents, birds, reptiles, insects, etc. The village Ramsar has good vegetation cover and the adjoining grasslands provide a favorable habitat for breeding and feeding for the Great Indian Bustard (*Ardeotis nigriceps*), a globally threatened bird.

A. Reconnaissance survey

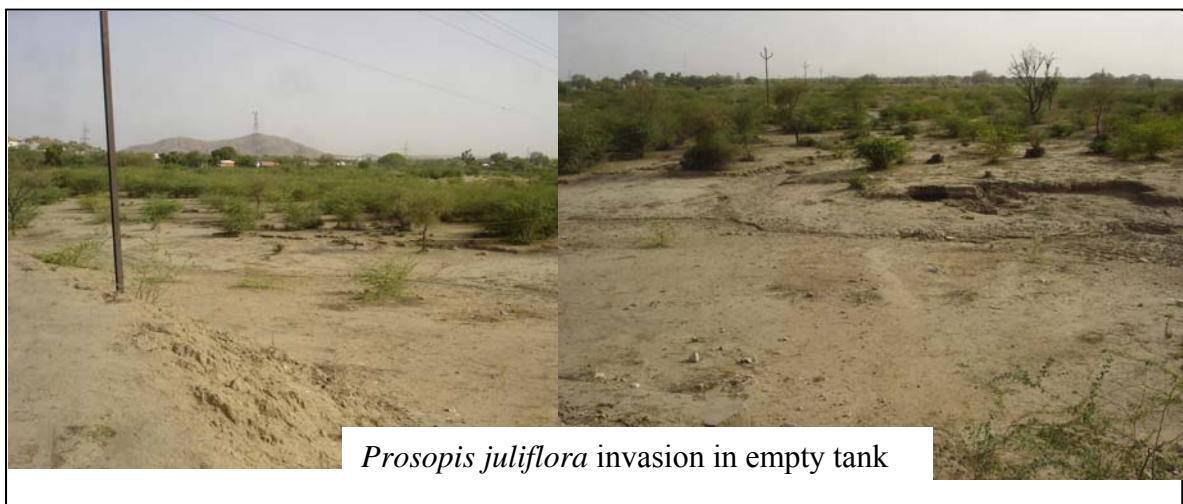
Parallel to collecting baseline information through literature survey and secondary information from concerned departments, a rapid assessment of vegetation was carried out to identify the important areas for detailed study.

A study was undertaken on BD (biodiversity) and LH (livelihood); *Prosopis juliflora* being the dominant species has been taken as main component of BD to understand its

various implications. The objective of the study is to understand *Prosopis*, its status, its value, negative impacts; promotion history and its invasion in the district, its management with special reference to LH (see objectives of the study). *Prosopis juliflora* is not an indigenous species to India and the subcontinent (*Prosopis cineraria* – Khejri is indigenous to India and can be seen in agricultural fields in the arid dryland tracts of India). It was promoted and planted on a large scale in different parts of the country about 80-90 years ago. It was considered a very good as a fuel wood; to facilitate increase of green cover and to act as a biological barrier for stopping the expansion of the desert expansion. All three dimensions have successfully taken place to some extent. Within this period, large forest patches have been covered. However in its wake, fallow lands, tanks and river-beds have also been infested (where the water availability is not regular or there is no water), village backyards, etc.

It is therefore important to study this species and at the same time it is also important to look at similar experiences of *Prosopis juliflora*-stories (its problems and management) in other parts of the world, as this Mexican species was promoted in many countries like India.

The life form of *Prosopis juliflora* is basically a tree but in India, it has survived and expanded mainly in the form of a bush, this has not allowed other species to come and grow. It is also a very adaptive kind of species and can grow in almost all kind of soils, all kind of water conditions (high water level to less water areas). In this way it has not only established in our wild areas but invaded even the agricultural fields, where it has replaced many indigenous and endemic species. Many studies demonstrate how *Prosopis juliflora* has changed species associations, ecosystems, habitats and thus changed the flora and also the fauna of the area as faunal species (birds, mammals, insects, etc.) are dependent on vegetation.



Before going ahead we need to take a look at the natural history of Ajmer district.

- Ajmer is the transition zone of North Alwar-Jaipur vegetation types and South Udaipur vegetation type. Ajmer and Todgarh-Ravli areas together are known as Merwada (a forest officer¹ from British Govt was deputed to make a management plan for Merwara as it was an important area for vegetation supporting many game and domesticated animals).

- The forests of the region were historically of dense mixed forest type of vegetation. Todgarh-Ravli forest is the now the only representative of that historical dense forest in the region. This is very similar to Kumbhalgarh forest (of Southern Aravalli type). Nagpahad is today open and barren, which had mixed forest with many climax species and many wild animal species like the Red-Spur Fowl (Sambhar also exists today, status unknown). It was degraded due to many reasons.

- Natural changes in ecology, is a slow process. Introduction of new species in the wild can happen only after destruction of the existing ecosystem². Forests were cut for many reasons. *Prosopis juliflora* was promoted in some parts of forest/ foot hills but grazing animals (like goats) played a key role in seed dispersal in other 'virgin' areas (which did not have any invasive species). As they eat the pods and the seeds treated by the digestive tract of the goat germinate faster. Other than this, rain fall (no. of rainy days) decreased, which increased aridity in the area and resulted in changed soil conditions. All these factors were responsible for the decline of local flora where the indigenous species were not able to germinate and grow easily (it is possible that some endemic and indigenous species got extinct, a detailed study is required to know the status).

- The district was having good resource of gold-blades i.e. very good large grasslands, which were supporting many key species like the big cat Cheetah, Caracal, Great Indian Bustard (GIB), Houbara Bustard, Lesser Florican, Sambhar, Chinkara, Blackbuck, Gray Jungle Fowl, etc. Today GIB is existing in the area (like Ramsar village) in very few numbers.

- People used to keep Cheetah³ as pets (there are records of old photographs showing it as a macho symbol); such captivity highly decreased their numbers (in captivity Cheetah can not do breeding). Other than this, Chinkara and Blackbucks were killed as 'shikar' and

¹ Name of the officer ? This management plan is with the current respective division, can provide detail and important historical status of the area.

² If the forest is dense, the existing indigenous species do not allow new species as this new species can not compete with other species. Once forest destruction takes place, the new species if able to manage the new conditions, able to grow and increase its cover.

³ Lion and Tiger are also big cats and they have nature to attack. Cheetah is running at 80km/hr but do not have such an aggressive nature and was easy to capture and rear as pets (pers. com. Dr.SK Sharma, 2009)

decreased in the area, which were the prey of Cheetah. All these resulted in Cheetah getting extinct from the area.

This is a snapshot of history which has many glimpses of how destruction and extinction took place resulting in a change in the ecology of the area. The Todgarh-Raoli forest study can provide many insights which can help to prepare an ecological restoration and management plan.

During the recon survey different river basin parts (Luni, Neran) and tanks with and without agriculture (peta-kasht) were visited. It was observed that:

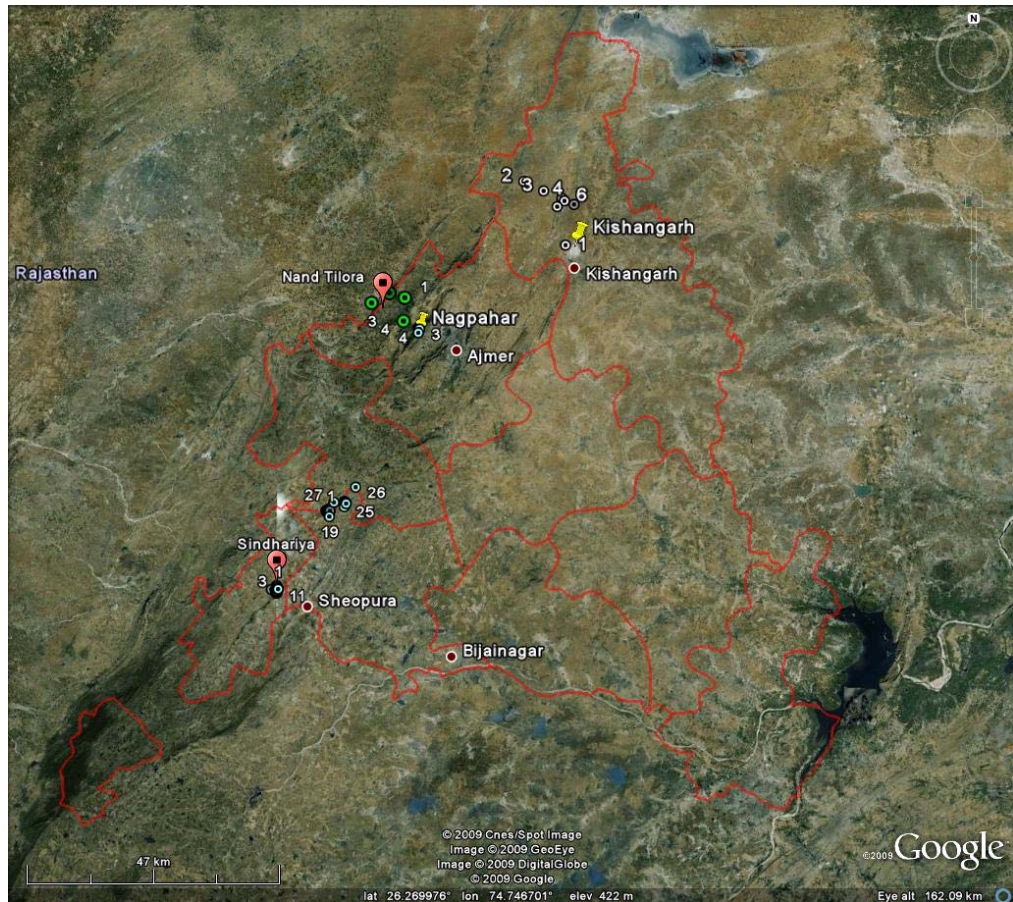
- There is high aridity (like the region Kachchh) and some parts of the area are having saline soil and related vegetation like *Fagonia indica*.
- large area has *Prosopis juliflora* invasion
- Mixed forests still exist in some places albeit with *Prosopis juliflora* dominance (Shrinagar, Mangaliyawas, Kharwa, etc.). Kundal area for instance has a good indigenous species cover.
- Agriculture is going on in some tanks but many dry tanks are completely cover with *Prosopis juliflora*.
- From the nature of species observed and aridity indicators, it was felt that the role of the Aravallis as an active ecological barrier in the district has been significantly reduced. How Aravallis acted as a barrier earlier has to be studied from the literature available so as to understand how the role has changed.
- To understand ecological change and climate change, phenological study will be important.
- The local people are linking their knowledge with the surrounding ecology and biodiversity (*Dival* – an *Agaricus* sp. was layered with oil and burned, which was burning and lighting for long time. Now there is electricity in villages and people do not go for this traditional technique – pers.com. Sh Kishansinghji of village Singhadiya, block Jawaja). It will be good to document the traditional knowledge for better management strategy development (old knowledge + new technology).
- During the recon survey some wild and domestic species were observed (64 species are wild and 19 domesticated),
- Other than plants, 15 bird species were reported in the field. Birds like Myna (three species seen), Red-vented Bulbul, Parakeets (three known species from the state), which are helpful to forest for seed dispersal were observed in the area.

