



PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY

DASU HYDROPOWER PROJECT

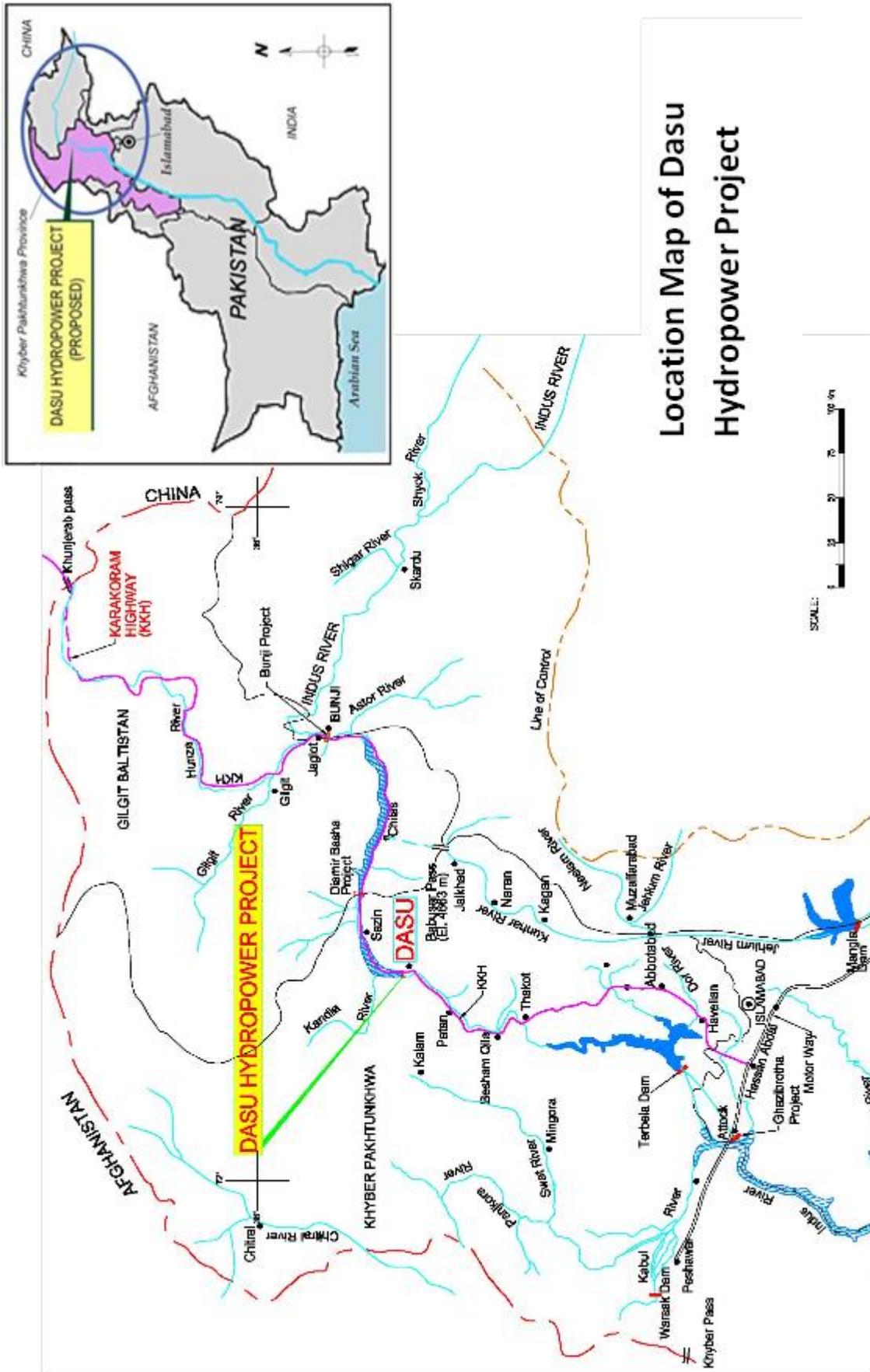


ENVIRONMENTAL MANAGEMENT ACTION PLAN

Volume 3: TERRESTRIAL ECOLOGY

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June 2013



Location Map of Dasu
Hydropower Project

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Vol 1: Executive Summary

Vol 2: Environmental Impact Assessment

Vol 3: Terrestrial Ecology

Vol 4: Aquatic Ecology

Vol 5: Physical Cultural Resources

Vol 6: Environmental Baseline Quality

Vol 7: Cumulative and Induced Impact Assessment

Vol 8: Environmental Management Plan

ABBREVIATIONS

ADB	Asian Development Bank
AKDN	Aga Khan Development Network
BAP	Biodiversity Action Plan
BAP	Biodiversity Action Plan
CBC	Community-based Conservation
CBD	Convention on Biological Diversity
CBNRM	Community-based Natural Resource Management
CCA	Community Conservation Area
CERC	Centre for Environmental Research and Conservation
CH	Conservation Hunting
CITES	Convention of International Trade in Endangered and Threatened Species
DCO	District Coordination Officer
DFO	District Forest Officer
DHC	Dasu Hydropower Consultants
DHP	Dasu Hydropower Project
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environment Protection Agency
FIV	Family Importance Value
FMP	Forest Management Plan
GB	Gilgit Baltistan
GEF	Global Environment Facility
GHG	Green House Gases
GIS	Geographical Information System
HKH	Hindukush, Karakorum and Himalayas
ICIMOD	International Centre for Integrated Mountain Development
IGC	Installed Generation Capacity
IUCN	International Union for Conservation of Nature
IWT	Indus Water Treaty
KCU	Kinnaird College University
KKH	Karakorum Highway
KP	Khyber Pakhtunkhwa
KP	Khyber Pakhtunkhawa
kWh	Kilo Watt Hour
MAB	Man and Biosphere Reserve
MASL	Meters Above Sea Level
MPMP	Medicinal Plant Management Plan
NARC	National Agricultural Research Centre
NBSAPS	National Biodiversity Strategies and Action Plans
NCCW	National Council for the Conservation of Wildlife
NRM	Natural Resources Management
PA	Protected Areas
PARC	Pakistan Agricultural Research Council
PEPA	Pakistan Environment Protection Act

PEPC	Pakistan Environment Protection Council
PFI	Pakistan Forest Institute
PMNH	Pakistan Museum of Natural History
PNCS	Pakistan National Conservation Strategy
PTDC	Pakistan Tourism Development Corporation
RNR	Renewable Natural Resources
SPCS	Sarhad Provincial Conservation Strategy
