CHAPTER 3
BASELINE BIODIVERSITY STATUS

3.1 INTRODUCTION

Biodiversity or biological diversity is the variability within and between all microorganisms, plants and animals as well as the eco-system, which they inhabit. It starts with genes and manifests itself as organisms, populations, species and communities, which give life to eco systems, landscape and ultimate to the biosphere (Swaminathan 1997). Biodiversity provides a fundamental base to the mountain agriculture and overlap economic system. It is the source of resiliency and regeneration, necessary for sustainability of eco system. It is the ultimate basis for local self-sufficiency and a global asset bringing benefits to people in terms of material welfare in many ways than we realize.

India has a long history of in-situ conservation of biodiversity through protected areas. Approximately 4.75% of the total geographical area of the country has been earmarked for extensive in-situ conservation of habitats and ecosystems. A protected area network of 88 National Park and 490 Wildlife Sanctuaries The results of this network has been significant in restoring viable population of large mammals such as Tiger, Lion, Rhinoceros, Crocodile, and Elephant etc.

The State of Himachal Pradesh varies in topography, geological formations, climatic conditions and the altitudinal range has made the State a veritable treasure house of biodiversity – both wild and domesticated. The range of biodiversity elements represented in the State varies from those of subtropical region to that of temperate and alpine regions.

Such is the relevance of biodiversity to the people of the State that “Deodar” has been adopted as the state tree, “Rhododendron” as the state flower, “Musk deer” as the state animal and “Monal” as the state bird. The baseline biodiversity status of Himachal Pradesh, Satluj Basin, the project influence area (7 km surrounding project site), project immediate influence area (500 meters surrounding the project side) and project affected area (total land acquired for the project) is discussed in details below.

3.2 BIODIVERSITY OF HIMACHAL PRADESH

Himachal Pradesh, one of the important mountainous states of India spreads over an area of 55673 Sq. Km in the Himalayan Region of India. The area is rugged and mountainous with ranges spreading along the Indus-Satluj river system. The height varies from 244 m above Mean Sea level (msl) in areas bordering Uttar Pradesh and Punjab plains to 6750 m in Trans Himalayan zone along Lahaul, Spiti and Pin valleys.

Geographically area of the state can be divided into three major zones i.e. subtropical zone extending from lower frames to a height of 1550 m above main sea level and incorporating Shivalik foothills & lower ranges of middle Himalaya. The temperate zone incorporating all hills and valleys situated between 1500 to 3200 m and the Alpine zone covering all hills and valleys situated above an altitude of 3200 m, which are, characterize by extreme cold climate.

3.2.1 Forest

Forestry is the major land use in Himachal Pradesh, owing to a wide range of altitude, temperature and rainfall, Himachal Pradesh supports diverse types of forests, now mostly confined to higher hills and interior valleys. The forests not only serve as a haven for biodiversity in our hilly state, but are also the mainstay for rural life and livelihoods. The total geographical area of 55,673 Sq. Km in the state, out of which 14,353 Sq. Km area is legally classified as forest. This includes meadows, grasslands and barren scree slopes above the tree line as well as areas under permanent snow. 1,093 Sq. Km is classified as “dense” forest and 5,377 Sq. Km as “open” forest.

The tree cover (dense forest and open forests) accounts for 25.78% of the geographical area of the State (SFR, 2003). The actual forest cover has decreased by 7 Sq. Km from the assessment made during 2001.

Table: 3.1
Change in Forest Cover of Himachal Pradesh

Year	Dense Forest (Sq. Km)	Open Forest (Sq. Km)	Total Forest (Sq. Km)
2001	10,429	3,931	14360
2003	8,976	5,377	14353
Change in Forest cover	-1,453	1,446	-7

Source: State of Forest Report 2003

Given the wide latitudinal and climatic range in the State, a wide variety of forests is met with at different altitudes and in different physiographic zones.

Table: 3.2
Major Forest Types Recorded in Himachal Pradesh

S.No	Major Forest Type	Classification Code
1	Tropical Moist Deciduous Forest	3C/ C 2A 3C/C2B
2	Tropical Dry Deciduous	5B/C-1 A 5B/C-2 5B/C2/DS1 5B/E9 5B/1-S2
3	Subtropical Dry Evergreen	10-C1 10-DS1
4	Himalayan Moist Temperate Forest	12/C-1a 12/C-1b 12/C-1c 12/C-1e 12/C2-a 12/C2-b 12/DS1 12/DS-2

S.No	Major Forest Type	Classification Code
5	Himalayan Dry Temperate Forest	13/C1 13/C2a 13/C2b 13/C4 13/C5
6	Sub Alpine Forest	14/C/a 14/C1-b 14/DS1
7	Subtropical Pine Forest	9C1 9DS1 9DS2
8	Most Alpine Scrub	15/C1 15/C2 15/E1 15/C3
9	Dry Alpine Scrub	16/C1 16/E1

Source: Forest Working Plan Rampur Forest Division

The forest wealth of Himachal Pradesh, replete with diverse vegetation, ranging from tropical to sub-tropical and temperate to alpine, has been sustaining rural life since time immemorial. The wide range of altitude, topography and climatic conditions have contributed towards the rich and diversified flora Coniferous forests dominant from mid to high hills, with a preponderance of Oaks in moist depressions. In the foothills, forests are dry deciduous, thriving in a low water table and dry soil conditions. The sub-Himalayan region is characterized by most deciduous forests, with Sal as the predominant species. In dry the dominant species, and the moist temperate region in characterized by the presence of Deodar forests.

3.2.2 Natural Flora

It is estimated that almost 3256 species of vascular plants occur in the forests of Himachal Pradesh. Of these, only about 100 odd are commonly utilized for timber, farming implements, fuel, fodder, and NTFP, include medicinal use. Based on published records for the State, the Botanical Survey of India has compiled a Flora of Himachal Pradesh (Chowdhery & Wadhwa, 1984). As per a tentative compilation of the total higher plants found in the State, there are 3120 angiosperm and 12 gymnosperm taxa while 34 species for lower plants including pteridophytes, bryophytes, fungi and algae.

3.2.3 Natural Fauna

The estimated 5721 species of vertebrate and invertebrate fauna listed in the state, perhaps only about 100 species are commonly observed and reported upon regularly. The faunal diversity includes 649 Chordates (77 Mammals, 447 Birds, 44 Amphibians and 81 Fishes), 4543 *Arthropods* (2 Bryozoa, 4362 *Insects*, 195 *Arachnids*, 11 *Myriopods* and 73 *Crustaceans*) and 412 others (60 *Annelids*, 73 *Mollusks*, 2 *Acanthocephala*, 132 *Nematodes*, 16 *Rotifers*, 90 *Platyhelminths*, 2 *Cnidaria*, 3 *Porifera* and 34 *Protozoan*). (Biodiversity Action Plan 2003)

The fauna of Himachal Pradesh is very diverse and unique. The rich faunal diversity includes 64 species of mammals, 447 species of birds, 44 species of reptiles, and 81 species of fish. Among the pheasants, with increasing altitude, are Kalij in the foothills Koklas and Monal in the temperate and mid-level forests, and the Snow cock in the alpine areas. The Western Tragopan, a rare and endangered species, is confined only to the western Himalayas. Himachal Pradesh also has probably the largest population of Chir pheasants in the world. Among herbivores are the Ibex, Serow, Blue sheep, Tahr, Musk deer, Goral and the Barking deer or of intermediate status such as Black Bear, Himalayan Weasel, Yellow Throated Martin, Stone Martin and Wolf are also found here. The Common Leopards and Snow Leopards are representative of the larger cats.

3.3 BIODIVERSITY OF SATLUJ BASIN

The river Satluj is the largest river system of Himachal Pradesh with a total catchment area of 20,398-km² spread over the districts of Lahaul & Spiti, Kinnaur, Simla, Solan and Bilaspur. Originating in Tibet, the river flows from east to west, enters the State at Shipki (6,608 m) in Kinnaur. Its various right bank tributaries including the Spiti, the Ropa, the Kasang, the Mulgaon, the Yul, the Wanger and the Throng in Kinnaur join it. The Tirung, the Gayanthing, the Duling, the Baspa, the Solding, the Manglad and the Nogli streams form some of its bank tributaries. Before entering the Punjab plains, it cuts a gorge in Naina Devi Dhar. A big dam across this gorge near Bhakra village has been constructed which has created a huge reservoir called the Govind Sagar in the district of Bilaspur.

3.3.1 Forest Types

The altitudinal variation in Satluj basin leads to variation on forest types. The various forest types reported in Satluj basin is as below.

Table: 3.3
Major Forest Types of Satluj Basin

S. No.	Major Forest Type	Classification Code
1	Northern Dry Mixed Deciduous Forests	5B/C-2
2	Himalayan Subtropical Pine Forests	9 C-1
3	Dry Bamboo Breks	5 B/E9
4	Himalayan Sub Alpine Fir Forests	14/ C1b
5	Himalayan Kharsoo – Oak Forests	12/C2 a
6	Himalayan Dry Temperate Forests	13/ C1
7	Himalayan Kharsoo – Oak Forests	12/C1a
8	Mixed Broad leaved Coniferous Forests	12/C1b
9	Coniferous Pine Forests	13/C2a
10	Western Mixed Coniferous Forests	12/C1d

Source: Enchanting Himachal Wildlife wing (2004)

3.3.2. Natural Flora

The marked altitudinal variation in Satluj leads to various forest types. The higher elevations i.e. upper reaches of Satluj basin is marked by great Himalayan Ranges with very high rugged mountains, covered with massive snow and glaciered rising as high as 6700 m above mean sea level. The area is known as Cold Desert, which covers about 35% of total geographical area of the state. The upper reaches of Satluj basin fall in Lahaul & Spiti and Kinnaur district. Major forest types found are Dry Alpine Scrub predominantly in Cold Desert area form 3600 to 5500m. The vegetation is sparse, discontinuous and scattered represented by shrubs having high medicinal values. The dominant shrubs are *Juniperus sp, Ephedra sp, Myricaria sp*, with supported herbs such as, *Rosa macrophylla*, *Ribes orientale*, *R.alpestrie*, *Lonicera spinosa, Clematis veratie*, *Capparis spinosa*, etc.

The Moist Alpine Scrubs are found where cold dry conditions prevail above 3600 m elevation. The dominant herbs represented by *Berberis, Loniccra, Cotoneaster, Astragalus, Potertilla, Geranium, Fritillaria, Corydalis* etc. Himalayan dry Temperate Forests found in Kinnaur district. The dominant tree species are *Pinus wallichiana* (Blue pine); *Picea smithiana* (Rai*), Abies spectabilis, Juniperus macropoda, Populus ciliata, Salix viminalis, Quercus dilata, Alnus indica*. The dominant shrubs comprise of *Salix, Barberis, Rosa, Viburnum, Lonicera* sp. etc.

The Middle basin of Satluj shows moist Deodar Mixed coniferous Forests at altitudinal range of 1800 to 2400m. & 2400 to 3300 m. *Cedrus deodara* (Deodar) is dominant species of forests. The Mixed Coniferous Forests include pure Spruce & Silver fir mixed with Deodar (*Cedrus deodara*), Kail (*Pinus wallichiana*) with associated species such as *Aesculus indica, Corylus colurna, Juglans regia*, *Prunus cornata* etc.

The Subtropical Pine Forests occurs between 600-1700m covering district of Solan, Shimla and Bilaspur in lower Satluj basin *Pinus roxburghii* (Chil) is the predominant species associated with *Quercus leucotrichophora, Rododendron arboreum, Lyonia ovalifalia, Acacia catehu, Terminalia chebula, Syzygium cumunni, Emblica officinalis, Mallotus philippinensis* and dominant shrubs as *Carissa opaca, Carissa spinarum, Dodonea viscosa, Indegofera heterantha, Rhamnus virgata* etc.

3.3.3 Natural Fauna

The altitudinal variation, also the climatic and forest types the variation in fauna of the Satluj basin is observed. The fauna of the upper basin i.e. Cold desert is of special concern; as most of the endangered, endemic and rare species of wildlife is reported, form this region. A large variety of carnivore of endangered/ rare status such as, Snow Leopard, Himalayan Brown Bear, Black Bear, Himalayan weasel, Yellow throated martin, Wooly hair Wolf, and Common Leopard. The herbivores are of various types of which, Ibex, Serow, Blue Sheep, Thar, Musk deer, Ghoral and Barking deer.

The small mammals include the Himalayan and long tailed marmots, Himalayan squirrels and Voles. The lower basin of the Satluj represents the different fauna such as Jungle cat, Bengal Fox, Indian Porcupine, Wild Boar, Common Palm Civet etc. The wildlife reported from various forests types are given in details below.

Table: 3.4
The List of Fauna Reported from Satluj Basin

Scientific Name	Common Name	Family
Mammals		
Canis lupus	Indian Wolf	Canidae
Canis aureus	Jackal	Canidae
Capra ibex	Himalayan Ibex	Bovidae
Capricornis sumatraensis	Serow	Sciuridae
Cervus unicolor	Sambar	Canidae
Felis bengalensis	Leopard cat	Felidae
Felis caracal	Caracal	Felidae
Hemitragus jemlahicus	Himalayan thar	Bovidae
Hylopetes, Petaurista	Flying Squirrels	Hylobatidae
Hystrix indica	Indian Porcupine	
Macaca mutata	Rhus Macaque	Cercopithecidae
Martes flavigula	Yellow Throated Martens	
Martes fonia intermedia, ,	Martens	
Moschus moschiferus	Musk deer	Cervidae
Muntiacus muntjak	Barking deer or Muntjac	
Nemorhaedus gora,	Gorals	
Ovis nahura	Bharal	Bovidae
Paguma larvata	Himalayan Palm Civet	
Panthera paradus	Leopard or Panther	Felidae
Panthera uncia	Snow leopard	Platanistidae
Presbytis entellus	Common langur	Cerocopithecidae
Petaurista pataurista	Common Giants squirrels	Sciuridae

Scientific Name	Common Name	Family
Selenarctos thibetanus	Himalayan black bear	
Sus scrofa	Wild pig	Suidae
Tragulus meminna	Mouse deer	Tragulidoe
Ursus arctos	Himalayan Brown bear	Ursidae
Vulpes bengalensis	Indian fox	Canidae
Vulpes ferrilatus	Tibetan fox	Canidae
Reptiles		
Bungarur cacraleus	Common Indian Crait	
Hemiductilus fuviviridis	Common House Geico	
Naja naja	Indian Cobra	
Varanus bengalensis	Monitor Lizard	*Varanidae*
Pyyas mocosus	Common rat Snake	*Bovidae*
Varanus bengalensis	Bengal Monitor Lizard	

Source: Enchanting Himachal Pradesh, 2004

3.4 BIODIVERSITY STATUS OF PROJECT INFLUENCE AREA

The project influence area is considered as the 7 Km area surrounding the project sites. The map of Project Influence Area is attached as **Fig 2**. Forests of the project influence area falls in Rampur division of Shimla District and Anni (Outer Seraj) Division of Kullu District. All proposed project units are situated along the bank of Satluj River falls in Rampur division. A total forest cover of Rampur division is 40, 372 ha. The details of project influence area are discussed below.