- Maximum wild species belong to family Mimosaceae, which is the predominant family of arid and dry deciduous forest. Species like, *Fagonia indica* is an indicator of saline soil condition. *Commiphora wightii* grows in dry-rocky areas. During the survey, it was observed that this species is spread in very small patches in Kharwa hill belt (Pipalaj-Kharwa and Kharwa forest blocks), with large numbers of *Euphorbia caducifolia* and dominance of *Prosopis juliflora*. Forest dept. is doing plantation of *C.wightii* (cuttings raised in nursery, Kharwa) in the forest area without removal of *P.juliflora* (survival of these plantation is questionable).
- It is very important to know why farmers allowed *Prosopis juliflora* to cover the tanks. If today they are not able to do agriculture in their tank *pattas*, how is the *Propospis* harvested and who benefits from it?



Petakasht in the way to Beawar to Ajmer. The status of petakasht is very poor in maximum areas of Ajmer.

- *Prosopis* is a bigger sized plant and is easy to notice; what about *Lantana* and *Parthenium* (consider toxic sp.) which have similar nature like *Prosopis*, even then remain unnoticeable. These all sp. are invasive in nature in the area so it is important to understand their impacts. *Cassia tora* is also reported in the area, its status and vegetation cover is important to understand degradation in the area.
- Invasive species are harmful for the local flora so it is important to make strategy for all invasive sp. and related livelihood options.



To know the status and function of floral and faunal diversity detailed study is necessary in the area.

B. Detail study/ survey

Methodology Followed:

(a) Literature Search

The work on the project was started with the compilation of existing published and unpublished literature on the district. To accomplish this, wherever possible, visits were done to different libraries of universities and institutions. In addition, communication to

different institutions and individuals were made in order to collect the published literature.

(b) Biodiversity Study

Based on the discussion with team members (Juned Khan, Dr. Jagdish Kumar Purohit, Jagadeesh Menon and Viren Lobo), the rapid assessment was taken up in the relatively rich forest and non-forest areas. However, while selecting forest areas, care was taken to represent variation in the forest types, landscape types (terrain) and land use type (forest, non-forest and fallow agriculture lands) to capture the plant diversity of entire study area. In such a way a total of about 3 village areas (Singhadiya, Kharwa, Ralawatan) and two forest areas- part of extreme eastern Aravalli ridge (Nagpahad, Nandtilora) were selected to understand in the entire district (Table 3).

In such a way five areas were surveyed and informal discussions were carried out with the villages to identify some “key persons” having knowledge on the area.

Within each study area, a number of vegetation parameters such as name of plant species, habit, and status of anthropogenic pressures were recorded. The geographical location of each area was recorded with the help of GPS. The identification of plant species was done with the help of existing published work in the form of floras (e.g. Kirtikar *et al.*, 1933; Bhandari, 1978; Shah, 1978; Blatter & McCann 1984).

General Observations:

(a) Floral Checklist

District Ajmer is quite rich in plant diversity. Through the present study 178 plant species were recorded while moving from one forest to another or from pasturelands, open forest plots, cultivated fields and roadsides (*Annexure 1: floral checklist*). Of the total 178 plants recorded in the present study, 23 species were recorded from the cultivated fields, while the rest 155 were recorded from wild habitats. The taxonomic analysis presented in this report is based on the 178 plant species, which dose not mean of the complete flora of the region. Of the total 178 species, 170 were Angiosperm and 8 species were from lower taxa including, Thalophyta - fungi (2), Bryophytes (2), Pteridophytes (3) and Gymnosperm (1).

i) Habit and family wise distribution

Habit wise distribution of 178 plant species is presented in Table 2. Almost 34% (56) of total plants were recorded under herb category, followed by trees (52). Of the total listing of plants about 14 species of grasses were also recorded from the study area.

Table 2 : Habit wise distribution of plants across taxa and habit class

No	Taxa	Habit	No. of species
1	Angiosperm	Herb	56
2		Grass	14
3		Climber	7
4		Twiner	6
5		Under shrub	5
6		Shrub	30
7		Tree	52
8	Gymnosperm	Climbing shrub	1
9	Pteridophyte	Herb	3
10	Bryophyte	Herb	2
11	Fungi	Herb	2
	Total		178

All the plants listed from the surveyed areas belong to 82 families. Of the total families, highest number of plants was recorded in family Poaceae with 14 species. Among others, Fabaceae (11), Mimosaceae (9), Euphorbiaceae, (6), Caesalpiniaceae (5) and Cucurbitaceae (5) were dominant families from species richness point of view.

According to the ocular observations on abundance and dominance of species, it was noticed that family Mimosaceae (all thorny members) is the dominant family, which is one of the main element of scrub and thorn forest. Species of this family are evergreen and provide good fuelwood (*Prosopis juliflora*), small timber (*Acacia nilotica*), gum (*Prosopis*, *Acacia*) and food source (*Prosopis cineraria*- Sangari).

All the grasses belong to the family Poaceae. Due to lack of water, grasses are not available for the whole year in the field. In the current scenario, the district does not have good grasslands/ pasturelands in comparison to its historical status. Few patches existing in the region are not sufficient for the fodder security of the entire livestock population of the district. Crop residues are the other source of fodder from agriculture fields. Since animal husbandry is a major livelihood (among agriculture, mining, industry, landless labour), it is very important to do a detailed ecological and agrostological study in the region (the current study gives an account of only 14 grass species).

ii) Overall Vegetation

The vegetation of Ajmer district is diverse. The major associations were reported from the

region were:

- *Anogeissus pendula-Boswellia serrata* type: in Kharwa, Nagpahad
- *Acacia-Capparis* type: Tilora, Badi Ghati
- *Prosopis cineraria - Capparis decidua - Zizyphus - Salvadoria* type: in Ralawatan border, Tityari, Salemabad, Badi Ghati (*Prosopis cineraria*: light demander grows in sandy soil, *Capparis decidua*: grows in gravelly area, *Zizyphus*: light demander, *Salvadora*: grows in saline area)
- *Cenchrus – Crotolaria burhia*: on Sand dunes (Pioneer association) in Tilora, Killa, Badi Ghati, Pushkar area, Salemabad, passage of Nandtilora ridge after Salemabad
- *Calligonum polygonoides* (Phog) stabilizes the sand dunes and prevents soil erosion is a woody plant of extreme xeric environment, reported from the border of the district towards Nagaur. *C.polygonoides* was found with *Leptadenia pyrotechnica* (Khip). This association represents extreme arid conditions. It is important to notice that this location is about 25 km from Nagpahad area, where moisture loving species are found with good ground cover in the same season (time).
- Agriculture and orchards also comprise a rich diversity of domestic plant species including vegetables, grains, pulses, fruits and flower species for commercial purposes.

The vegetation consists of dwarf grasses interspersed with few characteristic desert species, therefore xerophytic in character and shows various xeromorphic features like deep root, dry, hard and rod-like thick or fleshy stems; spines and indumentum well-developed; leaves either caducus (Ker, Khip, *Ephedra*) or much reduced (*Acacia*, *Prosopis*, *Cassia*) or modified into spines/thorns.

Local flora of the area is highly affected by alien species. *Prosopis juliflora*, once which was introduced in the area for fuel wood and as biological barrier (desert intensification). Along the years, due to high deforestation in Aravalli, the important factors for vegetation like, temperature, water availability (rainfall- number of rainy days) are changed in terms of high aridity and less numbers of rainy days. Also extensive mining and industrial development in the Aravalli also affected the indigenous vegetation. *P.juliflora* is highly adaptive species and able to grow in poor soils or dry adverse climate conditions in the area. But the local indigenous species are not able to regenerate and grow fast as they

were earlier. Hence, the local species could not increase their cover and *P.juliflora* became dominant and invaded large areas of forests, pasturelands, open tanks, agriculture fields (which remained fallow due to lack of rain for long period).

The unusually heavy biotic pressure in the region has resulted in reduced regenerative capacity of various floral species leading to loss of biodiversity. The slow growing and non coppicing species have been affected most and have slowly been localized to smaller pockets or have diminished.

(b) Fauna Checklist

Presence of fauna is typical to the vegetation type of the area. A total of 68 animal species were reported from the surveyed areas (*Annexure 2: Fauna checklist*), hence, this list is incomplete and needs more efforts to get a detailed account of the fauna of the district. Out of 68 species, 13 species are of mammals and 45 species are of birds. Among the other group, reptiles (2), butterflies (4) and Grasshoppers (2) were also reported. The Velvet Red Mite was also seen after the first shower.

The variety of birds inhabiting the area range from land birds to water birds. The multistoreyed forests of Nagpahad and Todgarh-Raoli Sanctuary having different types of fruit species, grasses and varied microenvironments inhabiting insects etc. form suitable habitat for various birds. Large Grey Babbler was reported very common in the area. Colonial mud nest of Streak breasted Swallow and House Swift were also reported at the fort of Kharwa. Brown Rock-Chat prefers dry stony pockets which is endemic to India was reported at Nagpahad (its status is unknown and need to study more).

Among the mammals maximum species are herbivores and hence directly dependant on the plant species for food and other purposes. The current situation of the forest in the area is very poor in terms of local species regeneration and vegetation cover due to change in climatic conditions and dominance of invasive species. This has resulted in the food scarcity for the wild herbivores and increased problem of agriculture crop damage by these animals for their food. Not only in the district Ajmer, but this is a burning issue of human-wildlife conflict all over the state.

Case studies from Ajmer:

Objective of the study:

The above details give an account on resources and problems in Aravallis of Ajmer district. The following case studies are a small attempt to understand these issues around different parts of Ajmer.

Three villages and two forest ridges were selected on the base of different criteria shown in the table # to understand the status of *Prosopis juliflora* and to develop some strategy for it. They are however not sufficient to understand the other aspects of natural resources and biodiversity and related inter linkages.

No.	Study area	Selection criteria
1.	Singhadiya	Grassland, <i>Prosopis</i> promotion, <i>Prosopis</i> invasion, Pastureland developed by village institution
2.	Kharwa	Mix deciduous forest, <i>Prosopis</i> invasion, mining, industrial area, degraded pastureland, affected agriculture, water scarcity
3.	Ralawatan	Semiarid vegetation with some arid area species presence, <i>Prosopis</i> invasion, tank – agriculture (very less <i>petakasht</i> remain), orchards under threat, mining, changing water pereniality
4.	Nagpahad	Mix deciduous forest, Hilly Scrub, Grassland, soil erosion, very near to desert boundary (approx. 25 km)
	Nandtilora	Mix thorn forest, increasing areas of sand dunes, sand dune prefer species association, high aridity, arid species association

1. Singhadiya:

a) Location:

Singhariya village is situated in Jawaja block of Ajmer district. There is no forest area of this village. Two types of pasturelands were observed- protected pastureland (plot A, B, C) and unprotected community pastureland (high encroachment area).

b) History

Around 25 years ago SPWD provided technical and financial support to the local NGO- MMVS for promotion of *P.juliflora* in Singhariya for fuelwood needs. With the help of villagers (village development committee), MMVS started this work with the common pastureland-a barren plot. The VDC raised nursery of *P.juliflora*

along with other species (Neem, Salar, etc.) and planted them in suggested plots. At that time, *P.juliflora* was welcomed as a field boundary marker/ biological fencing for protection purposes and helped avert a significant fuel wood shortage. Peoples' perceptions changed later as the negative effects of the invasion - colonization of village pasture land⁴, its sharp thorns, suppression of grasses and crops (near boundary of *P.juliflora* in farm) – became more pronounced.

c) Survey – Map

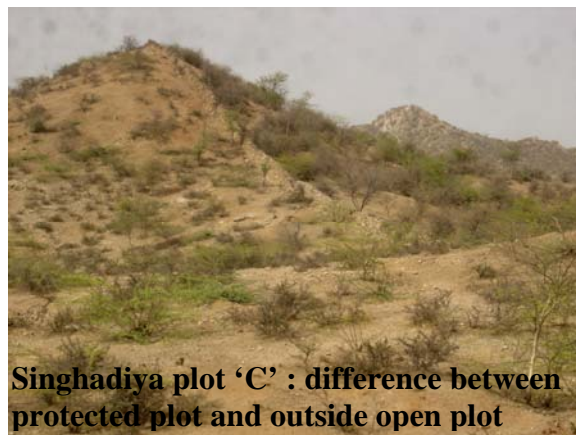


d) Observations

Among the three community-developed plots, plot 'A' is highly rich in terms of plant diversity and bird diversity. It is well treated and managed. Plot 'C' is comparatively low in terms of diversity of plants. More numbers of *P.juliflora* is observed in plot 'C'.