TE	Terrestrial Ecology
UAAR	University of Arid Agriculture Rawalpindi
UNDP	United Nations Development Programme
URMP	Ungulate Research Monitoring Program
WAPDA	Water and Power Development Authority
WB	World Bank
WCD	World Commission on Dams
WHC	World Heritage Convention
WWF	World Wildlife Fund

Volume 3
TERRESTRIAL ECOLOGY

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1. INTRODUCTION

This report presents results of terrestrial ecological studies conducted as an essential part of the environmental assessment for the development of the Dasu Hydropower Project (DHP or the Project). The report provides detailed baseline information on the terrestrial ecology of the Project including assessment of potential impacts and a management plan to address the impacts. This is volume 3 of the environmental assessment documentation, Environmental Management Action Plan (EMAP) of the Project.

1.1 PROJECT DESCRIPTION

Pakistan Water and Power Development Authority (WAPDA) of Pakistan is developing the DHP in the framework of the year 2025 hydropower project development plan in order to alleviate the shortage of electricity in Pakistan and by generating clean (no emissions) and sustainable hydropower. The Project will be operated as a run of the river project and after full development will have an installed generating capacity of 4320 MW power.

The dam site of the DHP is located about 7 km upstream of Dasu in, District Kohistan, Khyber Pakhtunkhwa (KP) province on Indus River. The project site is accessible by Karakorum Highway (KKH). A narrow reservoir (average width 365m) with a length of about 73 km will be formed upstream of the dam. The maximum flood level will be 950 meters above sea level (masl). At this level the reservoir area will be 23.85 km².

A layout map of the Project facilities, including dam and powerhouse, is shown in Figure 1.1. Detailed project information is provided in Section 3 of EMAP Volume 2: Environmental Impact Assessment (EIA).

1.2 OBJECTIVE AND SCOPE

Objectives of the terrestrial ecology study are:

- To identify potential adverse impacts on terrestrial ecology;
- Prepare an outline of the mitigation and enhancement measures necessary;
- Propose additional studies if required to reduce uncertainty and risk for the necessary environmental management measures.
- Prepare recommendations to be incorporated into the construction contracts with respect to ecological conservation.