3.4.1 Climate

The Climate of the study area is of temperate zone at high altitude above 1000mtr and sub tropical at lower elevations. Generally April to June and Oct-Dec. are dry months. The Major precipitation is received in the months July & August while snow and rain precipitate in the area during January to March. Snowfall occurs above 1600 m autumn is generally very cold, May and June is very hot at lower elevations.

3.4.2 Geology & Soil Types:

The whole tract of Rampur forest division drains into the Satluj River. The tract is hilly with altitude varying from 730 to 5690 m the slopes vary from moderate to steep & very steep to precipitous Rugged and sharp edged cliffs are very common. The main

rock types are Micaceous, Schist and Chositite Schist with Gneiss, Granite, States and Quartzite. Lime stone rocks are also found in Sangri area. In Delta area and along the Satluj the main rock types are Gneiss, Granite with outcrops of schists containing view of quartzite. The forest soil is mainly of two types (a) Acidic soil with low base status and (b) Neutral soil with high base status. Soil is rich in humus in Deodar and Fir forest, which hampers the natural regeneration.

3.4.3 Forest:

The forests are very important natural resource of the state, form the basis of rich biodiversity, and keep the perennial watercourses following. It also provides various lives supporting usufructs to the local communities and revenue to the state government. The wide attitudinal and climatic variation, a wide variety of forests is met with the different altitude. In general coniferous forests dominates mid to high hills while foothill forests are dry deciduous and scrub forests, thriving in a low water table & dry soil conditions. In dry localities Chir pine (*Pinus roxburghii*) occurs as a dominant species while moist temperate region is characterized by the presence of Deodar (*Cedrus deodara*) forests.

The forests of the study area falls under Rampur Forest Division of Shimla district & Anni forest division of the Kullu district. The total geographical area of Rampur division is 1,29,848 ha of which 49,955.71ha is forest area.The total geographical area of outer Seraj Anni forest division is 68513.79 ha. The total area of forest is 40495.94 ha. The details of landuse pattern of the Project Influenced Area is given in Table 3.5

Table 3.5

Land use Pattern of Forest in Project Influence Area

S N	Details of Land	Rampur (Area in Ha)	Ani (Area in Ha)
1	Demarkated Protected Forest	14737.01	13774.80
2	Un Protected Forest	16562.65	16212.49
3	Agriculture	7560.09	4618.90
4	Pasture	562.90	2637.63
5	Other	10532.25	3252.12
6	**Total**	**49955.71**	**40495.94**

Source: Rampur Forest Divison

There are total 12 protected forest under the study area of which 6 forest falls in Rampur Division while 6 in outer Seraj division of Kullu district. The details of protected forest are given in Table 3.6

Table: 3.6
List of Protected Forests under the Study Area

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S.No	Rampur Forest Division (Area in ha.)	Distance (Km)	Anni Forest Division	Distance (Km)
1	Bahli Protected Forest (176.17)	2.5	Marha Kod Protected Forest	5.25
2	Banavali Protected Forest	3.0	Khaira Kod Protected Forest	4.0

S.No	Rampur Forest Division (Area in ha.)	Distance (Km)	Anni Forest Division	Distance (Km)
3	Baruni Protected Forest (32.4)	0.75	Ramgarh Kondi Protected Forest	3.5
4	Daran Protected Forest (5.5)	5.5	Sanpatu Protected Forest	4.5
5	Gaura Protected Forest (113.8)	3.5	Shikarwah Protected Forest	3.75
6	Sanathali Protected Forest (299.70)	2.5	Tandi Thera Protected Forest	3.0

Source: Data collected form Rampur Forest Division

3.4.4 Forest Types

Distribution of forests type is mainly between the altitudes of 700 m to 2600 m in the Rampur Division. The forests of the traced are as per "The Forest Types of India: by Champion and Seth (1962)". Following forest types occurs in the protect influence area.

(1) 5B/C-2 Northern mixed deciduous forest:

This forest types is found above Rampur up to 40 Km upstream of river Satluj and its tributaries on the banks of the stream as well as river Satluj. The forests are largely of the scrub type.

Major Associates: Lannea - Mallotus - Cedrela
Bauhina - Albizzia - Bombax
Sapindus – Dalbergia - Cedrela

Minor Associates: Desmodium – Rhus - Colebrookia
Euphorbia - Woodfordia – Rubus- Cannabis

(2) Sub group 5/1-5-2 Khair – Sisoo Forests :

This type of forests restricted along the river Satluj on gravey and sandy loam soils.

Major Associate: Acacia- Dalbergia - Mallotus

Minor Associate: Adhatoda- Zizyphus - Mallotus - Aseculus

(3) Sub- group 9/C-1 Himalayan Subtropical Pine forests:

This type occurs between 1000m to 2000m elevation. *Pinus roxburghii* (Chir) occurs remarkably in pure and gregarious form. The crop is irregular and mature trees few and widely scattered.

Major Associates: Quercus - Rhododendron- Lyonia
Abizzia - Pinus wallichiana

Minor Associates: Woodfordia - Desmodium - Rhus
Rubus - Lillium - Berberis
Myrsine -Indigofera - Plectranthus

(4) Himalayan Moist Temperate Forests: -

This type of forest generally occurs between 1500 to 3300m. These are well-stocked forests of good height growth varying between 30-45m.

Major Associates: Quercus – Pine

Minor Associates: Sarococca – Skimmia - Strobilanthus
Rosa - Clematis- Hedera

(5) Sub group 12/C-1 Ban – Oak Forests;

The Ban Oak is common low level Oak of moist zone and is the major species over considerable area varies from 1500 to 2100m.

Major Associate: Rhododendron - Lyonia- Litsea
Cedrela - Carpinus

Minor Associate: Berberis - Indigofera - Sarcococca

Desmodium - Inyrrine - Vibernum

Prinsepia-Spiraea - Lonicera - Rubus

(6) Sub group 12/c-1b Mohru oak forests:

These forests occur in small patches above the ban forests between 2100-2500m.

Major Associates: Cedrela –Acer- Rhus
Aesculus – Prunus – Pyrus - Juglans

Minor Associates: Rubus - Lillium - Berberis
Myrsine -Indigofera - Plectranthus

(7) Sub group 12/DS-1 Oak Scrub:

This serial occurs near habitations between 1500-2200m and having affected by lopping, browsing, unregulated fallings for fuel and agricultural implements. I as a result Oak is reduced to low stunted, unsound and busy trees often of coppiced origin.

Major Associates: Rhododendron - Lyonia

Minor Associates: Berberis – Prinsepia

(8) Sub group – 12/DS-1/I-C Moist Deodar Forests :

The deodar forests occur between the altitudinal ranges of 1800-2400m. Deodar is poorly represented in the heavy rainfall zones adjoining Saharan and this type can be seen in Ramgarh – Kanji range of Anni division.

Major Associates: Deodar - Pinus wallichiana - Quercus incana

Minor Associates: Berberis – Launicere - Desmodium

3.4.5 Natural Flora:

The climatic and altitudinal variations markedly influence the type of species distribution in various zones. Physiognomically flora of the study area can be categorized as trees, shrubs, herbs and grasses the list of Flora recorded during survey is given in table 3.5. However flora reported by Rampur and Ani forest department is given as **Annexture-II** The climax and dominant species of forests are species of the forests are Chir (*Pinus roxburghii*) Kail (*Pinus wallichiana*), Deodar (*Cedrus deodara*) and Ban Oak (*Quercus incana*) along with their major associated species. The dominant associate of (*Cedrus deodara*) Deodar is Ban Oak (*Quercus incana*) Kharsu Oak (*Quercus semicarpifolia*).

Table: 3.7
FLORA RECORDED UNDER THE PROJECT INFLUENCE AREA (7km)

S. No.	SCIENTIFIC NAME	LOCAL NAME	FAMILY
TREES			
1	*Acacia leucophloea*	Subabul	Mimosaceae
2	*Albizzia lebbek*	Seris	Leguminosae
3	*Bauhinia variegata*	Kachnar	Leguminosae
4	*Bombax ceiba*	Semal	Bombaceae
5	*Callistemon citrinus*	Bottle brush	Myrtaceae
6	*Cedrala serrata*	Darloi	Miliaceae
7	*Cedrela toona*	Toon	Miliaceae
8	*Cedrus deodara*	Devdaar	Coniferae
9	*Celtis australis*	Kharak	Urticaceae
10	*Cupressus torulosa*	Leuri	Coniferae
11	*Dalbergia sissoo*	Shisham	Fabaceae
12	*Emblica officinalis*	Amla	Euphorbiaceae
13	*Eucalyptus globulus*	Safeda	Myrtaceae
14	*Ficus bengalensis*	Bargad	Urticaceae
15	*Ficus elastica*	Rubber tree	Urticaceae
16	*Ficus palmata*	Fedu, Phegru	Urticaceae

S. No.	SCIENTIFIC NAME	LOCAL NAME	FAMILY
17	*Ficus religiosa*	Pipal	Urticaceae
18	*Ficus roxburghii*	Timal	Urticaceae
19	*Grevillea robusta*	Silver oak	Proteaceae
20	*Grewia oppositifolia*	Biul	Tiliaceae
21	*Juglans regia*	Akhrot	Juglandaceae
22	*Lannea grandis*	Jinghini	Anacardiaceae
23	*Litlsea umbrosa*	Shuru	Lauraceae
24	*Mallotus philippinenisis*	Ruin	Euphorbiaceae
25	*Mangifera indica*	Aam	Anacardiaceae
26	*Melia azaderach*	Dhenk	Meliaceae
27	*Morus alba*	Tut	Urticaceae
28	*Morus serrala*	Himu, Tut	Urticaceae
29	*Morus sps*	Paper Mulberry	Urticaceae
30	*Pinus roxburghii*	Chil	Coniferae
31	*Populus ciliala*	Poplar	Salicaceae
32	*Prunus amygradus*	Badam	Rosaceae
33	*Prunus armeniaca*	Chuli	Rosaceae
34	*Prunus cerasoides*	Paja	Rosaceae
35	*Prunus communis*	Aloocha	Rosaceae
36	*Prunus persica*	Aroo	Rosaceae
37	*Punica granatum*	Aanar	Lythraceae
38	*Pyrus malus*	Seb	Rosaceae
39	*Quercus incana*	Ban	Cupuliferae
40	*Quercus dilata*	Moru	Cupuliferae
41	*Robinia pseudoacacia*	Pahari kikar	Papilionoidaea
42	*Rhodondendron arboreum*	Burans	Ericaceae
43	*Sapindus mukorossi*	Ritha	Sapindaceae
44	*Syzium cumini*	Jamun	Myrtaceae
45	*Tamarindus indica*	Imli	Caesalpiniaceae
SHRUBS			
1	*Adhatoda vasica*	Basuti, Vasika	Acanthaceae
2	*Agave americana*	Rambans	Cactaceae
3	*Aloe vera*	Aloe	Liliaceae

S. No.	SCIENTIFIC NAME	LOCAL NAME	FAMILY
4	*Artemesia vulgaris*	Kubash	Compositae
5	*Berberies aristata*	Karmshal, Kashmoi	Berberidaceae
6	*Berberis lyceum*	Kashmanl	Berberidaceae
7	*Calotropis gigantea*	Aak	Asclepiadaceae
8	*Cannabis sativa*	Bhang	Cannabinaceae
9	*Carissa spinarum*	Karonada	Apocynaceae
10	*Colebrookia oppositifolia*	Bambher, Sidhar	Labiatae
11	*Cotoneaster acuminata*	Ruinish	Rosaceae
12	*Cotoneaster baciIlaris*	Ruinish	Rosaceae
13	*Daphne papyracea*	Chamua, Satpura	Thymelaeaceae
14	*Debregeasia hypoleuca*	Sihanru	Artocarpeae
15	*Desmodium tiliaefolium*	Martoi	Leguminosae
16	*Dodonaea viscosa*	Mehandi	Sapindaceae
17	*Euphorbia royleana*	Shuru	Euphorbiaceae
18	*Girardinia heterophylla*	Bichhu, Kushki	Urticaceae
19	*Hypericum oblongifolum*	Phiunli	Hypericaceae
20	*Indigofera gerradiana*	Kathi	Leguminosae
21	*Indigofera pulchella*	Sakina	Leguminosae
22	*Lantana camara*	Lantana	Verbinaceae
23	*Lonicera anguslifolia*	Banchulu	Caprifoliaceae
24	*Mohonia nepalensis*	Khoru	Berberidaceae
25	*Moriandra strobilifera*	Pothi	Labiatae
26	*Murraya koengii*	Kath Neem	Rutaceae
27	*Musa paradisiaca*	Kela	Scitaminaeae
28	*Opuntia monocantha*	Nagphani	Cactaceae
29	*Plectranthus coesta*	Chichiri	Labiatae
30	*Princepia utilis*	Bhekal	Rosaceae
31	*Ricinus communis*	Arandi	Euphorbiaceae
32	*Rubus ellipticus*	Hinsar	Rosaceae
33	*Rumex hastatus*	Bhilmora	Polgonaceae
34	*Sarcococca saligna*	Tiliari	Euphorbiaceae
35	*Solanum surattense*	Kateli	Solanaceae
36	*Stribilianthus sp.*	----------	Acanthaceae