⁴ farmers did not allow its introduction in agriculture fields and regular removal helped to protect their farms from the invasion problem

Pellets of Nilgai also reported frequently in both the plots as they are rich in food resource in comparison to the adjoining Atitmand forest. Red Vented Bulbul and Small Minivet birds are very common in these plots. Plot 'B' is developed for fuel wood i.e. has maximum cover of *P.juliflora*.



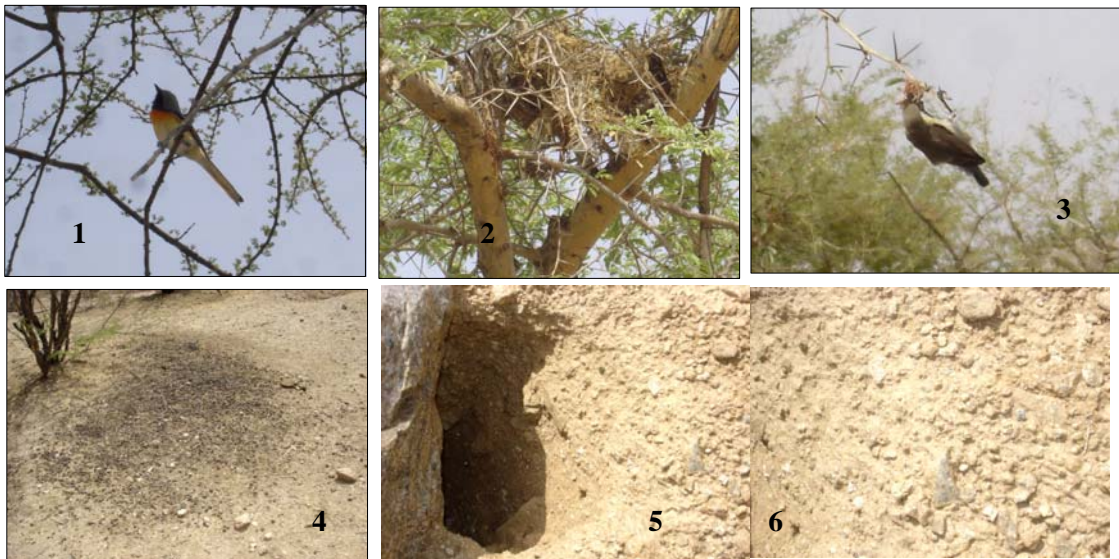
The diversity and number of plant species (according to the 2006-07 censuses) are shown in the table 4.

Sr.	Name of species	Plot 'A'	Plot 'B'	Plot 'C'
1	Deshi Babool	92		137
2	Iseraily Babool	263		5
3	Aronz	330		403
4	Ber	52		19
5	Neem	4		79
6	Khejadi	80		71
7	Khair	121		38
8	Subabool	41		3
9	Kalensi	157		46
10	Jungle-Jalebi	1		
11	Thor	96	8	158
12	Ker	6	5	7
13	Kumath	26		
14	Palash	7	3	
15	Jhinja	3		3
16	Dasan	574	574	8650
17	Dhonkada			5
18	Salar			4
19	<i>Prosopis juliflora</i>	148	380	165

Agriculture and livestock rearing are the main livelihoods of the village. Since the village has no forest, their fuel wood, fodder and other forest-based requirements are coming from these plots. According to the villagers, there is no regular rain and so grasses are not growing in the plots and other parts of common pastureland of village

(grass available for around three months/year only). For their livestock they are dependent on fodder providing trees existing in plots and their agriculture residues.

Biodiversity of Singhadiya:



1: Small Minivet

2: Nest of Indian Silverbill/ Whitethroated Munia

3: Purple Sunbird (female)

4: Droppings of Nilgay in Sindhadiya plot 'A'

5: Digging by some member of family Canidae

6: Scratch marks made by some wild animal in pursuit of digging

e) Institutional issues

The major landuse of this village are agriculture land and common pasture land. The village population has increased within past few years and therefore villagers want land for habitation expansion. As most of the area comes under the category culturable-waste, it is not easy for the local panchayat to allot land for this and this has increased illegal encroachments in the common pasture land.



Photographs showing high encroachment in common pasture land, Singhadiya.

It was felt that the exit policy (by MMVS and SPWD) was very poor or not clear to the villagers (VDC) after the development and maturity of the developed plots. The VDC generated revenue from these plots from the selling of dry woods, dead trees, wood of over covered *Prosopis juliflora*. According to the VDC members (Mishrusinghji, Kishansinghji) the revenue came from the plots has been used in other works in village like construction of temple but not for the plots properly. The VDC later handed over the protected plots to the local Panchayat to use NREGA funds. Now these plots do not have a proper management system. It is assumed that (in people participatory NRM work) the VDC who undertakes the responsibility of any natural resource, which is developed by the outer fund or source, the VDC should regenerate fund from the same resource and do further physical activities independently. The current VDC status of Singhariya is not so sound. They are very keen to develop other plots but they are not able to generate fund from the existing resources or also not able to use the panchayat fund as it is the village of one community only but having high political issues.

With the development of plots in village, the VDC also developed socially and the VDC helped the adjoining village Rampura to develop their forest plot. But this physical intervention could not build the social strength and so the Rampura plot, did not get proper attention by the Rampura villagers.

The invasion of *P.juliflora* is high in the village areas. According to the VDC members and other villagers, only plot 'B' should remain with *P.juliflora* and other the other parts should be cleared (removal of *P.juliflora* from roots). If there is any other solution or option of use of *P.juliflora*, should be introduced in the village (other than fuel wood).



1: Singhadiya plot 'A' sharing boundary with Rampura village plot, which was also developed with the help of Singhadiya VDC

2: The treated Singhadiya plot 'A'.

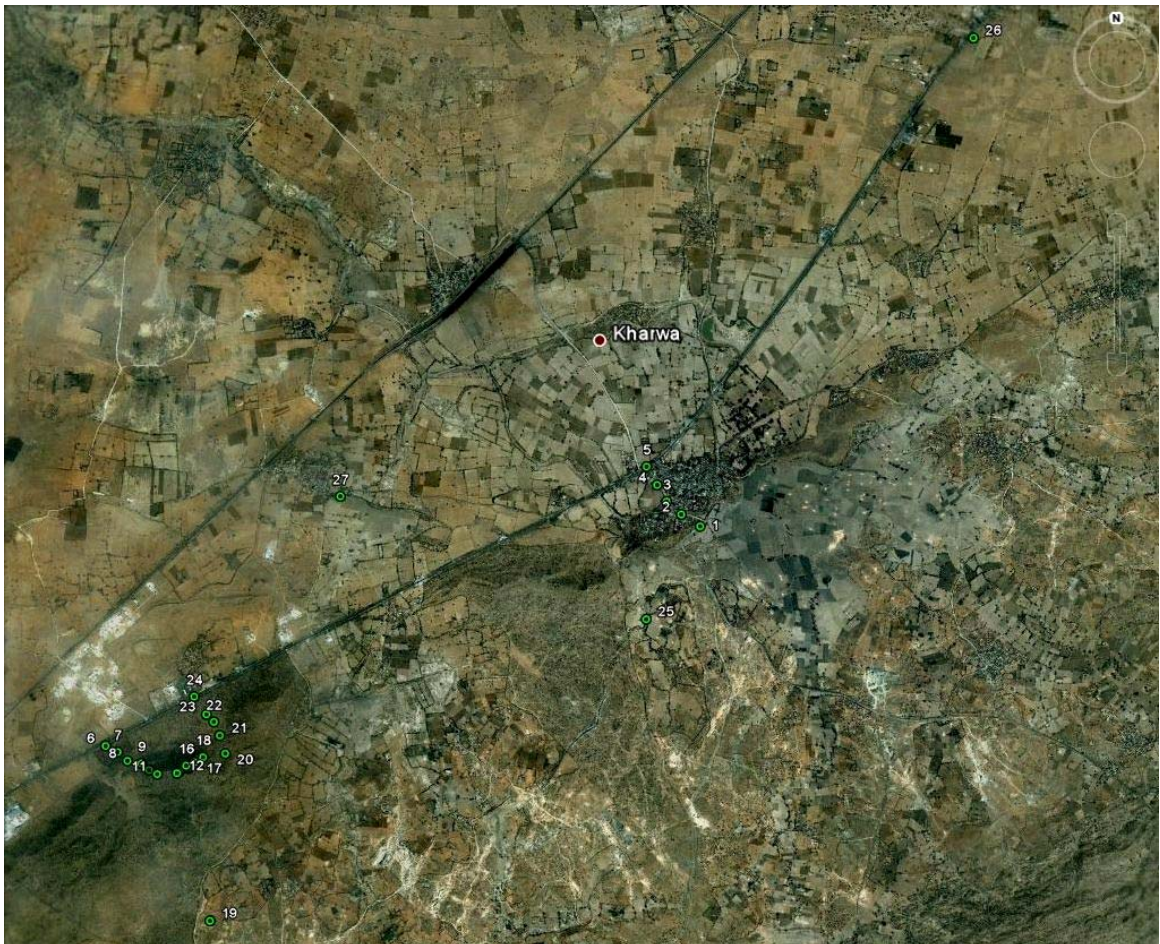
Some individuals made furniture from it but did not remain longer as the other timber woods. The member of VDC, Mishrusingh is aware of 'Akshay Urja' plant (energy generation plant), to establish an energy generation plant in the area with the help of *P.juliflora*, it is necessary to do detail phytosociological study of *P.juliflora* in the area.