1.3 TERRESTRIAL ECOLOGY INVESTIGATIONS IN THE PROJECT AREA

The study area boundaries for DHP impact assessment were defined and explained in Volume 2 EIA. For terrestrial ecology assessment, the study area limits are the foot prints of the Project, which means physical footprints for the dam, powerhouse, and reservoir submergence area and associated facilities such as construction work areas, resettlement sites, KKH realignment, and access roads. These facilities are mostly limited to 1,000 m elevation on both sides of Indus from Dasu/Komila to end of reservoir. However, the focus of the terrestrial ecology field study was extended up to 2000 meters elevation on both sides of the river. Few surveys and observations were also made to cover mountains up to 3,800 meters elevation where confirmed wildlife presence was reported by wildlife guards and key informants such as hunters. The terrestrial ecology components were also studied downstream from Dasu and Jalkot; all the way to Besham, Pattan and Thakot on both sides of the Indus.

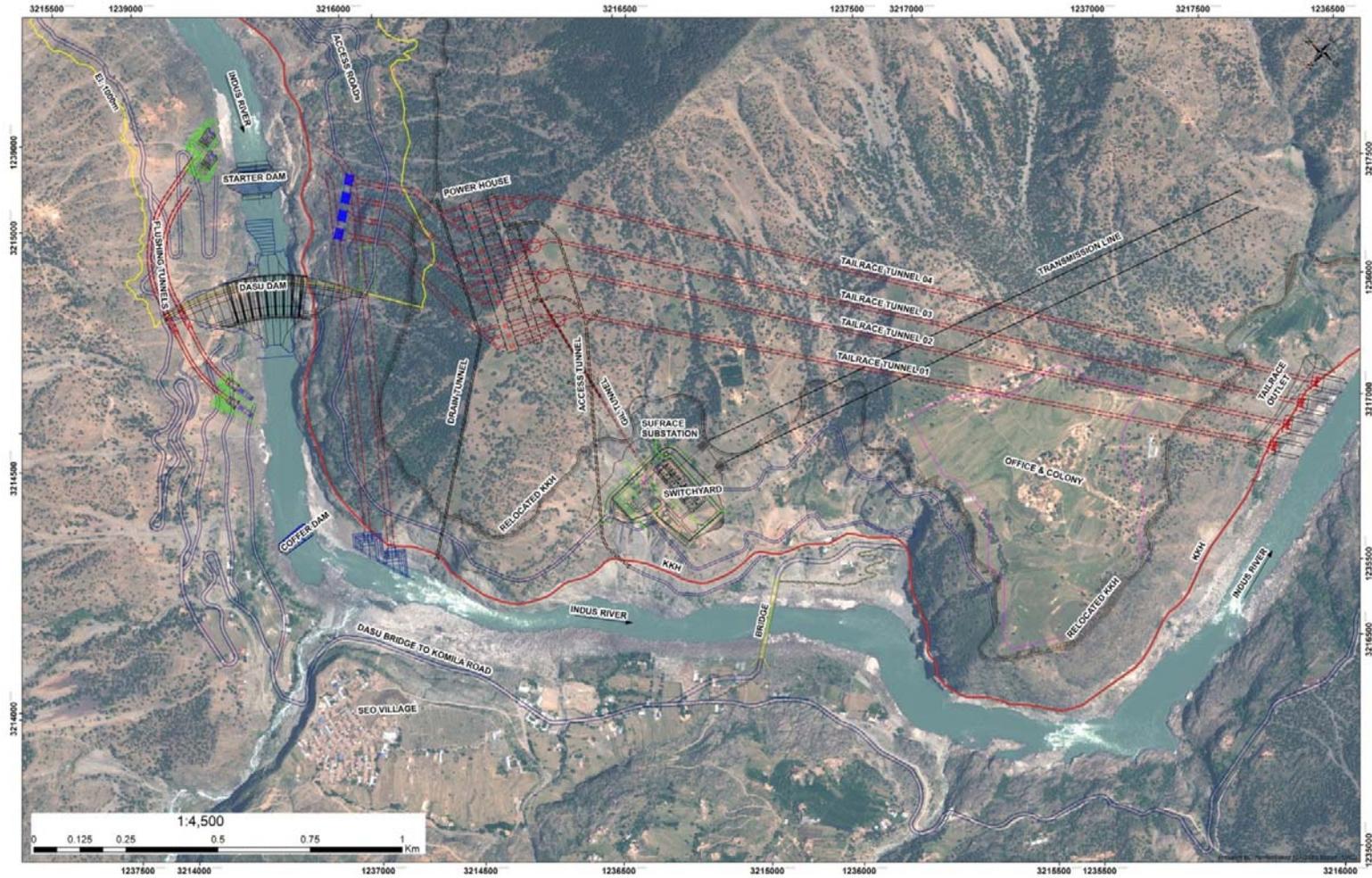


Figure 1.1: Layout Plan of Project Facilities marked on Satellite Imagery

The study area is situated near to the meeting point of three mountain ranges: Himalayas, Karakorums and Hindukush. The area is mostly occupied by high mountain peaks and slopes on both sides of the deeply incised Indus valley. The study area is a typical montane landscape with diverging mountain slopes along the Indus river inhabited by mountain communities, and higher altitudes mountain peaks and canyons with very steep and rocky slopes. This kind of habitat is widely distributed and relatively abundant in the whole project area with typically steep to moderate slopes on relatively higher altitudes. Other parts of the area are characterized by the presence of rocky outcrops encircling upland plains including several depressions with drainage gullies. Some of the higher reaches are used for cultivation and occupied by human settlements. Usually it is used for maize and wheat cultivation. This kind of habitat is relatively scarce and composed of sandy loamy soils with gravels. This habitat supports common weeds as well as grasses with potential of foraging. There are 17 smaller and larger tributaries (nullahs) feeding in the Indus and upstream of the DHP dam axis site.

1.4 METHODOLOGY/ APPROACH

The terrestrial ecology study was initiated from early July 2012 and there was limited time of 4 months available for completion of the study. Since seasonality is important for both physical access and ecology, a staged approach was adopted for the study – doing as much as possible to meet the Project preparation requirements within the available time, but clearly identifying needs for further studies beyond 2013. A three component approach was undertaken to investigate and analyse the data and compile reports. The field observations on various terrestrial species (flora and fauna) were preceded through focused group discussions with the officials of key line departments as well as