S. No.	SCIENTIFIC NAME	LOCAL NAME	FAMILY
37	*Woodfordia fruticosa*	Dhaula	Lythraceae
38	*Zizyphus jujuba*	Beri	Rhamnaceae
39	*Zizyphus nummularia*	Beri	Rhamnaceae
HERBS/CLIMBERS			
1	*Achyranthes aspera*	Aghada, Puthkanda	Amaranthaceae
2	*Argemone mexicana*	Prickly poppy	Papaveraceae
3	*Asparagus racemosa*	Sahansarpali	Liliaceae
4	*Bauhinia vahlii*	Malo	Leguminosae
5	*Chenopodium album*	Bathwa	Chenopodiaceae
6	*Chromolaena odorata*	Triva gandha	Chromolaenae
7	*Clemapis montana*	Kauniabali	Ranunculaceae
8	*Datura suaveolens*	Datura	Solanaceae
9	*Echinops echinatus*	Gokhru	Compositae
10	*Erigeron bellidioides*	Horse weed	Compositae
11	*Fragaria indica*	Bhumla	Rosoideae
13	*Frageria vesica*	Bhumla	Rosoideae
14	*Heliotropium strigosum*	Hatta-juri	Boraginaceae
15	*Jasminium officinalis*	Chameli	Oleaceae
16	*Ocimum basilicum*	Vantulsi	Labiatae
17	*Oxalis corniculata*	Amrit sak	Oxilidaceae
18	*Polygonatum chinensis*	Jangli palak	Polgonaceae
19	*Sonchus oleraceus*	Dudhi, Pathari	Convolvulanceae
20	*Thymus serphyllum*	Hasha	Lebiatae
21	*Tridex procumbens*	Ground weed	Amaranthaceae
22	*Trifolium pratense*	Purple clover	Papilionoidae
23	*Verbascum thapsus*	Gidar tamakus	Scrophulariaceae
	Ferns		
1	*Pteris sp*	Fern	Pteridaceae
2	*Adiantum sp*	Fern	Pteridaceae
	Epiphyte		
1	*Vanda roxburghii*	Badang	Orchidaceae
	Fungi		
1	*Morchella esculata*	Mashroom	

S. No.	SCIENTIFIC NAME	LOCAL NAME	FAMILY
GRASSES			
1	*Arundo donax*	Phiral, Naru	Gramineae
2	*Cynodon dactylon*	Dhub	Gramineae
3	*Saccharum spontaneum*	Kans	Gramineae
4	*Parthenium hysterophorus*	Congress grass	Compositae
5	*Phragimites communis*	Naal	Gramineae
6	*Erianthus munja*	Munj	Gramineae

Source : Field Survey CES (I) Pvt. Ltd, Feb- April 2006

The Chir *(Pinus roxburghii*) occurs remarkably in pure and gregarious form and constitute stable sub climax due to biotic factors. The crop is generally irregular and mature trees are widely scattered. It improves in quality where pure quartzite formations occur. The common associates of Chir (*Pinus roxburghii*) are Ruin (*Mallotus philippinenisis*); Toon (*Cedrela toona*), Kachnar (*Bauhina varigata*), Siris (*Albizzia lebbek*), and Semal (*Bombax ceiba*). The undergrowth generally consists of *Indigofera pulchella*, *Rosa mustata* etc. The ecological features with reference to their habitat, nature i.e. evergreen or deciduous, and their distribution in terms of altitude of the major forest species is given in details below

Table: 3.8
Ecological Features of Dominant Flora

S.No	Name of Species		Ecology		
	Scientific	Local	Habitat	Nature	Distribution (m)
1.	*Albizzia lebbek*	Siris	Hills	Deciduous	300 – 1300
2.	*Bombax ceiba*	Semal	Hill slopes	Deciduous	300 – 1500
3.	*Bauhinia varigata*	Kachnar	Forest	Deciduous	300 – 1500
4.	*Cedrus deodara*	Deodar	High forest	Evergreen	1800 – 3000
5.	*Dalbergia sissoo*	Shisham	Hill slopes	Deciduous	300 – 1500
6.	*Mallotus philippinenisis*	Roghs	Forest	Evergreen	300 – 1200
7.	*Pinus roxburghii*	Chir	Forest	Deciduous	300 – 1500
8.	*Pinus wallichiana*	Kail	Forest	Evergreen	1800 – 4300
9.	*Quercus incana*	Ban Oak	Forest	Evergreen	1200 – 2400
10.	*Quercus semicarpifolia*	Moharu Oak	Forest	Evergreen	2100 – 3800
11.	*Rododendron arboreum*	Brass	Forest	Evergreen	1800 – 4300
12.	*Sapindus mukurossii*	Ritha	Forest	Deciduous	200 – 1500

Source: Data collected during field survey

The Upper reaches (*Pinus wallichiana*) Kail generally occurs. The common associates are Brass (*Rododendron arboreum*), Ban oak (*Quercus incana*) is usually found in small proportion mixed with the Chil (*Pinus roxburghii*), Kai (*Pinus wallichiana*) and Deodar (*Cedrus deodana*). It occupies lower elevation in the northern slopes and along halls It requires a good soil rich in humus.

The Deodar (*Cedrus deodara*) forests occur at higher elevations. The snowfall is must for the existence of these forests. The Deodar prefers comparatively heavy soil formed disintegration of granite.

3.4.6 Community use of Natural Flora

The people from surrounding villages depend on forest for various purposes the Table given below depict various uses of trees by local people.

Table: 3.9
Major Uses of Trees from Forest

Name of Tree	Local	Charco-al	Resins	Fodder	Fuel	Timber	Manure
Cedrus deodara	Deodar	-	-	-	+	+	-
Mallotus philippinenisis	Ruin	-	-	-	+	+	+
Pinus roxburghii	Chir	+	+	-	+	+	+
Pinus wallichiana	Kail	+	+	-	-	+	+
Dalbergia sissoo	Shisham	-	-		+	+	_
Morus alba	Tut	-	-	+	+	-	+
Quercus incana	Ban oak	-	-	+	+	+	+
Quercus semicordifolia	Kharsu Oak	-	-	-	+	+	_

Source: Information Collected during Public Consultation

Considerable loss is done to the forest by the way of illicit felling of Deodar (*Cedrus deodara*) and Kail (*Pinus wallichiana*) for agricultural implements and manufacturing of packing cases. The resins are obtained from Kail (*Pinus wallichiana*) and Chir (*Pinus roxburghii*) by cutting deeply at the base of trees. The local villagers debark Chir (*Pinus roxburghii*) trees for roofing material of sheds and charcoal. The resinous wood is used by the villagers for igniting fires in their houses and as a torch for moving from one room/house to another.

Horticulture offers the better and maximum use of land besides checking soil erosion and ameliorating the economic condition of farmers. Fruit trees offer the possibility of a high food yield per unit of land. They optimize the moisture and nutrients from the sub-soil. Some of the fruit trees generally grown in fields are listed below.

Table: 3.10
Commercially Important Trees (Horticulture)

Botanical Name	English/Common Name
Juglans regia	Walnut
Pyrus malus	Apple
Mangifera indica	Mango
Prunus armeniaca	Apricot, Khumani,
Prunus avium	Cherry (sweet)
Prunus domestica	Plum
Prunus dulcis	Almond
Prunus persica	Peach, Aaru
Prunus cerasus	Cherry (sour)
Punica granatum	Pomigranate
Pyrus communis	Nashpati

Source: Information collected during Public consultation/survey

Large number of herbs is collected for various medicinal purposes. It is estimated that if all the household remedies are taken into account, an estimation of 1500 native plant species are used for health care purposes by the people of the State (Chauhan, 1999). In order to exercise some measure of control over the exploitation of medicinal plants, especially herbs, the Forest Department has prescribed a four-year exploitation cycle and has also fixed an export permit fee in respect of some heavily exploited species. The *Gentiana kurro, Podophyulum emodi* are extensively exported as dhup for incense. The important medicinal herbs of the forest is described in Table No. 3.11

Table: 3.11
Medicinal Plants of Forests

Name of Species		Chemical Property	Part of Plant Use	Use against Disease	Collection Period
Scientific	Local				
Acorus calamus	Barre	Carminative	Rhizome	Colic	Mat- June
Aconitum heterophyllum	Patis	Febrifuge	Root	Dysentery	Sept-Oct
Berberis lycium	Kashmal	Anti-malerial	Root	Jaundice	Nov - Mar
Adhatoda vasica	Basul	Expectorant	Leaves/root	Cough/cold	Dec-Mar
Juranea macrocephala	Dhoop	Freshener	Roots	Dhoop	Mar-May

Name of Species		Chemical Property	Part of Plant Use	Use against Disease	Collection Period
Scientific	Local				
Orchis latifolia	Salmam	Aphrodic	Tubers	Nervous debality	Sept- Nov
Pistacia intergerrima	Kakarsingi	Expectorant	Leaves	Asthama	Mar-May
Podophyllum emodi	Bankakdi	Purgative	Rhizome		Apr- Sept
Gentiana kurroo	Karu	Stimulant	Rhizome	Fever	Oct- Dec
Taxus baccata	Rakhal	Anti-carcinogenic	Bark/ Laves	Asthama	Mar- May
Rhum emodi	Chukri	Purgative	Rhizome		May-Jul

Source: Information Collected during Public consultation

3.4.7 Ethno-botanical Information

The climax species of forest are Deodar (*Cedrus deodara*), Chil (*Pinus roxburghii*) and Kail (*Pinus wallichiana*) hence pathological and ethno-botanical information has been collected with reference to various diseases pathogen type, major symptoms and put of plant affected. Following table depicts details of pathology & ethno-botanical information.

Table: 3.12
Ethno-botanical Approach for Major Plant Species of Forest

Name of Species		Group Pests	Part of Plant Affected	Symptoms	Name of Pests
Scientific	Local				
Cedrus deodara	Deodar	Insect	Needle	Defoliation	Electropis deodara
			Cone	Loss of seeds	Euzophrea cedrella
			Poles	Debarking	Scontus major
			Roots	Stunted growth	Cockchafer malolanthea
			Seedlings	Regeneration	Agrotis ypsilon
			Needle	Discoloration	Brachyxstus subsignatusis
		Fungus	Poles	Stunted Growth	Fomes annosus
Pinus roxburghii	Chir	Insect	Needle	Loss of needles	Platypus biferis
			Needle	Discoloration	Chlonophrous stroilicola

Name of Species		Group Pests	Part of Plant Affected	Symptoms	Name of Pests
Scientific	Local				
		Fungus	Shoots	Stunted Growth	Peridermium cedri
			Needle	Shunted Growth	Peridermium comanulatum
Pinus wallichiana	Kail	Insect	Poles	Debarking	Inslongifolia bores
			Cones	Discoloration	Polyranthus sp
		Fungus		Growth	Trametes pinii

Source: Information collected from Forest Working Plan Rampur / Seraj division

3.4.8 Natural Fauna

The fauna of the study area is represented by reptiles, birds and animals. The variation in altitude, climate, topography, forests type and forest cover leads to variation in animals the fauna can be characterized as domestic animals and wild life. The details are discussed below.

(I) Domestic Life

The rural population is primarily dependant on agriculture based economy for livelihood almost every family owns land and is engaged in agriculture, horticulture, floriculture and animal husbandry. Every family rears livestock for their day to day requirements for agriculture purposes and for cash income. The live stock is mainly dependant upon the natural resources, mainly forest for sustenance. Intensive agriculture is concentrated from foothills to mid-hills valley areas where irrigation facilities exist. In order to assess the population of domestic animals under the study area, animal census data is collected for Rampur division.

The animal census data revealed that cattle population dominated by contributing 42.17% followed by 39.37% of sheep and 18.21% of Goats are predominant group of Ganzers and browses. Local people use the horses, mule and donkeys for carrying their luggage/material in hilly areas.

Table: 3.13
Domestic Animal Census Data (2003) for Rampur Division

S. No.	Animal	Population
1	Cows	37267
2	Buffaloes	862
3	Horses	20
4	Mules	99
5	Donkeys	57

S. No.	Animal	Population
6	Sheeps	35553
7	Goats	16449
	Total	**90315**

Source: Information collected form District Statistical Handbook Govt. of Himachal Pradesh

(II) Wildlife:

The altitudinal variation in the study area is from 700-3000 m hence, wildlife also showed characteristic distribution pattern. The carnivore is represented by Leopard (*Panthera pardus*); Indian Wolf *(Canis lupus)* and Himalayan Fox *(Valpes vulpes).* Among herbivores Barking Deer *(Muntiacus muntiak)* is reported at elevations from 1600-2900mts. Musk Deer (*Moschus moschiferus*) is reported above 3000m, at lower elevation during the winter and higher altitude during summer. All the valleys hold good population of Black Bear (*Selenarctos thibetanus*). These animals move close to habitation during crop season particularly during summer.

The common representatives of reptiles are represented by common Indian Krait (*Bungarus caerules*), Himalayan viper (*Ancistrodous himalayanus*) Indian cobra (*Naja naja*) and Rat snake (*Pyers mocosus*) among Snakes while lizards were represented by Common Indian Monitor (*Varanus monitor*), common House Geeko (*Hemidactylus brooki*), and Rock lizard (*Agamo tuberculata*).