2. Kharwa

a) Location

The village Kharwa is situated in Beawar block of the district and has a very sound history background. The study area Kharwa is part of the Kharwa panchayat along with the other villages Gopalsagar, Danga ka Badiya, Ranisagar and Devpura.

b) Map



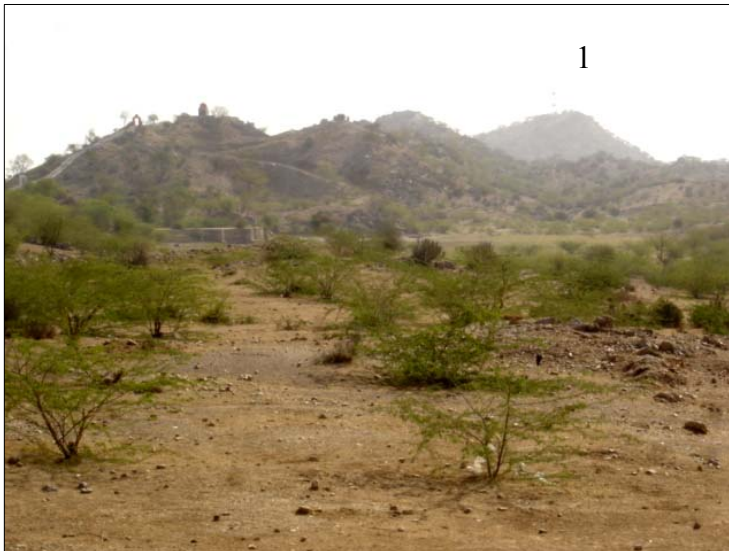
c) History

Kharwa was a '*Jageer*' and was having about 42 village association between Sojat to Mandal. The first royal family of Kharwa '*Jageer*' was established in Kharwa in the period of Mogul King Akbar. During the feudal system the forest was lush green and the pasture land were systematically protected (pers. comm. Sir Shyam Singhji, 17th generation of the royal family). Earlier they (the royal family) were hunting game animals but there was a ban on killing female and baby animals. The hunting was done

in balanced way. Two Bhil guards were placed from the king for the protection of forest, cutting of green trees was not allowed and there was a heavy fine if caught cutting the trees.. There were many perennial tanks/ village ponds in the area of the 'Jageer'. Agriculture was good as that time there was no any industry or mining in the area; mining was not allowed by the king. Animal husbandry was the key source of livelihood after agriculture. Cutting of trees began after the 'Jageer' Kharwa was merged with Ajmer district and the feudal system got replaced by democracy!! when Ajmer was merged into Rajasthan in 1956. Subsequently Kharwa panchayat was formed and the other parts of the Jageer merged in different blocks and districts.

d) Observations

The current status of forest, agriculture and animal husbandry are very poor which are the main livelihood and life supporting systems. The major landuse of the village are forest, agriculture land, pasture land, fallow land, empty ponds, mining, industries and habitation. The forest of Kharwa is in two parts and has few local plant species like Dhok, Salar, Guggul, *Euphorbia* clumps and great cover of *P.juliflora*. Leopard does not exist now in the forest.



1: Village pond- Kharwa, the royal property of Kharwa. The use right is with the village Piplaj. The empty pond is full with *P.juliflora*. this pond is sharing boundaries with Kharwa-Piplaj forest block, Piplaj Pastureland and Kharwa panchayat pastureland.

2 & 3: Industries on the border of the pond, just out side the Kharwa forest area.

The village has no experience of good rain for last ten years. The village ponds have not filled up in the last ten years and hence the wells of the area have also not got recharged. This resulted in poor agriculture as water availability is very low (many farmers sold their land to industry and today they are working as labour in the factories).



Pollution by the industries (around 400 factories between Kharwa and Beawar belt) harmed the forest, agriculture and pasture resources. Animal husbandry has also been affected due to lack of availability of fodder and water. All the livelihoods which are connected with forest, agriculture and pasture have been severely damaged and therefore there is a large dependence on industries and mining works.



A large number of mining quarries are active in different parts of the area including pasture lands and catchment areas! For the daily needs, around 15 thousand to 20 thousand workers from Kharwa and surrounding villages working in these industries and mining as daily wages, where the employment is highly insecure. Working of women and teenage girls in industries is very risky as they face numerous harassments, which in turn creates many social issues.

There is water in some wells of the village but it is saline and not useable. At present water is supplied to the area from Bisalpur for drinking purpose and is not enough for agriculture.



Photos showing poor condition of Pastureland of Kharwa

There is a drastic invasion of *P.juliflora* in pasture, fallow agriculture lands and forests. Some people have changed their livelihood from agriculture to poultry. Many agriculture fields are sold to rich people which has resulted in high rise of farm houses in the area. Such farm house developments do not support the economy of the local community. The local communities of Kharwa area are getting more and more pauperised.

e) Institutional issues

Kharwa is having two types of people from the same community. One group is highly influenced by the local politics and not ready for joining hands for preservation of the natural resources. The other group is deeply concerned about the destruction of the natural resources and are interested in its development..

Biodiversity in Kharwa forest, decreasing faster....



- 1: *Boswellia serrata*
- 2: *Asparagus racemosus*
- 3: *Commiphora wightii*
- 4: Colonial mud nest of Streak breasted Swallow
- 5: Colonial nest of House Swift
- 6: Brahminy Starling
- 7: Jackal scat
- 8: *Poeciloceris pictus*(Milk weed Grass Hopper)
- 9: Indian Garden Lizard (Male)

3. Ralawatan

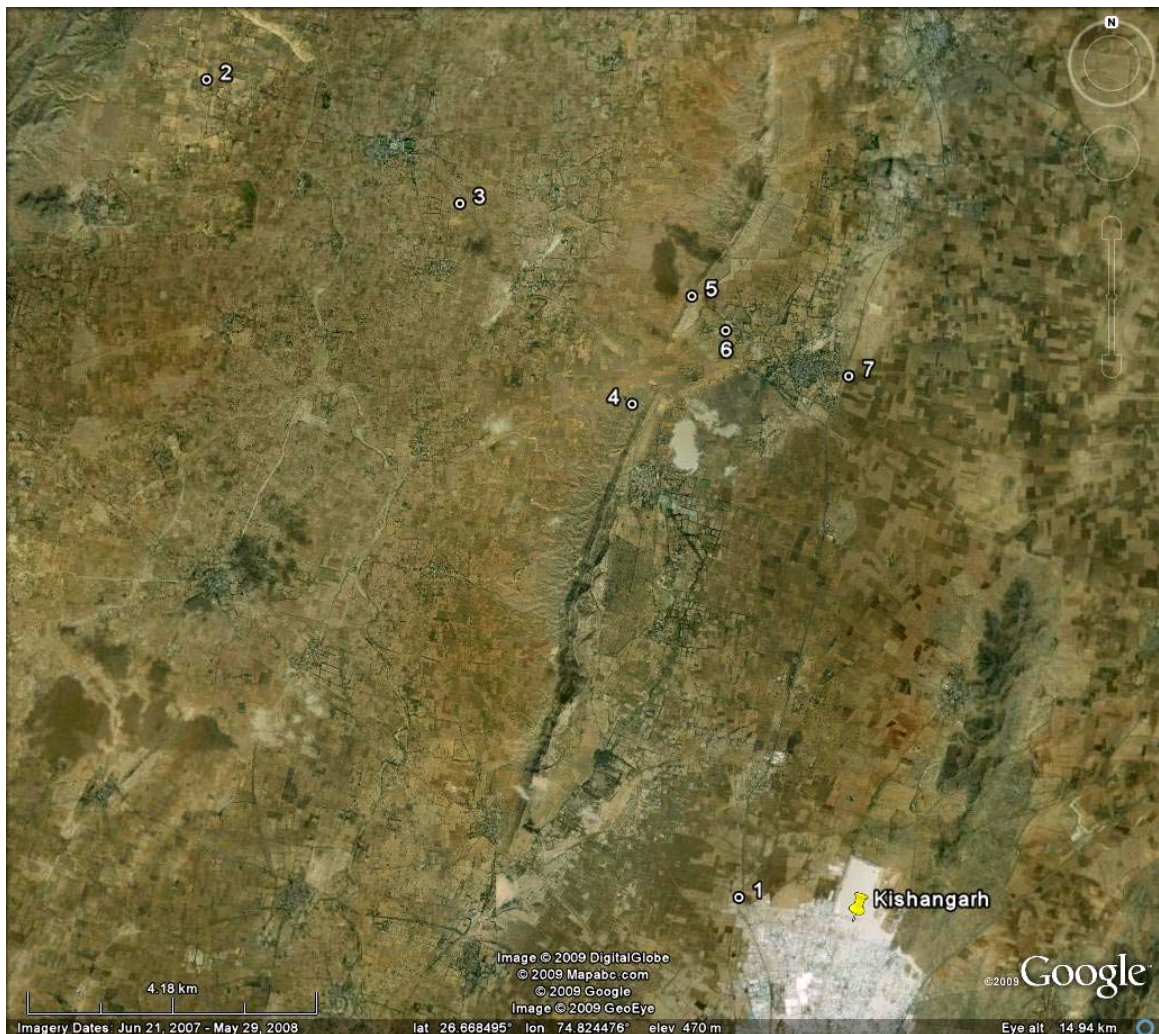
a) Location

The village Ralawatan is in Kishangarh block and is around 300 year old.

b) History

It was earlier known as 'Surajgarh' or part of Surajgarh. The villagers were changing their places many times in past so their habitation was quite unsteady (in hindi it is called, *rulta*), today where they are settled permanently, is named Ralawatan (pers. com. Sh Ghanshyam Sadavat).

c) Map



d) Observations

- Current situation of livelihood:

The village is dependent on natural resources. Forest land, pasture land, agriculture land, orchards, water bodies, habitation area are the main landuse over here.

Agriculture and animal husbandry were the main livelihoods of the village. But today, labour in agriculture and industries are the main source of earning of the village. Due to mining and high arid climate, the pastures and agriculture are highly affected. Wheat, chickpea, Pea etc. crops including kharif and Rabi were major crops in the cultivation practices. For last 20-15 years, only Rabi crops are under cultivation (only 25%) by the farmers. *Petakasht* was also very common in the village but for last 25 years it has decreased considerably. The major part of fodder also comes from crop residues. Few families purchase grass from outside, which is economically not profitable to them. About ten families in the village are doing stone mining in their own fields for earning (as they are not getting anything from their fields due to lack of water). Thirty to forty families are labouring in the nearby Rajnagar mines. More than 25 families migrated to Jaipur with their livestock for earning. The Gurjars are migrating with their small ruminants up to Agra due to insufficient fodder availability in the village. Some of these migrating people come back to the village and some of them get settled there (outside village where they migrate). Such kind of situation – migration- is happening in the village for last 25-30 years especially during the months of October to June.

- **Threatened orchards:**

Orchards are locally known as ‘*baag*’ or ‘*baug*’. Gonda, Aam, Jamun, Heena, etc. are important products of orchards and are very famous in the region. But due to scarcity of water, high aridity and invasion of *P.juliflora*, the biodiversity of the orchards are highly deteriorating.

- **Introduction of *Prosopis juliflora*:**

The forest area of the village is significantly big area but do not produce good biomass. As it is described earlier, for the same reason, *Prosopis juliflora* was introduced in the forest area. The aerial dispersal of seeds of *P.juliflora* was also done in the area. Some people grew the species as bio-fence around their farms for protection purpose. But gradually *P.juliflora* increased and within 40 years invaded 75% area including forest, pasture land, road sides and village fallow lands. It affected *petakasht* up to 70% as it established



well in village tanks and other water bodies (rivers), where there was no water income for long period.

- **Impacts of desert**

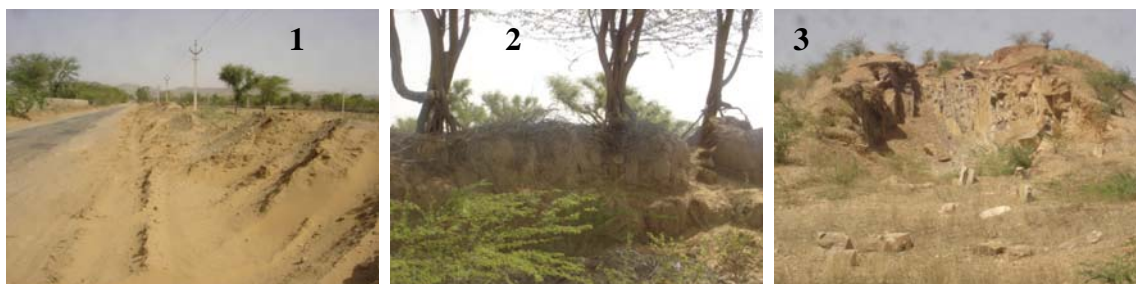
Number of the State tree Khejdi is decreasing day-by-day in the area. Generally big sized groves are not visible in this area.

However, a big Khejadi-grove exists near the pastureland of the village towards the Nagaur border-Tilora hills (photo). The Nagaur border is around 11-12 km far from the village Ralawatan. Due to the big passage in the Tilora hills⁵, the desert sand



continuously depositing from Nagaur to Ajmer areas like, Salarmaal, Salemabad, Tityari, Ralawatan and the remaining green hill parts towards Kishangarh. Since there is no dense wood cover in this border area, soil erosion is also rampant. The village Salarmaal (Salar i.e. *Boswellia serrata*, maal i.e. upland) was known for its Salar forest. Today there is no Salar trees and the desert species *Salvadora persica* is in good numbers in the area of Salarmaal.

The Salemabad nadi (river) of Salemabad is flowing near the periphery of Salarmaal, was providing water to the Ralawatan village through nallahs before 30 years. All the nallahs towards Ralawatan have been blocked due to unplanned constructions in nallah areas and the dry nallahs are dominated by *P.juliflora* (Photo). The Salemabad River which was the lifeline for Ralawatan is today flowing to Rupangarh and meets with the Rupnadi of Rupangarh.



⁵ Tilora hills: part of central Aravalli and running towards Pushkar-Nagaur border and called “Nand-Tilora” ridge.

- 1: Deposition of desert sand at roadsides and farms, near Salemabad
- 2: Soil erosion
- 3: Stone mining in forest of Ralawatan

e) Institutional issues

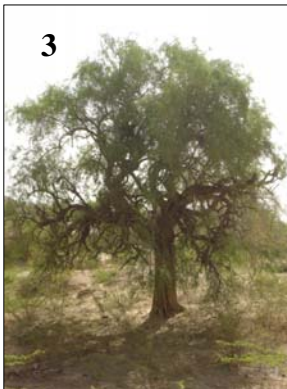
For last 40 years, the status of natural resources becomes worse. There is no significant production of NTFPs in forest. Forest areas are degraded and invaded by *P.juliflora* and not providing food security to the wild animals and hence there is no big game animals remain in the village forest.

There is no institutional work on removal of *P.juliflora* and plantation of local species in the area. The village women cut *P.juliflora* for fuel wood purpose in very non-systematic way so the species grows dichotomously (multi-branching) and can not produce a wood for making furniture.

There is no significant work on pasture lands for fodder needs. Migration has been a bitter experience for the migrants of this village. They remain far from their native; also face many hurdles like, un-natural death of animals, attacks, thieves, no fodder security guarantee, etc.

Work on a canal is going on by the local body to lift water from the Pahadi area to Ralawatan.

Biodiversity in and around Ralawatan



1: Black -shouldered Kite

2: Small Minivet (female)

3: *Salvadora oleoides*

4: A good traditional practice to protect the proproot of Banyan tree

5: *Tephrosia purpurea*

6: Pied Myna

C. 7: *Lepidagathis trinervis*

C. Study of Aravalli as ecological barrier:

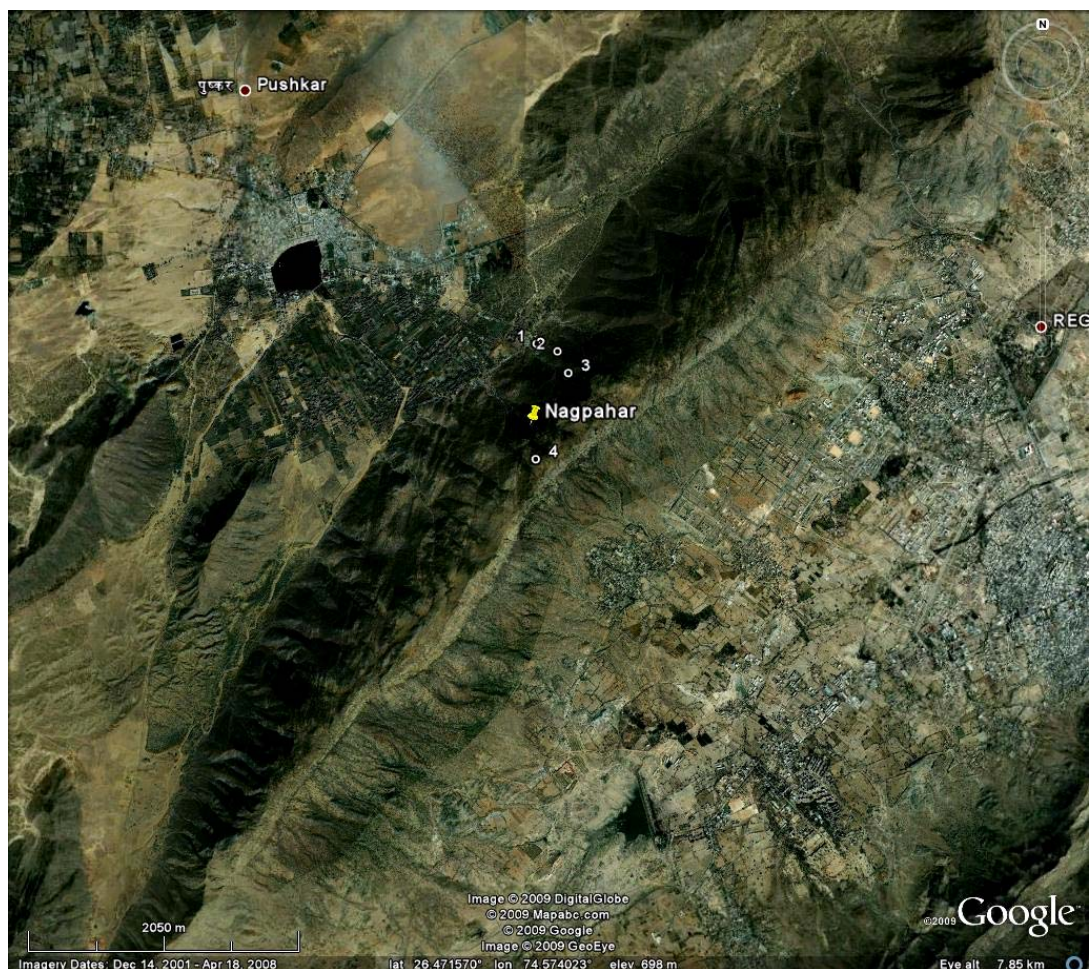
a) Study locations

The study was undertaken in two forest/ hill areas of Ajmer district are Nagpahad and Nandtilora. Nagpahad is having Northern Aravalli elements also and it is a junction of Central Aravalli - Northern Aravalli elements. Nandtilora is the extreme west border towards Nagaur, near Pushkar and is the first barrier of Central Aravalli towards the Great Indian Desert. After the Nandtilora ridge, there is no big ridge in the desert parts.

b) Detail of line transect survey and important findings from field:

1. Nagpahad:

Two line transects were laid in both the hill areas. The first transect was done in Nagpahad, which was started from the Nagkund (Yudhisthir kund) facing Pushkar site.



It is the west part of the hill and having lush green cover of local species including Baniyan tree, *Euphorbia caducifolia*, *Rhus mysurensis*, species of *Aristida* and *Chloris* grasses, Salar, Dhok, *Bauhinia*, *Vogalia*, Ferns (Photo), Bryophytes, fungi and many more floral species. Not only the flora, fauna is also well-protected in Nagpahad and some of the faunal species were also reported during transect. There is no *P.juliflora* in the west slope of Nagpahad (Pushkar facing side).



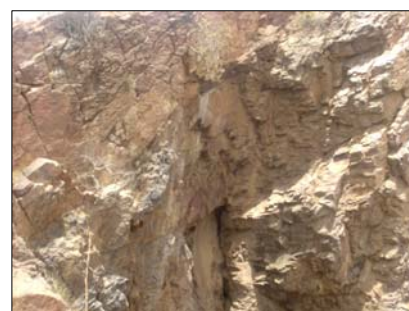
The other side of Nagpahad, which is facing

to Ajmer city area, the slope has a big cover of *P.juliflora* (Photo) and the rock weathering is more in comparison to the Pushkar facing side. The east slope of Nagpahad (facing Ajmer) has no good numbers of local species; the upper parts of the slopes are open and facing high weathering and soil erosion.



Ficus tomentosa is an element of northern Aravalli and Vindhyan, specially grows on dry vertical cliffs was reported from Nagpahad. Three fern species reported from Nagpahad, *Marsilea* sp., *Adiantum incisum* and *Actinopteris radiata* which are considered as dry zone ferns. Brown Rock-Chat prefers dry stony pockets which is endemic to India was reported at Nagpahad (its status is unknown and need to study more).

According to the local staff of Forest Department, number of vultures is decreasing very fast however in the area one can see few guano marks of Long-billed Vultures at only one locality of Nagpahad (photo) (it is very essential to do a detail study on status of Vultures in the area).



On the peak of Nagpahad, there is a sacred site of the Gurjar community, where Gurjars use to dig out stone breaks for foundation of their new constructions as a good omen for

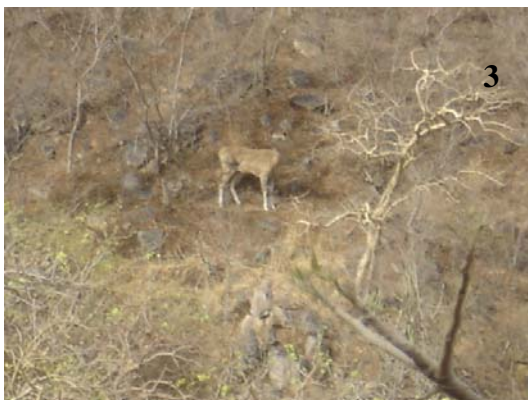
them, which is an age old tradition. This practice is very common in this community and collection of the stone breaks is on a large scale; this increases soil erosion on the hill (facing photo). As this practice is connected with the religion and faith, the local Forest Department is not able to stop this practice. The Nagpahad ridge is about 10 km long. The village Kharekadi is situated at the last part of the ridge (towards Pushkar-Ajmer passage). There is extremely illegal stone mining is going on in the forest part of this village. The village panchayat is earning royalty from this and therefore they are not ready to stop this. If this will continue, it will create a big passage between Pushkar and Ajmer in the Nagpahad ridge. The sand dunes which are today stabilized in Pushkar area, will also affect the other parts of Ajmer through this passage (Pers. Com. Mr. Mahesh Tank, RFO, Nagpahad-Pushkar range).