Important birds of the study area includes pheasants which shows typical altitudinal variation among them occurrences such as Kauj Pheasat in the foothill while Koklas & Monal Pheasant in temperate and mid level forest. The list of wildlife reported by forest department is given in following table:

Table: 3.14
List of Wildlife Reported from the Study Area and Their Status

Scientific Name	Common Name	Family	Status*
Mammals			
Barbastella barbasetellus	Barbos teliobat		
Canis lupus	Indian Wolf	Canidae	I
Capricornis sumatraensis	Serow	Sciuridae	II
Caprolagus hispidus	Hispid hare	Cervidae	I
Hylopetes, Petaurista	Flying Squirrels	Hylobatidae	II
Hystrix hodgson	Himalayan Porcupine		II
Martes flavigula	Martens		IV
Mustela sibirica	Himalayan weasel		
Mos homourus	Hill mouse		

Scientific Name	Common Name	Family	Status*
Moschus moschiferus	Musk deer	Cervidae	I
Muntiacus muntjak	Barking deer or Muntjac		III
Nemorhaedus gora,	Gorals		III
Nesekia indica	Indian Molr rat		
Pteromys petaurista	Brown Flying Squirrel		
Selenarctos thibetanus	Himalayan black bear		III
Vulpes vulpes	Red fox	Canidae	IV
Reptiles			
Agamo tuberculata	Rock Lizard		
Ancistrodous himalayanus	Himalayan pit viper		
Bungarus caerules	Common Indian Krait		
Hemidactylus brooki	Common House Geeko		
Naja naja	Indian Cobra		
Pyyas mocosus	Rat Snake		
Varanus flavescens	Monitor Lizard	Varanidae	
BIRDS			
Catreus wallichii	Cheer Pheasant	Phasianidae	I
Ithaginis cruentus tibetanus,	Blood Pheasants	Phasianidae	I
Catreus wallichii	Cheer Pheasant	Phasianidae	I
Syrmaticus humiae	Humes bar backed Pheasant	Phasranidae	I
Lophophorus impejanus,	Monal Pheasants	Phasianidae	I
Tetraogallus tibetanus	Tibetan Snow cock	Phasianidae	I

Source: Information collected from working plan Rampur/Seraj forest division

Status*: As per Wildlife (Protection) Act, 1972

Schedule-I : Endangered and Rare Species

Schedule-II : Special Game

Schedule-III : Big Game

Schedule-IV : Small Game

The Census data of wildlife for Rampur and Anni Forest Division depicts that population of monkeyis largest in both forest divisions. `Seven Leopards have been reported in Rampur Forest division however in Anni Forest division no Leopard are reported. The detail of wildlife census conducted in 2005 is given in the table below:

Table: 3.15
Census Data of Wildlife

Wildlife	Number	Forest division
Red Jungle Fowl	09	Rampur
Kelij Pheasant	04	Rampur
Koklas	09	Rampur
Himalayan Monal	04	Rampur
Monkey	5881	Rampur
Langur	664	Rampur
Leopard	07	Rampur
Monkey	5601	Anni
Leopard	00	Anni
Langur	552	Anni

Source: Forest Department Rampur wild Census 2005

3.5 BIODIVERSITY OF IMMEDIATE INFLUENCE AREA:

The project immediate influence area is comprised of 500m. Surrounding the project sides. The major ecological are steep hill slopes, foothills and passing of national Highways 21 and major Settlements such as Jhakari, Rampur and many townships. The entire area interrupted by agricultural or horticultural activities. The detail of forest types, Natural Flora and Fauna is discussed in detail below.

3.5.1 Forest Types

The major forest types falling under the project influence area are DS-I Himalayan sub tropical scrub and DS-II sub tropical scrub. The detail of forest types is given below.

(i) DS-I Himalayan Sub tropical Scrub :

The extensive growing areas used as grazing grounds & hay fields by the villagers forms this forest type. They are spread over in between Chir (*Pinus roxburghii*). There is frequent burning and large scale burning hence this type forms regressive serial stage.

Major Associates: Dodonea - Rhus - Woodfordid

Minor Associates: Berberts - Cotoneastor- Prinsepia

This type is due to heavy biotic interference of grazing and burning.

(ii) DS-II Sub tropical Euphorbia Scrub

Euphorbia royelana and *Opuntia* sp constitute this type of forest which spread along river Satluj. The common associates are *Zizyphus jujube, Zizyphus nummularia* & *Ficus sp*. This type is associated with lime stone formation.

3.5.2 Natural Flora

The natural flora of the immediate influence area is represented by natural flora along the slopes, foothills, the avenue plantation carried out along the existing NH-21, plantation of Eucalyptus & Dalbergia sissoo carried out by forests department as well as compensatory afforestationn and plantation under catchment area treatment plan of NJHEP project. A total number of 75 plant species observed during survey. The maximum number of 28 species accounted for trees followed by 26 for shrubs, 17 for herbs and 4 species for grasses. The detail of flora recorded is given below.

Table: 3.16
Flora Recorded Under the Immediate Project Area (500m)

S. NO	SCIENTIFIC NAME	LOCAL NAME	FAMILY
TREES			
1.	*Acacia leucophloea*	Subabul	Mimosaceae
2.	*Albizzia lebbek*	Seris	Leguminosae
3.	*Bombax ceiba*	Semal	Bombaceae
4.	*Callistemon citrinus*	Bottle brush	Myrtaceae
5.	*Celtis australis*	Kharak	Urticaceae
6.	*Cupressus torulosa*	Leuri	Coniferae
7.	*Dalbergia sissoo*	Shisham	Fabaceae
8.	*Eucalyptus globules*	Safeda	Myrtaceae
9.	*Ficus elastica*	Rubber tree	Urticaceae
10.	*Ficus religiosa*	Pipal	Urticaceae
11.	*Ficus palmate*	Fedu, Phegru	Urticaceae
12.	*Ficus roxburghii*	Timal	Urticaceae
13.	*Grevellia robusta*	Silver oak	Proteaceae
14.	*Grewia oppositifolia*	Biul	Tiliaceae
15.	*Mangifera indica*	Aam	Anacardiaceae
16.	*Melia azaderach*	Dhenk	Meliaceae
17.	*Mallotus philippinenisis*	Ruin	Euphorbiaceae
18.	*Morus alba*	Tut	Urticaceae
19.	*Morus sps*	Paper Mulberry	Urticaceae
20.	*Morus serrala*	Himu, Tut	Urticaceae
21.	*Pinus roxburghii*	Chil	Coniferae
22.	*Populus ciliala*	Poplar	Salicaceae
23.	*Prunus amygradus*	Badam	Rosaceae
24.	*Prunus communis*	Aloocha	Rosaceae

S. NO	SCIENTIFIC NAME	LOCAL NAME	FAMILY
25.	*Prunus persica*	Aroo	Rosaceae
26.	*Robinia pseudoacacia*	Pahari kikar	Papilionoidaea
27.	*Syzium cumini*	Jamun	Myrtaceae
28.	*Tamarindus indica*	Imli	Caesalpiniaceae
SHRUBS			
1	*Adhatoda vasica*	Basuti, Vasika	Acanthaceae
2	*Agave americana*	Rambans	Cactaceae
3	*Aloe vera*	Aloe	Liliaceae
4	*Artemesia vulgaris*	Artemesia	Compositae
5	*Berberies aristata*	Karmshal, Kashmoi	Berberidaceae
6	*Calotropis gigantea*	Aak	Asclepiadaceae
7	*Cannabis sativa*	Bhang	Cannabinaceae
8	*Carissa spinarum*	Karonada	Apocynaceae
9	*Colebrookia oppositifolia*	Bambher, Sidhar	Labiatae
10	*Debregeasia hypoleuca*	Sihanru	Artocarpeae
11	*Desmodium tiliaefolium*	Martoi	Leguminosae
12	*Dodonaea viscosa*	Mehandi	Sapindaceae
13	*Euphorbia royleana*	Shuru	Euphorbiaceae
14	*Girardinia heterophylla*	Bichhu, Kushki	Urticaceae
15	*Lantana camara*	Lantana	Verbinaceae
16	*Moriandra strobilifera*	Pothi	
17	*Musa paradisiaca*	Kela	Scitaminaeae
18	*Opuntia monocantha*	Nagphani	Cactaceae
19	*Plectranthus coesta*	Chichiri	Labiatae
20	*Princepia utilis*	Bhekal	Rosaceae
21	*Ricinus communis*	Arandi	Euphorbiaceae
22	*Rubus ellipticus*	Hinsar	Rosaceae
23	*Rumex hastatus*	Bhilmora	Polgonaceae
24	*Solanum surattense*	Kateli	Solanaceae
25	*Woodfordia fruticosa*	Dhaula	Lythraceae
26	*Zizyphus nummularia*	Beri	Rhamnaceae
HERBS			
1	*Achyranthes aspera*	Aghada, Puthkanda	Amaranthaceae

S. NO	SCIENTIFIC NAME	LOCAL NAME	FAMILY
2	*Argemone mexicana*	Prickly poppy	Papaveraceae
3	*Asparagus racemosa*	Sahansarpali	Liliaceae
4	*Chenopodium album*	Bathwa	Chenopodiaceae
5	*Chromolaena odorata*	Triva gandha	Chromolaenae
6	*Echinops echinatus*	Gokhru	Compositae
7	*Erigeron bellidioides*	Horse weed	Compositae
8	*Fragaria indica*	Bhumla	Rosoideae
9	*Heliotropium strigosum*	Hatta-juri	Boraginaceae
10	*Ocimum basilicum*	Vantulsi	Labiatae
11	*Oxalis corniculata*	Amrit sak	Oxilidaceae
12	*Pteris sps*	Fern	Pteridaceae
13	*Sonchus oleraceus*	Dudhi, Pathari	Convolvulanceae
14	*Tridex procumbens*	Ground weed	Amaranthaceae
15	*Trifolium pratense*	Purple clover	Papilionoidae
16	*Verbascum thapsus*	Gidar tamakus	Scrophulariaceae
17	*Jasminium officinalis*	Chameli	Oleaceae
GRASSES			
1	*Arundo donax*	Phiral, Naru	Gramineae
2	*Cynodon dactylon*	Dhub	Gramineae
3	*Saccharum spontaneum*	Kans	Gramineae
4	*Parthenium hysterophorus*	Congress grass	Compositae

Source: Field Survey CES (I) Pvt. Ltd, Feb- April 2006

The dominant tree species of avenue plantataion are *Acacia leucophloea* (Subabul), *Albizzia lebbek* (Seris), *Bombax ceiba* (Semal), *Callistemon citrinus* (bottle brush), *Ficus palmate* (Fedu), *Grevellia robusta* (Silver oak), *Grewia oppositifolia (*Biul*), Melia azaderach* (Dhenk), *Morus serrata* (Shehtut*), Populus ciliata* (Poplar), *Robinia pseudoacacia* (Pahari Kikar), *etc.* The plantation carried out by forests department is mainly of *Pinus roxburghi* (Chil), *Dalbergia sisso* (Sisham) *and Eucalyptus globulus* (Safeda)

The area is interrupted by various agricultural and horticultural activities hence fruit trees were commonly recorded such as *Mangifera indica (Mango), Prunus amygradus* (badam), *Prunus communis* (Aloocha), *Prunus persica* (Aroo), *Syzium cumini* (Jamun), *Tamarindus indica* (Imli) *etc.*

The common shrubs observed were *Adhatoda vasica ()Agave americana (*Rambans), *Calotropis gigantean* (Akh), *Cannabis sativa* (Bhang), *Carissa spinarum* (Karonda), *Colebrookia oppositifolia* (Bhaber*), Debregeasia hypoleuca* (Sihanaru), *Dodoneae*

viscosa (Mehandi), *Euphorbia royleana* (Shuru)*, Girardinia heterophylla* (Bichhu Ghas), *Moriandra strobilifera* (Pothi), *Rubus ellipticus* (Hinsar) *Rumex hastatus* (Bhilmora) *etc.,*

The common herb species of the immediate influence area is represented by *Achyranthes aspera* (Aghada), *Chenopodium album* (Bathua), *Erigeron bellidioides (Horse weed), Oxalis corniculata* (Amrit sack), *Sonchus oleraceus* (Dudhi), *Fragaria indica* (Bhumla) *etc.* The common climbers are represented by *Asparagus racemosa* (Shatavari) and *Jasminium officinalis* (Chameli).

3.5.3 Natural Fauna

The distribution of fauna is mainly dependant on availability and type of vegetation providing feeding, breeding, hiding & resting sites. As project area is dominated by hilly tracks with less vegetation cover and interrupted by agriculture activities in the form of trench cultivation. Fauna of the project area is represented by reptiles, birds and mammals. The reptiles were represented by *Calotes versicolor* (Common Lizard) common Geeko (*Hemidactylus brooki*). The mammals were represented by animals of local importance such as Cows, Oxes, Horese, Mule, Donkey, Pigs etc. No wildlife is recorded during the survey by direct or indirect evidiences. The total no of 35 species of birds where were recorded during the survey (Table 3.15) :

Table: 3.17
List of Avifauna Recorded Under the Immediate Influence Area

S. No.	Scientific Name	Common Name	Family
1.	*Acridotheres tristis*	Indian Myna	Sturnidae
2.	*Aeridotheres ginginianus*	Bank myna	Sturnidae
3.	*Cassa flavirostris*	Yellowbilled Blue Magpai	Carvidae
4.	*Columba livia*	Blue Rock Pigeon	Columidae
5.	*Corvus macrorhynchos*	Jungle Crow	Carvidae
6.	*Corvus splendens*	House Crow	Carvidae
7.	*Corvus corax*	Ravan	Carvidae
8.	*Dandroatta vagabunda*	Treepie	Corvidae
9.	*Dicrurus adsimilis*	Black Drongo	Dieruridae
10.	*Egretta garzetta*	Little Egret	Ardeidae
11.	*Gallus gallus*	Common Fowl	Phasinidae
12.	*Lanius schach*	Rofusedbacked Shrike	Campehagidae
13.	*Lanius excubitor*	Grey Shrike	Campehagidae
14.	*Megalaima malabarica*	Crimsonbreasted barbet	Cpilonidae
15.	*Megalaima zeylanica*	Largegreen barbet	Cpilonidae
16.	*Milvus migrans*	Pariah Kite	Acciptridae
17.	*Motacilla maderatensis*	Large pied wagtail	Motacillidae
18.	*Myiophonus horsfieldii*	Whistling Thrush	Turnidae

S. No.	Scientific Name	Common Name	Family
19.	*Nactarinia asiatica*	Purplerumpled Sunbird	Nectarinidae
20.	*Nectarinia minima*	Small Sunbird	Nectarinidae
21.	*Orthotomus sutorius*	Tailor Bird	Pachycephalinae
22.	*Parus major*	Gray Tit	Parinae
23.	*Passeer domesticus*	House Sparrow	Passerinae
24.	*Psittacula krameri*	Roseringed Parakeet	Psittacidae
25.	*Psittacula cyanocephala*	Blossomheaded Parakeet	Psittacidae
26.	*Psittacula himalayana*	Slatyheaded Parakeet	Psittacidae
27.	*Picnonotus articeps*	Black Headed Bulbul	Pycnonotidae
28.	*Picnonotus leucogenys*	White Cheeked Bulbul	Pycnonotidae
29.	*Picnonotus cafer*	Redvented Bulbul	Pycnonotidae
30.	*Sexicoloides fulicate*	Indian Robin	Muscicapidae
31.	*Sopsychus saularis*	Magpie Robin	Muscicapidae
32.	*Streptopelia chinensis*	Spotted dove	Columbidae
33.	*Streptopelia decaocto*	Ring Dove	Columbidae
34.	*Turdoides caudatus*	Common babbler	Muscicapidae
35.	*Terpsiphone paradisi*	Paradise Flycatcher	Muscicapinae
36.	*Turdus merula*	Blackbird	Turninae
37.	*Upupa epops*	Hoopoe	Upupidae
38.	*Zosterops palpebrosa*	White Eyed	Zosteropidae

Source: Field Survey CES (I) Pvt. Ltd, Feb- April 2006

3.6 BIO DIVERSITY OF PROJECT AFFECTED AREA

The project-affected area is comprised of forestland, which involves establishment of various project units i.e. 86.5 ha of land of which 48.9 ha is forestland for surface work. The layout plan of Project affected Area is attached as **Fig. 3**. The terrestrial biodiversity study was conducted on above mention forestland that is project area to provide information on baseline status of flora and fauna. Break up of forestland is given below

Table: 3.18
Breakup of Forest Land under the Project Area

S.No.	Name of Site	Forest Area		
		Mohal /Up Mohal	Forest Land	
			In Bighas	In Hect.
1	Cut & cover and Job facilities	Falti Kushwa (Kothi 15/20)	10-19	00-88-62
2	Adit Approach road & Job facilities Koja Adit).	Fatti Tunan (Kothi 15/20)	12-10	01-01-16
3	Job Facilities (Kajo	Fatti Tunan	05-14	00-46-13

S.No.	Name of Site	Forest Area		
		Mohal /Up Mohal	Forest Land	
			In Bighas	In Hect.
	Adit)	(Kothi 15/20)		
4	Dumping Area (Near Kojo Adit)	Fatti Tunan (Kothi 15/20)	89-13	07-25-53
5	Adit Approach & Job facilities (Kunni Adit)	Fatti Tunan (Kothi 15/20)	05-08	00-43-70
6	Dumping Area (Near Kunni Adit)	Fatti Tunan (Kothi 15/20)	15-03	01-22-61
7	Bridge & Approach road 9near Kunni Adit)	Fatti Tunan (Kothi 15/20)	00-13	00-07-69
8	Adit & Job Facilities (Goshai Adit)	Fatti Tunan (Kothi 15/20)	18-00	01-45-67
9	Dumping Area	Fatti Nirmand	29-10	02-38-74
10	Dumping Area	Fatti Nirmand	45-01	03-64-59
11	Approach road & Job facilities	Fatti Bayal	198-09	16-06-04
12	Power House, Penstocks, Approach road & Job facilities	Fatti Bayal	82-17	06-70-50
13	Approach road, Tail Race & job facilities	Fatti Bayal	08-02	00-65-55
14	Approach road & Job facilities	Fatti Bayal	15-11	01-25-84
15	Quarry road, Crusher & Job facilities	Gadej (Koel)	67-05	05-44-25
	Total		**604-15**	**48-96-62**

Source: Rampur Hydroelectric Project, Jhakri

3.6.1 Forest Type

The terrestrial ecosystem of the project area is represented by hilly mountainous tracks, steep hill slopes, foothills and Satluj river valley. The project area is mainly represented by dwarf shrubby vegetation interrupted by patches of Eucalyptus plantation. The total forests cover area of the project area is 48.9 ha for surface work and 20.41 ha forestland involves undergroung work. The major forests type occurring in Project Affected Area are discusses in details below

(I) DS-I Himalayan Sub tropical Scrub:

The extensive growing areas used as grazing grounds & hay fields by the villagers forms this forest type. They are spread over in between Chir (*Pinus roxburghii*). There is frequent burning and large scale burning hence this type farms regressive seral stage.

Major Associates: Dodonea - Rhus - Woodfordid

Minor Associates: Berberis - Cotoneastor- Prinsepia

This type is due to heavy biotic interference of grazing and burning.

(II) DS-II Sub tropical Euphorbia Scrub

Euphorbia royleana and *Opuntia* sp constitute this type of forest which spread along river Satluj. The common associates are *Zizyphus jujuba Zizyphus nummularia & Ficus sp.* This type is associated with lime stone formation.

3.6.2 Natural Flora

The species were identified and categorized for their ecological characteristics. The flora of project area is represented by 64 species belonging to 52 genera and 34 families. Physio-gnomically vegetation has been categorized as trees, shrubs, herbs and grasses. The flora recorded under the project affected sites is presented below in the table:

Table: 3.19
Flora Recorded Under the Project Affected Area

S. NO	SCIENTIFIC NAME	LOCAL NAME	FAMILY
TREES			
1	*Acacia leucophloea*	Subabul	Mimosaceae
2	*Bombax ceiba*	Semal	Bombaceae
3	*Celtis australis*	Kharak	Urticaceae
4	*Dalbergia sissoo*	Shisham	Fabaceae
5	*Eucalyptus globulus*	Safeda	Myrtaceae
6	*Ficus palmata*	Fedu, Phegru	Moraceae
7	*Grewia oppositifolia*	Biul	Tiliaceae
8	*Mangifera indica*	Aam	Anacardiaceae
9	*Melia azaderach*	Dhenk	Meliaceae
10	*Millingtonia hortensis*	Akas Neem	Sapotaceae
11	*Mallotus philippinenisis*	Ruin	Euphorbiaceae
12	*Morus alba*	Tut	Meliaceae
13	*Pinus roxburghii*	Chil	Coniferae
14	*Prunus communis*	Aloocha	Rosaceae
15	*Prunus persica*	Aroo	Rosaceae
16	*Robinia pseudoacacia*	Pahari kikar	Papilionoidaea
17	*Tamarindus indica*	Imli	Caesalpiniaceae
SHRUBS			
1	*Adhatoda vasica*	Basuti, Vasika	Acanthaceae
2	*Agave americana*	Rambans	Cactaceae

S. NO	SCIENTIFIC NAME	LOCAL NAME	FAMILY
3	*Aloe vera*	Aloe	Liliaceae
4	*Artemesia vulgaris*	Artemesia	Compositae
5	*Berberies aristata*	Karmshal, Kashmoi	Berberidaceae
6	*Calotropis gigantea*	Aak	Asclepiadaceae
7	*Cannabis sativa*	Bhang	Cannabinaceae
8	*Carissa spinarum*	Karonada	Apocynaceae
9	*Colebrookia oppositifolia*	Bambher, Sidhar	Labiatae
10	*Debregeasia hypoleuca*	Sihanru	Artocarpeae
11	*Desmodium tiliaefolium*	Martoi	Leguminosae
12	*Dodonaea viscosa*	Mehandi	Sapindaceae
13	*Euphorbia royleana*	Shuru	Euphorbiaceae
14	*Girardinia heterophylla*	Bichhu, Kushki	Urticaceae
15	*Lantana camara*	Lantana	Verbinaceae
16	*Musa paradisiaca*	Kela	Scitaminaeae
17	*Opuntia monocantha*	Nagphani	Cactaceae
18	*Princepia utilis*	Bhekal	Rosaceae
19	*Ricinus communis*	Arandi	Euphorbiaceae
20	*Rubus ellipticus*	Hinsar	Rosaceae
21	*Rumex hastatus*	Bhilmora	Polgonaceae
22	*Solanum surattense*	Kateli	Solanaceae
23	*Zizyphus nummularia*	Beri	Rhamnaceae
HERBS			
1	*Achyranthes aspera*	Aghada, Puthkanda	Amaranthaceae
2	*Argemone mexicana*	Prickly poppy	Papaveraceae
3	*Asparagus racemosa*	Sahansarpali	Liliaceae
4	*Chenopodium album*	Bathwa	Chenopodiaceae
5	*Chromolaena odorata*	Triva gandha	Chromolaenae
6	*Echinops echinatus*	Gokhru	Compositae
7	*Erigeron bellidioides*	Horse weed	Compositae
8	*Fragaria indica*	Bhumla	Rosoideae
9	*Heliotropium strigosum*	Hatta-juri	Boraginaceae
10	*Ocimum basilicum*	Vantulsi	Labiatae
11	*Oxalis corniculata*	Amrit sak	Oxilidaceae

S. NO	SCIENTIFIC NAME	LOCAL NAME	FAMILY
12	*Pteris sps*	Fern	Pteridaceae
13	*Sonchus oleraceus*	Dudhi, Pathari	Convolvulanceae
14	*Tridex procumbens*	Ground weed	Amaranthaceae
15	*Trifolium pratense*	Purple clover	Papilionoidae
16	*Verbascum thapsus*	Gidar tamakus	Scrophulariaceae
17	*Jasminium officinalis*	Chameli	Oleaceae
GRASSES			
1	*Arundo donax*	Phiral, Naru	Gramineae
2	*Cynodon dactylon*	Dhub	Gramineae
3	*Saccharum spontaneum*	Kans	Gramineae
4	*Parthenium hysterophorus*	Congress grass	Compositae

Source: Field Survey CES (I) Pvt. Ltd, Feb- April 2006

3.6.3 Community Uses of Natural Flora

The trees in the project area are used for various purposes. The major uses of trees falling under the project area are as given below:

Table: 3.20
Major Uses of Trees under the Project Area

Name of Tree	Fence	Ornamental	Avenue Planting	Fodder	Fuel	Timber	Fruit
Acacia leucophloea	+	-	-	+	–	–	–
Bombax ceiba	-	+	-	-	+	-	-
Celtis australis	-	-	-	+	-	+	–
Dalbergia sisso	-	-	-	-	+	+	-
Eucalyptus globulus	-	-	+	-	-	+	-
Ficus palmata	-	-	-	+	-	-	+
Grewia oppositifolia	-	-	-	+	-	-	-
Mangifera indica	-	-	-	-	-	-	+
Melia azaderach	-	-	-	+	-	-	-
Millingtonia hortensis	-	-	-	-	+	-	-

Name of Tree	Fence	Ornamental	Avenue Planting	Fodder	Fuel	Timber	Fruit
Mollotus phillipinenisis	-	+	-	-	+	-	-
Morus alba	-	-	-	-	+	-	+
Pinus roxburghii	-	+	-	-	+	-	-
Prunus communis	-	-	-	-	-	-	+
Prunus persica	-	-	-	-	-	-	+
Robinia pseudoacacia	-	+	-	+	-	-	-
Tamarindus indica	-	-	-	-	-	-	+

Source : Public Consultation

3.6.4 Natural Fauna

The distribution of fauna is mainly dependant on availability and type of vegetation providing feeding, breeding, hiding & resting sites. As project, area is dominated by hilly tracks with less vegetation cover and interrupted by agriculture activities in the form of trench cultivation. Fauna of the project area is mainly represented by reptiles, birds and mammals. The reptiles were represented by *Calotes versicolor* (Common Lizard) and *Hemidactylus brooki* (Common Geeko).

(1) Avifauna

Birds were identified with binox .The common birds recorded during the survey are given below:

Table: 3.21
List of Avifauna Recorded Under the Project Affecte Area

S. No	Scientific Name	Common Name	Family
1	*Acridotheres tristis*	Indian Myna	Sturnidae
2	*Aeridotheres ginginianus*	Bank myna	Sturnidae
3	*Columba livia*	Blue Rock Pigeon	Columidae
4	*Corvus macrorhynchos*	Jungle Crow	Carvidae
5	*Corvus splendens*	House Crow	Carvidae
6	*Corvus corax*	Common raven	Carvidae
7	*Dandroatta vagabunda*	Treepie	Corvidae
8	*Dicrurus adsimilis*	Black Drongo	Dieruridae
9	*Egretta garzetta*	Little Egret	Ardeidae

S. No	Scientific Name	Common Name	Family
10	*Lanius excubitor*	Grey Shrike	Campehagidae
11	*Megalaima malabarica*	Crimson breasted barbet	Cpilonidae
12	*Milvus migrans*	Pariah Kite	Acciptridae
13	*Motacilla maderatensis*	Large pied wagtail	Motacillidae
14	*Nactarinia asiatica*	Purplerumpled Sunbird	Nectarinidae
15	*Nectarinia minima*	Small Sunbird	Nectarinidae
16	*Orthotomus sutorius*	Tailor Bird	Pachycephalinae
17	*Passeer domesticus*	House Sparrow	Passerinae
18	*Psittacula krameri*	Rose ringed Parakeet	Psittacidae
19	*Picnonotus leucogenys*	White Cheeked Bulbul	Pycnonotidae
20	*Picnonotus cafer*	Red vented Bulbul	Pycnonotidae
21	*Sexicoloides fulicate*	Indian Robin	Muscicapidae
22	*Sopsychus saularis*	Magpie Robin	Muscicapidae
23	*Streptopelia chinensis*	Spotted dove	Columbidae
24	*Turdoides caudatus*	Common babbler	Muscicapidae
25	*Terpsiphone paradise*	Paradise Flycatcher	Muscicapinae
26	*Turdus merula*	Blackbird	Turninae
27	*Upupa epops*	Hoopoe	Upupidae

Source: Field Survey CES (I) Pvt. Ltd, Feb- April 2006

(2) Domestic Animals

The common domestic animals observed were Cow, Bulls, Sheep, Goats, Dogs, Cats and Fowls. The major grazers were cows and bulls while browsers were sheep and goats.

(3) Wildlife

During field survey of project-affected area, no evidences of existence of any wildlife either direct or indirect were recorded. None of the endangered, rare, threatened or endemic wildlife species was noticed from the project area.

3.7 QUANTITATIVE ASSESSMENT OF FLORA

Assessment of Importance Value Index and Diversity index of flora of Project affected areas and immediate influence area has been conducted. Importance Value Index

(IVI) expresses dominance and ecological success of any species in an area whereas Diversity Index expresses the variety of species in an area.