The % of cover of some of the important floral species in Nagpahad is as follows –

Ronjiya*	1-2%	Dhok	80-90%
Salar	20-30%	Sisam	1-2%
Dasan	80-90%	Kala Siras	10%
Khirmi	10-15%	Guggul	5%
Kadamb	1-2%	Gurjan	5-7%
Dhak	3-4%	Bans	- in nallahs
Thor	80-90%	Bargad	Few numbers
Kamda	5% in nallahs	Pipal	Few numbers
*: refer the annexure 1 for scientific names of species			
The information given by Mr.Gordhanlal Prajapati, Nagpahad-Pushkar range			

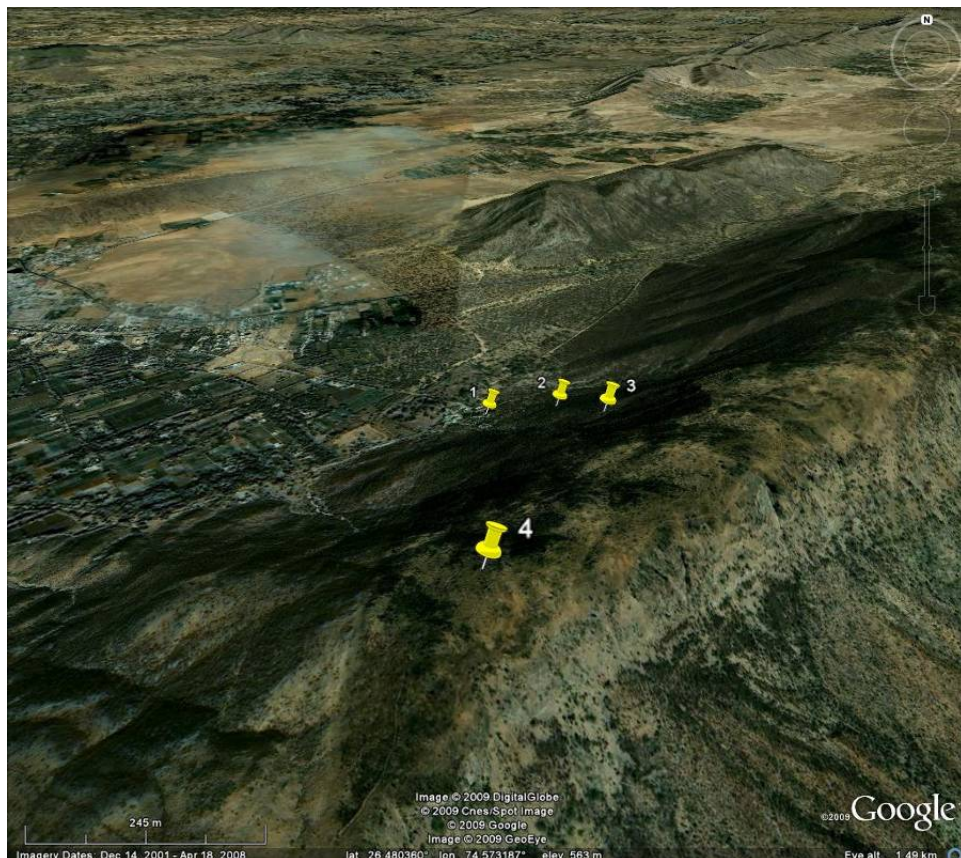
Biodiversity of Nagpahad



- 1: *Ficus tomentosa* element of N.Aravalli and Vindhyan
- 2: Brown Rock-Chat ... prefers dry stony pockets (Endemic to India)
- 3: Sambhar (female)
- 4: Porcupine pellets
- 5: *Sphingonotus coeruens* (Grasshopper), feeds on weeds near water bodies; healthy sign of unpolluted water bodies
- 6: Mixed grassland of *Aristida adscensionis* & *Cenchrus ciliaris* on the top of the Nagpahad

2. Nandtilora:

The status of Nandtilora ridge as an ecological barrier is very significant for the region as it is the 'first wall' against desert and its impacts. The survey was done in both the side of the ridge i.e. Tilora of Ajmer, Badi Ghati and Kila villages of Nagaur to understand the current scenario.



The ridge has different types of species on the both sides- Tilora village (Ajmer) side and Nagaur side. During the survey it was seen that there is a large scale stone mining, which is harmful for the area as it will result in big passages in the ridge and this situation will increase desert sand areas in the inter areas of border and will affect the agriculture of the region.



Before 80 -90 years, there was no passage in the ridge near the border of Tilora-

Nagaur. For the easy accessibility to Pushkar from Nagaur for the Pashumela (the

livestock fair) the British government made the passage in the ridge at Tilora-Badi Ghati border⁶. This Pashumela was one of the important fair of Pushkar, where more than 2 lakh domestic animals used to display for purchase and sell. The Nagori breed of cow and bull were very famous; to participate in the fair, their owners used to pay tolls in different toll-collection booths in the Ajmer area. The British Govt. was getting high revenue from this, therefore, they created the Tilora-Badi Ghati passage.



Due to lack of water and fodder, the Nagori breed is decreased in numbers. The Pashumela also does not have that historical glory today.

The desert sand is getting continuously translocated in the border parts (hills, roads, farms, pasturelands, etc.) of Tilora and Pushkar from the adjoining Nagaur through the passage (photo). On account of the prolonged weathering action of the wind and sunlight on rocks and by the accumulation of organic matter in such rocks, the sand becomes stabilized. Majority of plants in such habitats are big tuft-forming bushes like *Capparis decidua*, *Crotolaria burhia*, *Leptadenia pyrotechnica*, *Sarcostemma acidum* (Ajmer areas), *Calligonum polygonoides* (Nagaur areas).

Main species in the ridge (facing Pushkar) are Thoor, Khip, Ker, *P.juliflora*. The vegetation is poor on this slope but in comparison to the Nagaur side of the ridge it is better. It was clearly observed that the sand cover is increasing its area between Nagaur and Ajmer.

Ephedra foliata, the only wild gymnosperm species of western arid India, indicating arid condition was recorded associated with *Maytenus emarginatus*, has not been listed in the previous floral checklists from Pushkar area near Tilora village (photo).



The Thavala forest range which is handling the management of Nandtilora forest of

⁶ Ajmer was under British rule and Nagaur was part of the Jodhpur riyasat. Both the areas were connected by the ridge but both the area was having different currency at the same time of period (Pers. Com. Sh Krishnaram Gurjar)

Nagaur side, has done large plantation of *Jatropha curcas*, which is according to the local villagers, not good for the local livestock as well as the wild animals.

The foothills of Kila village of Nagaur are covered by sand. The village area is full of *P.juliflora* but the villagers cut and collect *Boswellia serrata* for their daily requirements as it is thorn less species and easy to cut and carry (photo).



The Badi Ghati area of Nagaur was famous for animal husbandry and milk production (the milk was not sold as it was said that '*Dudh aur Poot nahi bechate*' means milk and son can not be sold). The major species cover and their status on the ridge facing Nagaur side is as follows-

Dasan	50%	--
Dhok	25%	decreasing
Khejadi	20%	decreasing
<i>P.juliflora</i>	50%	increasing



- 1: A passage made by Britishers in Tilora ridge (Ajmer-Nagaur highway-89) with special attention given to the Pushkar (Animal) mela where more than 2 lakh animals were displayed
- 2: Vast area of *Leptadenia pyrotechnica* and *Calligonum polygonoides* in the way from Badi Ghati to Killa village in Nagaur
- 3: Soil erosion, Badi Bhati, just after the Tilora border
- 4: Transported sand on eastern aspect of Aravalli (way from Badi Ghati to Killa village)
- 5: Stabilized sand dunes due to pioneers - *Crotalaria burhia* + *Cenchrus* sp.: Xerosere - successor on sand dune (process to check the advancement of sand dunes towards eastern part of State).

D. General issues emerging from the village case studies:

1. Change in climate is being felt by the natives (it is also reflected by the local hydrology and vegetation)
2. Impacts of desert- increasing day-by-day (everywhere)
3. Change in landuse (everywhere)
4. Invasion of *P.juliflora* drastically (everywhere)
5. No proper management of *P.juliflora* for survival of indigenous flora and fauna (everywhere)
6. Mal-practices in forests (Kharwa)
7. Change in vegetation type – mix deciduous to desert vegetation (everywhere)
8. Change in livelihood pattern, highly unsecure and economically not sound (everywhere)
9. Perenniality of water bodies decreasing (everywhere)
10. Threats increased over the natural resources (everywhere)
11. Decline of biodiversity (everywhere)
12. Over exploitation of water (everywhere)
13. Unplanned Industrial development- not supporting biodiversity and natural resources (Kharwa)
14. Mining (Kharwa, Ralawatan)
15. Mining in catchment areas- highly dangerous for the village and forest life (Kharwa)
16. High pollution level (Kharwa)
17. Collapse of local economy-local agriculture and animal husbandry systems (everywhere)
18. Threatened Petakasht- the lifeline for landless families (everywhere)
19. Change in livelihood pattern- replacement of big animals, poultry farms increasing (Kharwa)
20. Threats on social and cultural systems (Kharwa)
21. Black-money developments: not supportive to local communities-farm houses increasing in the area (Kharwa)
22. Settlement problems in the area (Sindhadiya)
23. Lack of proper Inter-departmental co-ordination
24. Inadequate infrastructure

25. Lack of scientific information and database.
26. Policy level problems.
27. Lack of holistic and landscape level approach in physical interventions.

Distribution of some common tree species in Ajmer:

ON FOOT HILLS AND PLAIN AREA:	
Khair	<i>Acacia catechu</i>
Roonjh	<i>Acacia leucophloea</i>
Babool	<i>Acacia nilotica</i>
Dhawda	<i>Anogeissus latifolia</i>
Ingodi	<i>Balanites aegyptiaca</i>
Jhinja	<i>Bauhinia recemosa</i>
Dhaak, Palash	<i>Butea monosperma</i>
Bargad	<i>Ficus benghalensis</i>
Pipal	<i>Ficus religiosa</i>
Kankeda	<i>Maytenus emarginata</i>
Ber	<i>Zizypus mauritiana</i>
ON MIDDLE SLOPES:	
Kumtha	<i>Acacia senegal</i>
Dhokda	<i>Anogeissus pendula</i>
Goyakhair, Imnakhair	<i>Dichrostachys cinerea</i>
Aanwala	<i>Emblica officinalis</i>
Kadamb	<i>Mitragyna parvifolia</i>
Khirni, Khinni	<i>Wrightia tinctoria</i>
ON UPPER REACHES:	
Salar	<i>Boswellia Serrata</i>
Gurjan, Godal	<i>Lannea coromandelica</i>
Kadaya, Karaya	<i>Sterculia urens</i>

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Annexure 1: Floral checklist