3.7.1 Project Affected Area

Assessment of flora of project-affected area has been conducted. Area specific Diversity index and importance value of affected project area have been derived. All the sites are open scrub areas dominated by thorny shrubs and weed species. The dominant shrub species recorded are *Adhatoda vasica, Zizyphus nummularia, Rumex haustatus, Colebrookia oppositifolia, Cannabis sativa, Artemesia vulgaris*, *Euphorbia royleana, Dodoneae viscose etc.* These species are representative of degrade area and are abundantly found in dry areas and wasteland.
The dominant herbs and grasses are represented by *Pathenium hysterophorus*, *Arundo donax, Cynodon dactylon, Oxalis corniculata, Tridex procumbens, Erigeron bellidioides etc.* Parthenium is weed species present in the area is indicators of degraded land and are found throughout the arid zones and degraded areas

The Tree species is represented by *Eucalyptus globules*, which is an exotic species planted in the area. Besides Eucalyptus some fruit trees like, *Prunus persica, Prunus communis* etc. are present. The area wise assessment of the flora is provided in the tables below:

Table: 3.22
Assessment of Flora of Dumping Area near Curtain Cover Head Race Tunnel

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Artemesia vulgaris	42.85	78.26	10.81	131.9
Euphorbia royleana	42.85	17.39	30.83	91.08
Ficus palmate	14.28	4.34	58.37	77.01
Herbs & Grasses				
Argemone mexicana	20.00	7.14	1.01	28.16
Arundo donax	40.00	42.86	89.66	172.5
Parthenium hysterophorus	40.00	50.00	9.14	99.14

Table: 3.23
Assessment of Flora of Dumping Area near Kazo Adit

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Adhatoda vasica	14.81	27.27	14.75	56.83
Agave americana	3.70	1.81	0.72	6.24

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Aloe vera	3.70	1.81	0.662	6.18
Bombax ceiba	3.70	1.81	61.37	66.88
Calotropis gigantea	7.40	9.36	0.937	17.70
Cannabis sativa	11.11	14.54	2.245	27.90
Carissa spinarum	3.70	1.81	0.49	6.01
Colebrookia oppositifolia	11.11	16.36	7.99	35.46
Dodonaeae viscosa	7.40	3.63	0.641	11.68
Opuntia monocantha	3.70	1.81	3.07	8.59
Prinsepia utilis	7.40	3.63	1.70	12.74
Ricinus communis	3.70	1.81	0.371	5.89
Rumex hastatus	11.11	7.27	0.837	19.22
Zizyphus nummularia	14.81	16.36	5.17	36.35
Herbs & Grasses				
Chenopodium album	10.00	13.79	18.32	42.11
Chromolaena odorata	20.00	17.24	18.95	56.19
Cynodon dactylon	10.00	13.79	33.93	57.7
Jasminium officinalis	20.00	6.89	1.864	28.76
Oxalis corniculata	10.00	17.24	15.38	42.62
Tridex procumbens	30.00	31.03	11.58	72.61

Table: 3.24
Assessment of Flora of Kazo Adit Job Facilities

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Berberies aristata	10.00	3.33	1.52	14.85
Cannabis sativa	10.00	13.33	1.53	24.86
Carissa spinarum	10.00	3.33	0.42	13.75
Colebrookia oppositifolia	40.00	66.66	23.64	130.3
Desmodium titiaefolium	20.00	10	1.41	31.41
Pinus roxburghii	10.00	3.33	71.49	84.82
Herbs & Grasses				
Achyranthes aspera	12.49	7.69	10.44	30.63

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Asparagus racemosa	6.24	2.56	3.55	12.37
Echinops echinatus	18.74	17.94	26.84	63.53
Ocimum basilicum	24.99	17.94	17.90	60.85
Oxalis corniculata	18.74	17.94	11.86	48.56
Parthenium hysterophorus	6.24	20.51	16.24	43.00
Pteris sps.	12.49	15.38	13.07	40.96

Table: 3.25
Assessment of Flora of Kazo Adit Approach Road

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Acacia leucophloea	9.09	4.00	23.44	36.53
Calatropis gigantea	18.18	8.00	0.341	26.52
Cannabis sativa	27.27	56.0	2.61	85.88
Colebrookia oppositifolia	27.27	20.0	3.91	51.18
Mollotus phillipinenisis	27.27	16.0	69.37	112.6
Rumex haustatus	27.27	16.0	0.80	44.08
Solanum surattense	9.09	4.00	0.74	13.83
Herbs & Grasses				
Heliotropium strigosum	25.0	22.22	18.34	65.56
Ocimum basiculum	16.66	22.22	22.53	61.42
Oxalis corniculata	16.66	18.51	15.41	50.59
Saccharum spontaneum	25.0	29.63	34.73	89.36
Verbascum thapsus	16.66	7.40	8.86	32.94

Table: 3.26
Assessment of Flora of Kazo Adit

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Pinus roxburghii	33.33	50.05	99.78	183.16
Rumex hastatus	66.66	50.05	0.192	116.90
Herbs & Grasses				
Parthenium hysterophorus	49.97	66.66	48.17	164.81
Saccharum spontaneum	49.97	33.33	51.83	135.14

Table: 3.27
Assessment of Flora of Dumping Area near Kunni Adit

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Adhatoda vasica	10.71	7.84	19.50	38.06
Berberies aristata	3.57	1.96	3.02	8.55
Calatropis gigantea	7.14	5.88	6.09	19.12
Cannabis sativa	7.142	15.68	10.73	33.56
Carissa spinarum	3.57	1.96	2.46	7.99
Colebrookia oppositifolia	17.85	25.49	16.40	59.82
Debregeasia hypoleuca	3.57	1.96	2.77	8.31
Dodonaea viscosa	21.42	19.60	18.90	59.93
Euphorbia royleana	3.57	1.96	5.02	10.55
Lantana camara	14.28	11.76	8.10	34.15
Rubus ellipticus	3.57	1.96	2.76	8.29
Zizyphus nummularia	3.57	3.92	4.125	11.61
Herbs & Grasses				
Fragaria indica	18.18	15.38	18.30	51.86
Launaea procumbens	18.18	23.07	21.28	62.54
Parthenium hysterophorus	36.36	34.61	40.56	111.54
Tridex procumbens	27.27	26.92	19.85	74.05

Table: 3.28
Assessment of Flora of Kunni Adit

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Calotropis gigantea	40.00	37.50	39.67	117.17
Rumex hastatus	60.00	62.50	60.32	182.82
Herbs & Grasses				
Cynodon dactylon	49.99	41.66	41.25	132.92
Parthenium hysterophorus	49.99	58.33	58.74	167.07

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Table: 3.29
Assessment of Flora of Dumping Area near Goshai Adit

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Dodoneae viscosa	60.00	71.43	1.82	133.25
Eucalyptus globulus	20.00	14.28	91.99	126.28
Euphorbia royleana	20.00	14.28	6.18	40.47
Herbs & Grasses				
Oxalis corniculata	50.00	60.00	58.44	168.44
Tridex procumbens	50.00	40.00	41.55	131.55

Table: 3.30
Assessment of Flora of Dumping Area Nimrand Bridge

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Adhatoda vasica	17.65	20.0	3.16	40.81
Cannabis sativa	11.76	16.00	2.56	30.33
Carissa spinarum	5.882	4.00	0.67	10.56
Colebrookia oppositifolia	17.65	24.00	7.42	49.07
Euphorbia royleana	23.53	20.00	29.89	73.4
Ficus palmata	5.882	4.00	27.19	37.07
Opuntia monocantha	5.882	4.00	2.09	11.98
Robinia pseudoacacia	5.882	4.00	25.97	35.85

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Zizyphus nummularia	5.88	4.00	0.99	10.88
Herbs & Grasses				
Fragaria indica	16.67	10.52	9.20	36.39
Oxalis corniculata	33.33	38.59	36.57	108.50
Parthenium hysterophorus	41.67	47.36	50.4	139.53
Verbascum thapsus	8.33	3.50	3.715	15.55

Table: 3.31
Assessment of Flora of Dumping Area near Veri

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Calotropis gigantea	25.00	29.99	1.68	56.68
Colebrookia oppositifolia	25.00	20.0	3.00	48.00
Zizyphus nummularia	25.00	29.99	2.54	57.54
Eucalyptus globulus	25.00	20.0	92.66	137.66
Herbs & Grasses				
Parthenium hysterophorus	75.00	86.84	96.10	257.95
Cynodon dactylon	25.00	13.15	3.84	42.00

Table: 3.32
Assessment of Flora of near Surge Shaft Area-- Approach road

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Adhatoda vasica	25.0	35.55	3.57	64.13
Cannabis sativa	12.5	26.66	1.16	40.33
Carissa spinarum	4.16	2.22	0.17	6.55
Eucalyptus globulus	12.5	8.88	90.0	111.38
Euphorbia royleana	12.5	6.66	3.26	22.43
Opuntia monocantha	8.33	4.44	0.65	13.43
Princepia utilis	8.33	4.44	0.52	13.29
Rumex hastatus	8.33	6.66	0.40	15.40
Saccharum spontaneum	62.5	63.63	32.03	158.17
Zizyphus nummularia	8.33	4.44	0.24	13.01

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Herbs & Grasses				
Arundo donax	37.5	36.36	67.96	141.82

Table: 3.33
Assessment of Flora of Power House Area & Approach Road

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Adhatoda vasica	9.30	11.86	0.32	21.49
Agave Americana	6.97	5.08	2.41	14.4
Ailanthus excelsa	2.32	1.69	3.02	7.04
Cannabis sativa	6.97	10.17	0.16	17.3
Carissa spinerum	4.65	5.08	0.21	9.95
Celtis australis	2.32	1.69	2.60	6.62
Dalbergia sissoo	2.32	1.69	1.29	5.31
Eucalyptus globules	9.30	11.8	39.0	60.20
Euphorbia royleana	2.32	1.69	0.85	4.87
Ficus palmata	2.32	1.69	3.00	7.02
Girardinia heterophylla	2.32	3.3	0.20	5.9
Grevia sps	2.32	1.69	2.70	6.72
Lantana camara	2.32	6.78	0.10	9.20
Mangifera indica	2.32	1.69	13.52	17.5
Melia azaderach	6.97	5.08	4.50	16.5
Milingtonia hortensis	2.32	1.69	3.43	7.45
Morua alba	2.32	1.69	3.32	7.34
Musa paradisiaca	2.30	1.69	4.21	8.23
Prinsepia utilis	4.65	3.39	0.15	8.19
Prunus communis	4.65	6.78	6.30	17.7
Prunus persica	4.65	3.39	6.01	14.0
Ricinus communis	4.65	3.39	0.09	8.13
Rumex haustatus	4.65	3.3	0.03	8.07
Solanum surattense	2.32	1.69	0.29	4.31
Tamrindus indica	2.32	1.69	2.14	6.16
Herbs & Grasses				
Arundo donax	11.11	6.89	64.69	82.699

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Chenopodium album	11.11	6.897	1.272	19.28
Cynodon dactylon	22.22	31.04	11.35	64.604
Fragaria indica	11.11	13.79	5.875	30.78
Oxalis corniculata	22.22	24.14	6.666	53.02
Trifolium pratense	11.11	13.79	5.525	30.43
Verbascum thapsus	11.11	3.44	4.627	19.187

Table: 3.34
Assessment of Flora of Quarry site

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Adhatoda vasica	10.52	6.25	5.16	21.94
Calatropis gigantea	5.263	3.12	0.05	8.44
Eucalyptus globulus	5.263	12.50	12.83	30.60
Euphorbia royleana	10.52	9.37	2.79	22.69
Ficus palmata	5.263	3.12	7.34	15.73
Melia azaderach	10.52	6.25	12.30	29.08
Musa paradisiaca	5.263	6.25	10.97	22.49
Prunus communis	15.78	21.87	34.03	71.69
Prunus persica	10.52	12.50	14.18	37.21
Rumex hastatus	10.52	9.37	0.15	20.05
Zizyphus nummularia	10.52	9.37	0.1	20.05
Herbs & Grasses				
Argemone mexicana	11.11	10.00	11.52	32.63
Erigeron bellidioides	22.22	15.00	13.65	50.87
Fragaria indica	22.22	20.00	19.36	61.58
Oxalis corniculata	22.22	20.00	18.20	60.42
Sonchus oleraceus	11.11	15.00	15.92	42.03
Tridex procumbens	11.11	20.00	21.36	52.47

The Diversity Index for the project-affected area has been calculated. The diversity of the area is very low. Highest value of diversity index recorded is 1.28 for Powerhouse and approach road area. For all other sites, the diversity index is below 1. This

indicates that the area is not rich in floral wealth and represents poor diversity. The diversity index of the project-affected area is given in the table below.

Table: 3.35
Diversity Index of Project Affected Area

S.N	SITE	DIVERSITY INDEX (H)	
		Trees & Shrubs	Grasses & Herbs
1	Curtain Cover Head Race Tunnel	0.27	0.39
2	Dumping Area (near Kazo Adit)	0.90	0.58
3	Dumping Area (near Kunni Adit)	0.97	0.73
4	Kazo Adit	0.27	0.27
5	Kazo Job Facility	0.48	0.79
6	Kazo Approach Road	0.51	0.66
7	Kuni Adit	0.28	0.29
8	Goshai Adit	0.34	0.29
9	Dumping Area (Nirmand Bridge)	0.83	0.46
10	Veri Dumping Area	0.59	0.16
11	Surge Shaft Area (Approach road)	0.78	0.28
12	Power House Area (Approach road, tail race and job facilities)	1.28	0.75
13	Quarry road, Crusher & Job Facilities	0.97	0.76

3.7.2 Assessment of Flora of the Immediate Influence Area

Assessment of flora of immediate influence area has been conducted (500m from the project-affected areas). Random Quadrat sampling has been conducted and site-specific Diversity Index and Importance Value Index have been derived. The Diversity index is low and maximum value is 1.41. The value of diversity index for trees & shrubs is higher than grasses & herbs. Importance Value Index (IVI) expresses dominance and ecological success of any species in an area. The flora of the area is dominated by succulent shrubs such as *Agave americana* (Rambans), *Euphorbia royleana* (Shuru), and *Opuntia monocantha* (Nagphani) followed by thorny species such as *Carissa spinarum* (Karonda), *Zizyphus nummularia* (Beri), *Rubus ellipticus* (Hinsar), *Solanum surrattense* (Kateli) etc. The assessment of flora depicts that *Eucalyptus globules* is the dominant tree in the area followed by *Mallotus phillipinenisis and* fruit trees of Prunus sps.

Among herbs and grasses *Parthenium hysterophorus* is dominant species followed by *Arundo donax, Cynodon dactylon, Oxalis corniculata, Tridex procumbens,*

Erigeron bellidioides, Jasminium officinalis, Fragaria indica etc. The site wise quantitative assessment of the flora of project affected sites are discussed below

Table: 3.36
Assessment of flora of Kunni Area

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Callistemon citrinus	5.40	5.88	7.20	18.44
Dalbergia sissoo	5.40	3.92	9.43	18.76
Eucalyptus globules	5.40	3.92	13.91	23.24
Ficus religiosa	2.70	1.96	2.91	7.57
Ficus palmata	2.70	1.96	3.09	7.75
Ficus roxburghii	2.70	1.96	4.27	8.93
Grevellia robusta	2.70	3.92	12.32	18.95
Mangifera indica	2.70	1.96	17.07	21.73
Mallotus philippinenisis	2.70	1.96	1.43	6.10
Pinus roxburghii	2.70	3.9	12.32	18.95
Prunus communis	5.40	3.92	1.66	10.99
Robinia pseudoacacia	2.70	1.96	3.86	8.52
Adhatoda vasica	5.40	5.88	1.149	12.43
Artemesia vulgaris	5.40	5.88	0.64	11.93
Calotropis gigantean	2.70	1.96	0.21	4.87
Cannabis sativa	2.70	5.88	0.80	9.38
Colebrookia oppositifolia	2.70	1.96	0.36	5.03
Debregeasia hypoleuca	5.40	3.92	1.68	11.00
Dodonaea viscosa	2.70	5.88	1.20	9.79
Girardinia heterophylla	5.40	5.88	1.20	12.49
Lantana camara	2.70	1.96	0.13	4.79
Moriandra strobilifera	2.70	1.96	0.36	5.03
Plectranthus coesta	2.70	3.92	0.40	7.02
Princepia utilis	2.70	1.96	0.26	4.93
Rubus ellipticus	5.40	5.88	1.10	12.39
Rumex hastatus	2.70	5.88	0.30	8.88

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Woodfordia fruticosa	2.70	1.96	0.50	5.16
Zizyphus nummularia	2.70	1.96	0.10	4.76
Herbs & Grasses				
Achyranthes aspera	4.54	5	6.03	15.57
Chenopodium album	4.54	5	4.05	13.5
Chromolaena odorata	4.54	2.5	1.86	8.90
Erigeron bellidioides	9.09	7.5	5.44	22.03
Fragaria indica	9.09	7.5	7.52	24.11
Heliotropium strigosum	9.09	12.5	10.23	31.82
Oxalis corniculata	9.09	10	7.99	27.08
Sonchus oleraceus	9.09	7.5	5.53	22.12
Tridex procumbens	4.54	5	2.72	12.27
Verbascum thapsus	4.54	5	4.13	13.67
Jasminium officinalis	13.63	12.5	8.06	34.20
Cynodon dactylon	4.54	2.5	2.49	9.54
Saccharum spontaneum	4.54	7.5	9.10	21.15
Parthenium hysterophorus	9.09	10	24.77	43.86

Table: 3.37
Assessment of flora of Nirmand Area

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Acacia leucophloea	3.33	2.27	4.70	10.3
Albizzia lebbek	3.33	2.27	5.30	10.9
Callistemon citrinus	3.33	4.54	5.53	13.4
Cupressus torulosa	3.33	4.54	5.99	13.8
Dalbergia sissoo	3.33	2.27	4.61	10.2
Eucalyptus globulus	3.33	2.27	6.91	12.5
Ficus palmate	3.33	2.27	3.53	9.14

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Ficus roxburghii	3.33	2.273	4.88	10.4
Grevellia robusta	3.33	2.273	5.38	10.9
Melia azaderach	3.33	4.545	8.45	16.3
Morus sps	3.33	2.273	5.76	11.3
Pinus roxburghii	6.66	6.818	18.6	32.1
Populus ciliata	3.33	2.273	5.38	10.9
Prunus communis	3.33	4.545	2.30	10.1
Robinia pseudoacacia	3.33	2.273	4.41	10.0
Adhatoda vasica	3.33	4.545	0.87	8.75
Agave Americana	3.33	2.273	0.34	5.95
Artemesia vulgaris	3.33	4.545	0.49	8.37
Cannabis sativa	6.66	9.091	1.22	16.9
Colebrookia oppositifolia	3.33	4.545	0.92	8.80
Debregeasia hypoleuca	3.33	2.273	0.69	2.96
Dodonaea viscose	3.33	2.273	0.49	6.10
Euphorbia royleana	3.33	4.545	0.99	8.87
Girardinia heterophylla	3.33	2.273	0.384	5.99
Lantana camara	3.33	2.273	0.230	5.83
Plectranthus coesta	3.33	4.545	0.307	8.18
Princepia utilis	3.33	2.273	0.307	5.91
Rumex hastatus	3.33	4.545	0.3075	8.18
Woodfordia fruticosa	3.33	2.273	0.538	6.14
Herbs & Grasses				
Achyranthes aspera	3.84	2.632	3.89	10.37
Argemone mexicana	3.84	2.632	5.72	12.21
Chenopodium album	3.84	5.263	4.83	13.94
Echinops echinatus	3.84	2.632	0.01	6.478
Erigeron bellidioides	3.84	2.632	2.16	8.643

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Fragaria indica	7.69	10.53	11.91	30.13
Heliotropium strigosum	7.69	7.895	7.31	22.91
Oxalis corniculata	7.69	10.53	9.53	27.75
Sonchus oleraceus	7.69	13.16	10.99	31.85
Tridex procumbens	11.5	7.895	4.87	24.31
Trifolium pratense	7.69	5.263	4.81	17.77
Verbascum thapsus	3.84	2.632	2.17	8.654
Jasminium officinalis	3.84	2.632	2.06	8.54
Cynodon dactylon	3.84	5.263	5.26	14.38
Saccharum spontaneum	11.5	10.53	13.74	35.81
Parthenium hysterophorus	7.69	7.895	10.65	26.24

Table: 3.38
Assessment of flora Near Bayal Village

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Ficus elastica	5.26	3.704	7.648	16.61
Mangifera indica	5.26	3.704	29.08	38.05
Melia azaderach	5.26	3.704	6.373	15.34
Mallotus philippinenisis	5.26	7.407	5.307	17.98
Morus serrata	5.26	3.704	8.633	17.6
Prunus amygradus	5.26	11.11	10.08	26.46
Prunus communis	5.26	7.407	3.476	16.15
Prunus persica	5.26	7.407	5.214	17.88
Syzium cumini	5.26	3.704	5.62	14.59
Tamarindus indica	5.26	3.704	5.041	14.01
Adhatoda vasica	5.26	7.407	1.321	13.99
Artemesia vulgaris	5.26	7.407	0.746	13.42
Colebrookia oppositifolia	5.26	3.704	0.695	9.662
Debregeasia hypoleuca	5.26	3.704	1.043	10.01
Dodonaea viscosa	5.26	3.704	0.753	9.72

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Girardinia heterophylla	5.26	3.704	0.579	9.546
Lantana camara	5.26	7.407	0.695	13.37
Musa paradisiacal	5.26	3.704	7.068	16.04
Zizyphus nummularia	5.26	3.704	0.637	9.604
Herbs & Grasses				
Achyranthes aspera	8.33	3.704	6.159	18.2
Erigeron bellidioides	8.33	3.704	3.424	15.46
Fragaria indica	16.7	18.52	23.55	58.74
Heliotropium strigosum	8.33	14.81	15.43	38.58
Ocimum basilicum	8.33	7.407	7.609	23.35
Oxalis corniculata	8.33	11.11	11.3	30.75
Tridex procumbens	16.7	25.93	18.01	60.6
Trifolium pratense	8.33	7.407	7.609	23.35
Verbascum thapsus	16.7	7.407	6.884	30.96

Table: 3.39
Assessment of Importance Value Index Near Pashada Forest Area

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Adhatoda vasica	4.166	5.71	0.95	10.83
Artemesia vulgaris	4.166	5.71	0.55	10.43
Berberies aristata	4.166	2.85	0.35	7.382
Bombax ceiba	4.16	2.85	6.73	13.75
Carissa spinarum	8.333	5.71	0.55	14.60
Celtis australis	4.16	2.85	5.13	12.16
Dalbergia sissoo	4.16	2.85	5.57	12.60
Desmodium tiliaefolium	4.166	2.85	0.27	7.30
Eucalyptus globulus	8.33	5.71	10.04	24.08
Euphorbia royleana	4.166	2.85	0.35	7.38
Grewia oppositifolia	4.166	2.85	5.89	12.92

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Lantana camara	4.166	5.71	0.51	10.3
Mallotus philippinenisis	8.333	8.57	6.45	23.35
Moriandra strobilifera	4.16	2.85	0.36	7.39
Pinus roxburghii	12.5	22.8	53.5	88.90
Plectranthus coesta	4.166	5.71	0.70	10.58
Princepia utilis	4.166	2.85	0.55	7.581
Rumex hastatus	4.16	5.71	0.8	10.75
Solanum surattense	4.16	2.8571	0.51	7.54
Herbs & Grasses				
Achyranthes aspera	7.69	4.34	2.4	14.49
Arundo donax	7.69	4.34	4.28	16.32
Chenopodium album	7.69	8.69	7.35	23.7
Cynodon dactylon	7.69	8.69	9.55	25.94
Echinops echinatus	15.3	13.0	8.82	37.25
Fragaria indica	7.69	13.0	11.3	32.13
Heliotropium strigosum	15.38	13.0	11.7	40.1
Parthenium hysterophorus	15.38	21.739	31.86	68.98
Pteris sps	7.69	4.34	2.4	14.49
Saccharum spontaneum	7.69	8.69	10.04	26.43

Assessment of diversity index for immediate project area have been conducted which depicts that the diversity of the area is low for both trees & shrubs and grasses & herbs. All the value of diversity index fall below 1.5. The difference in value of diversity of the area is insignificant. The assessment of diversity is presented in the tables below.

Table: 3.40
Diversity Index of Immediate Influence Area

S.N.	SITE	DIVERSITY INDEX (H)	
		Trees & Shrubs	Grasses & Herbs
1.	Kunni Area	1.40	1.10

S.N.	SITE	DIVERSITY INDEX (H)	
		Trees & Shrubs	Grasses & Herbs
2.	Nirmand Area	1.41	1.13
3.	Near Pashada Forest Area	1.17	0.94
4.	Bayal Village	1.24	0.87

3.8 Ecological Status of Species: Flora & Fauna (Endangered/Rare/Threatened /Endemic)

The forests are a very important natural resource of the State form the basis of rich biodiversity of the State. Forests of the state is utilized in various puposes such as tomber, fuelwood, fodder, grasses, horticulture, leaf collection for cattle bedding & manure. As a result forests are under severe threats. The forest studies revealed that (SSR 1999) a total 440 Sq km of dense forests have degreaded to open forests from 1997 to 1999. The loss of forests leads to loss of habitat to wildlife and hence their ecological status has change to endangered, threatened or rare. The ecological status of flora & fauna is discussed in details below.

3.8.1 Status of Flora

Forests of Himachal Pradesh are rich with a variety of plants that are utilized for their medicinal properties. The Alpine meadows and Alpine scrub forests provide habitat to a variety of important mrdicinal flora of the state. It is estimated that if all the households remedies are taken into consodarartion, an estimated 1500 native plant speciesare used for health care purposes by the people of the state (Chauhan 1999). Local villagers residing in forests have rights to harvest medicinal plants. Overexploitation of medicinal plants leads to change thir status to threatened endangered, or rare species. The list of rare & threatened plants of Himachal Prasdesh is given below

Table 3.41
Status of Rare and Threatened Species

S.No.	Name	S.No.	Name
1.	*Achillea millefolium*	34.	*Juniperus recurva*
2.	*Aconitum heterophyllum*	35.	*Jurinea tibetica*
3.	*Aconitum violaceum*	36.	*Leontopodium frinbriligerum*
4.	*Arnebia benthami*	37.	*Limosella aquatica*
5.	*Arnebia euchroma*	38.	*Meconopsis bikramii*
6.	*Arnebia guttata*	39.	*Orobanchhe hansii*
7.	*Astragalus candolianus*	40.	*Pedicularis albida*
8.	*Astragalus grahmianus*	41.	*Pedicularis pychnantha*
9.	*Astragalus leucocephalus*	42.	*Pedicularis purpurea*
10.	*Betula utilis*	43.	*Physochlaina praealta*

11.	*Bunium persicum*	44.	*Picrorhiza kurrooa*
12.	*Carex borii*	45.	*Pinus gerardiana*
13.	*Carum carvi*	46.	*Podophyllum hexandrum*
14.	*Chrysanthemum pyrathroides*	47.	*Potentilla curviseta*
15.	*Cortusa mathiole*	48.	*Potentilla fulgens*
16.	*Dactylorhiza hatagirea*	49.	*Rheum australe*
17.	*Draba cachemirica*	50.	*Rheum moorcroftianum*
18.	*Draba lasiophylla*	51.	*Rheum spiciforme*
19.	*Ephedra geradiana*	52.	*Saussurea gnapholoides*
20.	*Eremurus himalaicus*	53.	*Saussurea gossypiphora*
21.	*Euphrasia jaeschkei*	54.	*Saussurea obvallata*
22.	*Euphrasia pauciflora*	55.	*Scrophularia koelzii*
23.	*Euphrasia platyphylla*	56.	*Scrophulria suffruticosa*
24.	*Ferula jaeshkeana*	57.	*Sedum jaeschkei*
25.	*Galium serphylloides*	58.	*Seseli tribobium*
26.	*Gentiana tianschanica*	59.	*Silene stewartii*
27.	*Hedysarum cashmerianum*	60.	*Silene stewartii*
28.	*Heracleum candicans*	61.	*Thylacospermum caespitosum*
29.	*Heracleum thomsoni*	62.	*Valeriana jaeschkei*
30.	*Heteropappus holohermaphroditus*	63.	*Veronica biloba*
31.	*Hyoscyamus niger*	64.	*Viola biflora*
32.	*Inular racemosa*	65.	*Waldhemia glabra*
33.	*Juniperus communis*	66.	*Waldhemia stoliczkei*
		67.	*Waldhemia tomentosa*

Source : Biodiversity Action Plan 2003

The medical plants are distributed to alphine pasture & alpoine scrubs of higher altitudenal range of 3000 to 5500mts. The distribution of endangered plants species in the project-influenced area, immediate influence area and project-affected area is discussed below.