Sr.	Species	Local Name	Family	Habit *	Habitat #
Angiosperms					
1	<i>Abrus precatorius</i> L.	Chirmi, Charmoli	Fabaceae	Tw	W
2	<i>Abutilon indicum</i> (L.) Sw.		Malvaceae	Us	W
3	<i>Acacia catechu</i> (L.f.) Willd.	Khair	Mimosaceae	T	W
4	<i>Acacia leucophloea</i> (Roxb.) Willd.	Ronjiya, Aronj	Mimosaceae	T	W
5	<i>Acacia nilotica</i> subsp. <i>indica</i> (Bth.) Brenan	Deshi Babool	Mimosaceae	T	W
6	<i>Acacia senegal</i> (L.) Willd.	Kumtha, Kegar	Mimosaceae	T	W
7	<i>Acalypha indica</i> L.		Euphorbiaceae	H	W
8	<i>Achyranthes aspera</i> Var. <i>aspera</i> L.		Amaranthaceae	H	W
9	<i>Aegle marmelos</i> (L.) Corr	Bel	Rutaceae	T	W
10	<i>Aerva lanata</i> (L.) Juss.		Amaranthaceae	H	W
11	<i>Ailanthus excelsa</i> Roxb.		Simaroubaceae	T	W
12	<i>Albizia lebbek</i> (L.) Benth.	Kaliya shirish	Mimosaceae	T	W
13	<i>Albizia procera</i> (Roxb.) Benth.	Garad	Mimosaceae	T	W
14	<i>Allium cepa</i> L.	Pyaz	Liliaceae	H	D
15	<i>Aloe barbadensis</i> Mill.	Gwarpahta	Liliaceae	S	W
16	<i>Alysicarpus monilifer</i> (L.) DC.		Fabaceae	H	W
17	<i>Amaranthus lividus</i> L.		Amaranthaceae	H	W
18	<i>Ammannia baccifera</i> L.		Lythraceae	H	W
19	<i>Anagallis arvensis</i> L.		Primulaceae	H	W
20	<i>Anisomeles indica</i> (L.) Ktze.		Lamiaceae	H	W
21	<i>Anogeissus latifolia</i> (Roxb. ex DC.) Well. ex Guill. & Perr.	Dhavda	Combretaceae	T	W
22	<i>Anogeissus pendula</i> Edgew.	Dhonkda	Combretaceae	T	W
23	<i>Apluda mutica</i> L.		Poaceae	G	W
24	<i>Argemone mexicana</i> L.		Papaveraceae	H	W
25	<i>Aristida adscensionis</i> L.		Poaceae	G	W
26	<i>Asparagus racemosus</i> Willd.	Satawari, Naharkanta	Liliaceae	Cl	W
27	<i>Azadirachta indica</i> A. Juss.	Neem	Meliaceae	T	W
28	<i>Balanites aegyptiaca</i> (L.) Del.	Ingodi	Balanitaceae	T	W
29	<i>Barleria prionitis</i> L.		Acanthaceae	S	W
30	<i>Bauhinia racemosa</i> Lamk.	Jhinja	Caesalpinioideae	T	W
31	<i>Bauhinia variegata</i> L.	Koliyar, Khati hetri	Caesalpinioideae	T	W
32	<i>Blepharis lineariaefolia</i> Pers.		Acanthaceae	S	W
33	<i>Bombax ceiba</i> L.	Himbol/ Simbal	Bombacaceae	T	W
34	<i>Borreria stricta</i> (L.f.) K. Schum		Rubiaceae	H	W
35	<i>Boswellia serrata</i> Roxb. ex Coleb.	Salar	Bursaceae	T	W
36	<i>Bougainvillea glabra</i> Choisy	Boganvel	Nyctaginaceae	Cl	D
37	<i>Butea monosperma</i> (Lam.) Taub.	Khakhra	Fabaceae	T	W
38	<i>Calligonum polygonoides</i> L.		Polygonaceae	S	W
39	<i>Calotropis gigantea</i> (L.) R. Br.	Safed Aakda	Asclepiadaceae	S	W
40	<i>Calotropis procera</i> (Ait.) R. Br.	Aakda	Asclepiadaceae	S	W
41	<i>Canna indica</i> L.		Cannaceae	H	D
42	<i>Capparis decidua</i> (Forsk.) Edgew.	Ker	Capparaceae	S	W

43	<i>Cardiospermum halicacabum</i> L.	Kanfutaniya	Sapindaceae	H	W
44	<i>Carica papaya</i> L.	Papita	Caricaceae	T	D
45	<i>Carissa congesta</i> Wt.	Karamada	Apocynaceae	S	W
46	<i>Cassia auriculata</i> L.	Awal	Caesalpiniaceae	S	W
47	<i>Cassia fistula</i> L.	Garmela	Caesalpiniaceae	T	W
48	<i>Cassia obtusifolia</i> L.		Caesalpiniaceae	H	W
49	<i>Cassia</i> sp.		Caesalpiniaceae	H	W
50	<i>Cassia tora</i> L.	Puvadiya	Caesalpinioideae	H	W
51	<i>Catharanthus roseus</i> (L.) G. Don	Barmasi	Apocynaceae	H	D
52	<i>Celastrus paniculatus</i> Willd.	Mal kankani/ Mali	Celastraceae	Tw	W
53	<i>Cenchrus ciliaris</i> L.		Poaceae	G	W
54	<i>Chloris barbata</i> (L.) Swartz.		Poaceae	G	W
55	<i>Chrozophora rottleri</i> (Geis.) Juss.		Euphorbiaceae	H	W
56	<i>Chrysopogon fulvus</i> (Spreng.) Chiov.		Poaceae	G	W
57	<i>Cissampelos pariera</i> L.	Pad, Malipad	Menispermaceae	Tw	W
58	<i>Citrullus colocynthis</i> (L.) Schrad		Cucurbitaceae	H	W
59	<i>Citrullus fistulosus</i> Stocks	Tinda	Cucurbitaceae	H	D
60	<i>Citrullus lanatus</i> (Thunb.) Mat. & Nakai.	Tarbooj	Cucurbitaceae	H	D
61	<i>Citrus limon</i> (L.) Burm.	Nimbu	Rutaceae	S	D
62	<i>Clitoria ternatea</i> L.		Fabaceae	Tw	W
63	<i>Cocculus hirsutus</i> (L.) Diels.		Menispermaceae	Cl	W
64	<i>Commelina benghalensis</i> L.		Commelinaceae	H	W
65	<i>Commiphora wightii</i> (Arn.) Bhandari	Gugal, Guggul	Burseraceae	S	W
66	<i>Convolvulus arvensis</i> L.		Convolvulaceae	H	W
67	<i>Corallocarpus epigaeus</i> (Rottl. & Willd.) Hk. f.		Cucurbitaceae	Cl	W
68	<i>Corbichonia decumbens</i> (Forssk.) Exell.		Molluginacea	H	W
69	<i>Corchorus capsularis</i> L.		Tiliaceae	H	W
70	<i>Cordia dichotoma</i> Forst.	Lisuda, Gonda	Ehretiaceae	T	W
71	<i>Cordia gharaf</i> (Forsk.) Ehrenb. & Asch.	Gundi, Rai gundi	Ehretiaceae	T	W
72	<i>Crotalaria burhia</i> Buch.-Ham.	Kharshan, Sangetaro	Fabaceae	Us	W
73	<i>Croton bonplandianum</i> Baill.		Euphorbiaceae	H	W
74	<i>Cucumis callosus</i> (Rottl.) Cogn.		Cucurbitaceae	H	W
75	<i>Cucumis sativus</i> L.	Kakadi	Cucurbitaceae	Cl	D
76	<i>Cymbopogon martinii</i> (Roxb.) Watr.	Rohi	Poaceae	G	W
77	<i>Cynodon dactylon</i> (L.) Pers.		Poaceae	G	W
78	<i>Cyperus rotundus</i> L. Ssp. <i>tuberosus</i> (Rottb.) Kuk.		Cyperaceae	H	W
79	<i>Dactyloctenium aegyptium</i> (L.) P.Beauv.		Poaceae	G	W
80	<i>Dahlia variabilis</i> Desf.		Asteraceae	S	D
81	<i>Dalbergia latifolia</i> Roxb.	Sisam	Fabaceae	T	W
82	<i>Datura metel</i> L	Dhatura	Solanaceae	Us	W
83	<i>Delonix regia</i> (Boj.) Raf.		Caesalpiniaceae	T	D
84	<i>Derris indica</i> (Lam.) Bennet	Karanj	Fabaceae	T	W
85	<i>Dichanthium annulatum</i> (Forsk.) Stapf.		Poaceae	G	W

86	<i>Dichrostachys cinerea</i> (L.) Wt. & Arn.	Imna, Goya kher	Mimosaceae	S	W
87	<i>Digera muricata</i> (L.) Mart.	Satyanashi, Lahsua	Amaranthaceae	H	W
88	<i>Dyerophytum indicum</i> (Gibs. Ex Wight) Kuntze.		Plumbaginaceae	S	W
89	<i>Echinops echinatus</i> Roxb.		Asteraceae	H	W
90	<i>Eleusine indica</i> (L.) Gaertn.		Poaceae	G	W
91	<i>Emblica officinalis</i> Gaertn.	Anwala	Euphorbiaceae	T	D
92	<i>Enicostemma axillare</i> (Lamk.) Roynal		Gentianaceae	H	W
93	<i>Eremopogon foveolatus</i> Stapf.	Buari	Poaceae	G	W
94	<i>Eucalyptus globulus</i> Labill.	Nilgiri, safeda	Myrtaceae	T	D
95	<i>Euphorbia caducifolia</i> Haines	Thor	Euphorbiaceae	S	W
96	<i>Euphorbia hirta</i> L.		Euphorbiaceae	H	W
97	<i>Euphorbia tirucalli</i> L.		Euphorbiaceae	S	W
98	<i>Evovulus alsinoides</i> L.		Convolvulaceae	H	W
99	<i>Fagonia indica</i> Burm.		Zygophyllaceae	H	W
100	<i>Ficus benghalensis</i> L.	Bargad	Moraceae	T	W
101	<i>Ficus racemosa</i> L.	Gular, Umbari	Moraceae	T	W
102	<i>Ficus religiosa</i> L.	Pipal	Moraceae	T	W
103	<i>Ficus tomentosa</i>		Moraceae	T	W
104	<i>Fumaria indica</i> (Hausk.) Pugsley		Fumariaceae	H	W
105	<i>Grewia sp.</i>		Tiliaceae	T	W
106	<i>Grewia tenax</i> (Forssk.) Fiori	Kheski, Gangeran	Tiliaceae	S	W
107	<i>Heteropogon contortus</i> (L.) P.Beauv.ex. R. & S.		Poaceae	G	W
108	<i>Hibiscus rosa-sinensis</i> L.		Malvaceae	S	D
109	<i>Holoptelea integrifolia</i> (Roxb.) Planch.	Chureil	Ulmaceae	T	W
110	<i>Indigofera cordifolia</i> Heyne ex Roth		Fabaceae	H	W
111	<i>Indigofera linifolia</i> Var. linifolia Retz.		Fabaceae	H	W
112	<i>Ipomoea fistulosa</i> Mart. Ex Choisy	Besharmi	Convolvulaceae	S	W
113	<i>Ipomoea obscura</i> (L.) Ker.-Gawl.		Convolvulaceae	H	W
114	<i>Ipomoea pes-tigridis</i> L. Var. pes-tigridis		Convolvulaceae	Tw	W
115	<i>Jatropha curcas</i> L.	Ratanjyot	Euphorbiaceae	S	W
116	<i>Kickxia ramosissima</i> (Wall.) Zanchen		Scrophulariaceae	H	W
117	<i>Lannea coromandelica</i> (Houtt.) Merr.	Guran, Godal, Gola	Anacardiaceae	T	W
118	<i>Lantana camara</i> L.		Verbenaceae	S	W
119	<i>Launaea procumbens</i> (Roxb.) Ram. & Raj.		Asteraceae	H	W
120	<i>Lawsonia inermis</i> L.	Mehndi	Lythraceae	S	W
121	<i>Lemna minor</i> L.		Lemnaceae	H	W
122	<i>Lepidagathis trinervis</i> Wall. ex Nees		Acanthaceae	H	W
123	<i>Leptadenia pyrotechnica</i> (Forssk.) Decne.	Khip	Asclepiadaceae	S	W
124	<i>Limonia acidissima</i> L.	Kaith	Rutaceae	T	W
125	<i>Mangifera indica</i> L.	Aam	Anacardiaceae	T	D
126	<i>Maytenus emarginatus</i> (Willd.)	Kankeda	Celastraceae	S	W