A total number of 27 medicinal plant speaes reported by forest department (Rampur/Anil Forest Div) from the project influence area out of 27 only seven plant species are reported to be endangered category as per the IUCN red data book. The medicinal plants such as Aconitum heterophyllum (Mithi patish), Picorhiza Karoo (Karoo) and Podophyllum emodi (Bankakari) are endanagered due to 50% reduction in population while Rheum emodii (Rewand chini), Polygonatum verticillatum (Salammishri), velerina wallichii (Nalchnihani) and Acorus calamus (Birch) 20% reduction in population in wild in last ten years (Singh P.B. 1999).

In order to excerise some measures of control over the exploilation of medicinal plants the forest department has prescribed a four year exploitation cycle and has also fixed an export permit fees in respect of heavily exploited species as per the Native list of Export 1994. Forest department also encouraging medicial farming.
None of the above mentioned medicinal plants were recorded/reported neither from the project immediate influenced area nor from the project affected area.

3.8.2 Status of Fauna

The variation in climatic, altitudinal and forests diversity resulted in diversified fauna. The faunal biodiversity is under tremendous threat due to fragmentation, degreadation and loss natural of habitat. Himachal Pradesh Govt. has provided special protection to wildlife by declaring Musk deer as state animal while Monal phesant as state bird. The list of wild animals of Himachal Pradesh owing to their ecological status is given below.

Table 3.42
Status of Rare, Endangered and Protected Species of Fauna

Scientific Name	Common Name
Protected	
Panthera pardus	Leopard
Panthera uncia	Snow leopard
Felis bengalensis	Leopard
Ovis ammon hodgsoni	Nayan
Pseudois nayaur	Bharal
Capricornis sumatraensis	Serow
Moschus moschiferus	Musk deer
Hemitragus jemlahicus	Himalayan Thar
Hemitragus jemlahicus	Himalayan Thar
Catreus wallichii	Cheer Pheasant
Endangered	
Panthera uncia	Snow leopard
Capra ibex	Himalayan Ibex
Hemitragus jemlahicus	Himalayan Thar
Vulnarable	
Panthera pardus	Leopard
Moschus moschiferus	Musk deer
Panthera uncia	Snow leopard

The distribution of endangered/protected and vulnerable animals in project influenced area, immediate influence area and project affected area is discussed below.

(i) Project Influence Area

The information about the distribution of endangered wildlife is collected from respective forest division i.e. Rampur/Ani forest Division Himachal Pradesh. The endangered animals reported from project influence area are Leopard (Panthera pardus); Himalayan Black Bear (Selenarctos thibetanus), Barking deer (Muntiacus muntiak); Himalayan fox (Vulpes valpes) wolf (Canis lupus) and among birds Monal phesant (Lophophorus impejanus), Koklaj Pheasant(Purcra sia macrolopha) and Cheer Pheasant (Catreus wallichii) are reported from the forests of the study area.

The carnivore representative of forest under the study area is Leopard (Panthera pardus). It is member of cat family is a sleek short haired and agile animal with a fabulous coat marked with close-set rosettes. It has adapted itself to the forest aera as well as to the open countryside. It

is known to lift sheep & cattle from the shed. The Himalayan Blackbear (Selenarctos thibetanus) inhabits the oak forests from 1800 m to 2500 m it is considered a savage animal by villagers for its raids on village cultivation and occasional attacks on humanbeings. Jackel (Canus aureus) have been reported from populated areas while Himalayan fox (Vulpes valpes) reported during winter near habitations in forests.

The Musk deer (Muschus mosehiferus), a solitary and secretive animal is reported from Alpine and sub alpine zones of the forests at altitude above 2900-4000 mts elevation range The havey show fall in higher altitudes leads to downward migration up to 2800 to 2500 mt is reported during winter. The Rhesus macaque (macaca mulata) reported between 1200 to 2400 m mostly in broad-leaved forests while Langoor (Presbytes entellus) reported 1800 to 2800 m.
The large sexually dimorphic members of phesant family are found throughout the forests. The Monal phesant (Lophophorus impejanus) a colourful & attractive bird reported fom 300 to m while Koklaj Pheasant (Purcra sia macrolopha) found on steep forested hillsides between 500 to 3000 m elevatioin and that of Cheer Pheasant (Catreus wallichii) found on hillsides between 1800 to 2500m.

(ii) Project Immediate Influenced Area

The area is marked by degraded scrub forest, heaving populated along the National Highway interrupted with intensive agriculture/horticulture/animal hasbandary practices, etc Hence chances of wildlife habitats are not expected; and no records of wild life reported from the project area.

(iii) Project Affected Area

The area is marked by dry denuaded steep hillslopes, foothills with sdcanty thorney shrubs type vegetation cover and plantation paches od Eucalyptus interrepted by agricultural activities. None of the wildlife was noticed either direct or indirect evidences as well as there are no reports of wildlife from forest department records

3.9 COMPARITIVE ASPECTS OF FLORA AND FAUNA

Inorder to compare status of various issues of terrestrial biodiversity the comparative status of various isses are diacussed below

3.9.1 Comparative Status of Forests Types

Forest is the major land use of Himachal Pradesh. The recorded forest area of the state is 3.54 million ha**,** which constitutes 66.6% the total geographical area of the state**.** The wide range of altitude, topography and climatic conditions contributed towards diverse forest types ranging from Tropical to Sub-tropical & temperate to Alpine Forests. As per the Champian & Seth (1962), a total nine major forest types and 35 sub-groups of forests were reported through out the State.

Table: 3.43
Comparative Distribution of Forests Types

Forest Types	H.P.	S.B.	PIA	PIIA	PAA
Tropical Moist Deciduous Forest..	Siwalic Sal Forest. 3C/C2a Bhabur Sal Forest. 3C/C2b	- -	- -	- -	- -
Dry Alpine Scrub (3000-3600m.)	+	16/C1	-	-	-
Moist Alpine Scrub (3000-3600m)	+	Alpine Pasture 15/C3	-	-	-
Sub Alpine Forest.. (3000-3500m.)	+	Fir Frs. 14/C1a Pasture 14/DS1	-	-	-
Himalayan Dry Temperate Forest.. (2500-3000m.)	+	Coniferous Dry D. Frs. 13/C2b Con. Pine Frs. 13/C1 Blue Pine Frs. 13/C2b	- - -	- - -	- - -
Himalayan Moist Temperate Forest.. (1500-2500m)	+	Ban-Oak Frs. 12/C1a Kharsu Oak Frs. 12/C2a Moist Deodar Frs. 12/C1C Oak- Fir Frs. 12/C2b Mix. Con Frs. 12/C1d Moharu Oak Frs. 12/C1 Oak Scrub Frs. 12/Ds1	+ + + - + + +	- - - - - - -	- - - - - -
Sub- tropical Pine Forest..	+	Himalayan Sub- tropical Pine Frs. 9C1	+ St. Euph Srb 9DS2	- +	- +
Sub-tropical Dry Evergreen Forest..	+	+	Dodonea Srb 10DS1	+	+

Forest Types	H.P.	S.B.	PIA	PIIA	PAA
Tropical Dry Deciduous Forest.	+	+	Northern Dry Mixed Dec.	-	-
	+	+	Frs. 5/C2 Khair – Sissoo Forest. 5B/1S2	-	-
Total	9/36	8/9	4/10	2/2	2/2

The table shows comparative distribution of forest types in Himachal Pradesh, Satluj Basin, Project Influenced Area, Project Immediate Influenced Area & Project Affected Area. It revealed that Shivalik Sal Forest differentiate Himachal Pradesh from Satluj Basin. While High Altitude Forest (3500-6600m) Alpine & Sub-Alpine Forest differentiate Satluj Basin and Project Influenced Area.

The Project Immediate Influenced Area and Project Affected Area represents minimum forest types i.e. Sub-tropical Euphorbia Scrub and Dodonea Scrub, which are sparsely distributed along foothills and hill slopes.

3.9.2 Comparative Distribution of Flora

The wide range of altitude topography and climatic conditions resulted in rich and diversified flora in Himachal Pradesh. The flora of Himachal Pradesh comprised of higher plants, ferns, mosses, fungi and lichens. A total number of 3256 vascular plants has been reported from the State of which 3210 are angiosperms, 12 are gymnosperms and 34 species of lower plants. Local people for timber, fodder, fuel, food and medicines have used the flora. The comparative statement on flora recorded during survey is given below

Table: 44
Comparative Distribution of Flora

S.N.	Nature of Flora	PIA	PIIA	PAA
1	Trees	45	28	17
2	Shrubs	39	26	23
3	Herbs	21	14	16
4	Climber	04	02	01
5	Grasses	06	04	04
6	Ferns	02	02	02
7	Epiphytes	01	01	-
8	Mushroom	01	-	-
	Total	**119**	**77**	**63**

Taxonomically flora of the Project Influenced Area recorded highest number of 119 species belonging to 98 Genera & 58 Families followed by 77 and 63 in Project Immediate Influenced Area and Project Affected Area respectively. Physiognomically where flora can be categorized as trees, shrubs, herbs, climbers, grasses, ferns, epiphytes & mushrooms.

The diversity of flora of project affected area and immediate influence area does not show much variation. The value of diversity index for trees & shrubs fall in the range of 0.27 to 1.30 for project affected sites and 1.17 to 1.41 for immediate influence areas. The range for diversity index of project affected sites and immediate influence area are given in the table below.

Table: 3.45
Comparison of Diversity Index

Area	Diversity index Range for Trees & Shrubs	Diversity index Range for Grasses & Herbs
Project Affected Area	0.27 – 1.30	0.17 – 0.80
Immediate Influence Areas	1.17 - 1.41	0.87 – 1.13

3.9.3 Comparative Distribution of Fauna

The variation in forest type and vegetation pattern resulted in distribution of diversified flora throughout the state. The rich faunal diversity includes 64 species of mammals, 447 species of birds, 44 species of amphibians & reptiles and 81 species of fishes. The Himachal Pradesh supports rich wildlife fauna, which is generally recorded from higher altitude forest (3500-6600m). The comparative distribution of endangered, rare & protected species of Himachal Pradesh is given below

Table: 3.46
Comparative Distribution of Endangered Species of Wildlife

Forest Type	Wild life	H.P	S.B.	PIA	PIIA	PAA
Cold Desert	Snow Leopard	+	+	-	-	-
Dry Alpine Scrub	Him Brown Bear	+	+	-	-	-
Moist Alpine	Tibetan Wolf	+	+	-	-	-
Sub Alpine Frs. (3500-6600)	Red Fox	+	+	-	-	-
	Common Leopard	+	+	+	-	-
	Him Black Bear	+	+	+*	-	-

	Bharal	+	+	-	-	-
	Him Thar	+	+	-	-	-
	Him Ibex	+	+	-	-	-
	Musk Deer	+	+	+*	-	-
	Barking Deer	+	+	+*	-	-

HP- Himachal Pradesh, SB- Satluj Basin, PIA- Project Influence Area

PIIA- Project Immediate Influence Area, PAA- Project Affected Area

+- Present, - - Absent *- Altitudinal Migration

It revealed that only four species of Wildlife are reported from the Project Influenced Area of which Himalayan Black Bear reported only during summer while Musk & Barking deer showed altitudinal migration during winter. The Common Leopard is reported to follow cattle/goat/sheep herd commonly surrounding the villages in forest areas. None of the endangered rare or protected species is reported from Project Immediate Influenced Area or Project Affected Area.

The base line faunal survey of the Project Influenced Area revealed that a total 58 species of fauna recorded during survey of which 18 species are recorded for mammals, 38 species of birds and 2 species of reptiles. Fauna of Project Affected Area and Project Immediate Influenced Area show poor distribution and mainly represented by domestic animals of local interest such as cows/buffaloes/horses/donkeys/mules/cats/dogs etc.

3.9.4 Comparative Status on Protected Area Network

The Himachal Pradesh is endowed with the vast canvas of dense forest & colorful wildlife. The Protected Area network of Himachal Pradesh is comprised of 32 Wildlife Sanctuary and two National Parks occupying 13.6% of the Geographical Area of the States. Following table shows comparative distribution of Protected Area Network.

Table: 47
Comparative Status of Protected Areas

Protected Areas	H.P.	S.B.	PIA	PIIA	PAA
National Park	**2**	**1**	**-**	**-**	**-**
Wildlife Sanctuary	**32**	**8**	**-**	**-**	**-**

3.10 FACTORS AFFECTING TERRESTRIAL BIODIVERSITY

The factors responsible for the degradation of forests can be categorized as Natural calamities and anthropogenic activities. The details are discussed below.

3.10.1 Natural Calamities

It is caused by the extent of snow, wind action, hail storms mainly by lightening, frost and drought. Due to heavy show fall, breaking & uprooting of trees is quite common. Usually wind damage occurs during October, November and March leading to uprooting/breaking of trees. Hailstorms are common during April. Young seedling suffers in case of winter frost. While drought period is of 2-3 months before and after rainy, season and causes mortality to large number of seedlings in the afforested areas. Damage by fire is highest during period of prolonged drought.

3.10.2 Anthropogenic Activities

This factor is largely responsible for degradation of forests and a major threat to the forests. Anthropogenic activities can be categorized as follows.

- Illegal felling for agricultural implements and pack.
- Grazing & browsing pressure by sheep/goals
- Severe Lopping for fodder, fuel, manure etc.
- Fires due to local incendiaries with the belief that the burning of forest areas improves the fodder resources by getting fresh grass and tender herbage.
- Heavy Timber demand
- Fuel wood and charcoal
- Torch wood extraction to Chirr & Kail by cutting deeply the resinous wood from base portion of stem. The damage trees weaken at the base & fall due to wind action.

The resinous wood is used by the villagers for igniting fires in their houses and as torch for moving from one room to another.

Debarking: The local villagers debark Ban, Spruce and Chir trees for rooting material of sheds and black smith manufacture charcoal. The walnut roots are debarked for making sticks, which are sold in market clandestinely.