	Ding Hou				
127	<i>Medicago sativa</i> L.	Rajka	Fabaceae	H	D
128	<i>Mimusops elengi</i> L.		Sapotaceae	T	W
129	<i>Mitragyna parviflora</i> (Roxb.) Korth.	Kabda, Kadamb	Rubiaceae	T	W
130	<i>Momordica dioica</i> Roxb. ex Willd.	Kikodi	Cucurbitaceae	Cl	W
131	<i>Monsonia senegalensis</i> Guill. & Perr.		Geraniaceae	H	W
132	<i>Moringa oleifera</i> Lam.	Sargvo, Sehjana	Moringaceae	T	D
133	<i>Murraya koenigii</i> (L.) Spr.	Mitha neem	Rutaceae	S	D
134	<i>Musa paradisiaca</i> L.	Kela	Musaceae	H	D
135	<i>Ocimum basilicum</i> L.		Lamiaceae	H	W
136	<i>Oldenlandia diffusa</i> (Willd.) Roxb.		Rubiaceae	H	W
137	<i>Opuntia elatior</i> Mill.		Cactaceae	S	W
138	<i>Phoenix sylvestris</i> (L.) Roxb.	Khajuri	Arecaceae	T	W
139	<i>Polyalthia longifolia</i> (Sonn.) Thw.	Asopalav	Annonaceae	T	D
140	<i>Polygonum plebeium</i> R. Br.		Polygonaceae	H	W
141	<i>Portulaca</i> sp.		Portulacaceae	H	W
142	<i>Prosopis chilensis</i> (Molina) Stuntz	Vilayati babool	Mimosaceae	S	W
143	<i>Prosopis cineraria</i> (L.) Druce	Khejdi	Mimosaceae	T	W
144	<i>Psidium guajava</i> L.	Amrood	Myrtaceae	T	D
145	<i>Pulicaria wightiana</i> (DC.) Cl.		Asteraceae	H	W
146	<i>Rhus mysurensis</i> G. Don	Dansan	Anacardiaceae	T	W
147	<i>Rosa</i> sp.	Gulab	Rosaceae	H	D
148	<i>Saccharum spontaneum</i> L.		Poaceae	G	W
149	<i>Salvadora oleoides</i> Decne.	Jar, Pilu	Salvadoraceae	T	W
150	<i>Sarcostemma acidum</i> (Roxb.) Voigt		Asclepiadaceae	S	W
151	<i>Sehima nervosum</i> (Rottl.) Stapf.	Heran	Poaceae	G	W
152	<i>Sericostoma pauciflorum</i> Stocks ex Waight		Boraginaceae	Us	W
153	<i>Solanum surattense</i> Burm.	Bhoringni	Solanaceae	H	W
154	<i>Sterculia urens</i> Roxb.	Kadaya, Kadua	Sterculiaceae	T	W
155	<i>Striga asiatica</i> (L.) Ktze.		Scrophulariaceae	H	W
156	<i>Syzygium heyneanum</i> (Duthie) Wall. ex Gamble	Jamun	Myrtaceae	T	W
157	<i>Tamarindus indica</i> L.	Imli	Caesalpinioideae	T	W
158	<i>Tamarix aphylla</i> (L.) Karst.		Tamaricaceae	T	W
159	<i>Tecomella undulata</i> (Seem) Seem		Bignoniaceae	T	W
160	<i>Tephrosia purpurea</i> (L.) Pers.		Fabaceae	Us	W
161	<i>Thespesia populnea</i> (L.) Soland. ex Corr.	Paras papal	Malvaceae	S	D
162	<i>Tinospora cordifolia</i> (Willd.) Miers	Amarvel, Ambarvela, Nim giloy	Menispermaceae	Tw	W
163	<i>Trichosanthes cucumerina</i> L.		Cucurbitaceae	Cl	W
164	<i>Triumfetta rhomboidea</i> Jacq.		Tiliaceae	H	W
165	<i>Urginea indica</i> (Roxb.) Kunth.	Jungli kanda	Liliaceae	H	W
166	<i>Vitex nigundo</i> L.	Nirgund	Verbenaceae	T	W
167	<i>Wrightia tinctoria</i> (Roxb.) R. Br.	Khirmi/ Khinni	Apocynaceae	T	W
168	<i>Xanthium strumarium</i> L.	Bada gokharu	Asteraceae	H	W
169	<i>Zizyphus mauritiana</i> Lam.	Bor, Ber	Rhamnaceae	T	W
170	<i>Zizyphus nummularia</i> (Burm.f.) W. & A.	Ber	Rhamnaceae	S	W

Gymnosperm					
171	<i>Ephedra foliata</i> Boiss. & Kotschy		Ephedraceae	S	W
Pteridophytes					
172	<i>Actinopteris radiata</i> (Swartz) Link.		Pteridaceae	H	W
173	<i>Adiantum cordatum</i>		Pteridaceae	H	W
174	<i>Cheilanthes albomarginata</i> Clarke	Silver fern	Pteridaceae	H	W
Bryophytes					
175	<i>Funaria hygrometrica</i> Var. <i>hygrometrica</i> Hedw.		Funariaceae	H	W
176	<i>Plagiochasma articulatum</i>		Aytoniaceae	H	W
Fungi					
177	<i>Agaricus sp.</i>		Agaricaceae	H	W
178	<i>Amanita fulva</i>		Amanitoid	H	W
*: Cl = Climber; G = Grass; H = Herb; S = Shrub; T = Tree; Tw = Twiner; Us = Under shrub #: W = wild; D= domestic					

Annexure 2: Fauna checklist

Sr.	English name	Scientific name	Common name
Mammals			
1	Common house rat	<i>Rattus rattus</i>	Chuha
2	Common mongoose	<i>Herpestes edwardsii</i>	Nevla
3	Five striped palm squirrel	<i>Funambulus pennanti</i>	Gilahari
4	Hanuman langur	<i>Semnopithecus entellus</i>	Bandar
5	House mouse	<i>Mus musculus</i>	Chuha
6	Indian hare	<i>Lepus nigricollis</i>	Khargosh
7	Indian porcupine	<i>Hystrix indica</i>	Heli
8	Indian wild boar	<i>Sus scrofa</i>	Jangli bhund, Hoor
9	Jackal	<i>Canis aureus</i>	Shiyal
10	Nilgai	<i>Boselaphus tragocamelus</i>	Roj, Neelgai
11	Pygmy pipistrelle	<i>Pipistrellus mimus</i>	Vaglo
12	Rhesus macaque	<i>Macaca mullata</i>	Lal bandar
13	Sambar	<i>Cervus unicolor</i>	Sambhar
Birds			
14	Common Babbler	<i>Turdoides caudatus</i>	Laledi
15	Jungle Babbler	<i>Turdoides striatus</i>	Laledi
16	Large Grey Babbler	<i>Turdoides malcolmi</i>	Laledi
17	Small Green Bee-eater	<i>Merops orientalis</i>	
18	Red-vented Bulbul	<i>Pyconotus cafer</i>	Peecha
19	House Crow	<i>Corvus splendens</i>	Kaga
20	Large-billed Crow / Jungle Crow	<i>Corvus macrorhynchos</i>	Kagada
21	Asian Koel	<i>Eudynamis scolopacea</i>	Koyal
22	Greater Coucal	<i>Centropus sinensis</i>	Kauwa
23	Pied Cuckoo	<i>Clamator jacobinus</i>	
24	Small Minivet	<i>Pericrocotus cinnamomeus</i>	
25	Black Drongo	<i>Dicrurus macrocercus</i>	
26	Black-shouldered Kite	<i>Elanus caeruleus</i>	
27	Long-billed Vulture	<i>Gyps indicus</i>	Giddha
28	Shikra	<i>Accipiter badius</i>	
29	Cattle Egret	<i>Bubulcus ibis</i>	
30	Indian Pond Heron	<i>Ardeola grayii</i>	
31	Common Hoopoe	<i>Upupa epops</i>	
32	Common Kingfisher	<i>Alcedo atthis</i>	
33	Indian Silverbill/ Whitethroated Munia	<i>Lonchura malabarica</i>	
34	Spotted Owlet	<i>Athene brama</i>	
35	Alexandrine Parakeet	<i>Psittacula eupatria</i>	Tota
36	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Tota
37	Common Quail	<i>Coturnix coturnix</i>	Lawro
38	Grey Francolin	<i>Francolinus pondicerianus</i>	Titar
39	Indian Peafowl	<i>Pavo cristatus</i>	Mor
40	Painted Francolin	<i>Francolinus pictus</i>	Keela
41	Collared Dove/ ring Dove	<i>Streptopelia decaocto</i>	Hola
42	Rock Pigeon	<i>Columba livia</i>	Parewa
43	Spotted Dove	<i>Streptopelia chinensis</i>	Holi
44	Red-wattled Lapwing	<i>Vanellus indicus</i>	
45	Indian Roller	<i>Coracias benghalensis</i>	
46	House Sparrow	<i>Passer domestica</i>	Chakli

47	Bank Myna	<i>Acridotheres givgivadis</i>	Kabar
48	Brahminy Starling	<i>Sturnus pagodarum</i>	
49	Common Myna	<i>Acridotheres tristis</i>	Kabri
50	Pied Myna	<i>Sturnus contra L.</i>	
51	Purple Sunbird	<i>Nectarinia asiatica</i>	
52	House Swift	<i>Apus affinis</i>	
53	Streak-throated Swallow/ Streak breasted Swallow	<i>Hirundo fluvicola</i>	
54	Brown Rock-Chat	<i>Cercomela fusca</i> (Blyth)	
55	Indian Robin	<i>Saxicoloides fulicata</i>	
56	Oriental Magpie Robin	<i>Copsychus saularis</i>	
57	Baya Weaver	<i>Ploceus phiippinus</i>	
58	Black-rumped Flameback	<i>Dinopium benghalensis</i>	
Reptiles			
59	Indian Garden Lizard	<i>Colotes versicolor</i>	Girgit
60	Common Skink	<i>Mabuya carinata</i>	
Butterflies			
61	Blue Pancy	<i>Precis orithya</i>	Titli
62	Common Evening Brown	<i>Melanitis leda</i>	Titli
63	Common Gull	<i>Huphina nerissa</i>	Titli
64	Pea Blue	<i>Lampides boeticus</i>	Titli
Grasshoppers			
65	C.gigatea grasshopper	<i>Poecilocerus pictus</i>	Tidda
66	Grasshopper	<i>Sphingonotus coeruens</i>	Tidda
Arthropods			
67	Indian Bee	<i>Apis indica</i>	Madhumakkhi
Others			
68	Velvet red mite		Ramji ka ghoda