key informants and local leaders of the project area (Appendix 1.1 and 1.2). Several discussions were held with various professionals and officials in Islamabad and Lahore. Similarly two questionnaires (plant and animal ecology) were developed to acquire any pertinent/ latest information from various hunters/ villagers and key informants throughout the study area both on right and left bank of Indus River (Appendix 1.3 and 1.4). Various national and international resource centres were visited in person and through online searches to access any data and information from various sources/ resource persons. Field/ analytical approach adopted a comprehensive inventory of the terrestrial ecology along with the any endangered/ threatened species that are appropriately discussed/ mitigated in the detailed reports. An overview of the terrestrial ecology fieldwork and analytical approach is provided below;

- i. Field work and Laboratory work (July-September 2012) was conducted on both right and left banks of Indus to survey fauna and flora species. These surveys were completed through plant specimen collection/ identification, sampling of floral species, point counts and line transects for representative bird species and photography. Wildlife surveys were conducted at selected vantage points.
- ii. Questionnaires/ data sheets (Appendix 1.5) were designed and used to collect data through direct observations and from local communities, elders, hunters and a variety of other stakeholders in project area and those having an interest or role in the biodiversity assessment/ management in the project area.
- iii. Forestry aspects were studied through direct observations in the project area to assess any impacts of the project on forests. Information on forestry practices was also gathered from local forest office/ department.
- iv. Focus group discussions/ consultations were held with line departments, key informants in the area (officials, hunters, conservationists), and selected provincial and federal agencies.
- v. Comments noted from the participants of the national workshops for appropriate integration in the detailed reports.

- vi. Comprehensive literature review was completed at various resource centres and institutions.
- vii. Interviews of biodiversity experts and key informants performed.
- viii. Consultations carried out with a variety of stakeholders in the project area, provincial and federal focal points as well as various resource centers.
- ix. Project footprints studied thoroughly to assess and record the impacts and propose mitigation measures.



Figure 1.2: Terrestrial Ecology Field Surveys/ Consultations in DHP

1.4.1 Terrestrial Ecology Team

Member	Role
Dr. Kashif M. Sheikh	International Terrestrial Ecologist
Dr. Sajid Nadeem	National Terrestrial Ecologist
Dr. Rahmatullah Qureshi	National Botanical Expert

1.4.2 Terrestrial Ecology Team Field Surveys/ Dates

Months/ Dates	Duration
July 2012	July 14 th – July 18 th and 24 th – 28 th July
August 2012	4 th – 10 th August;
September 2012	September 1-10 th

1.5 PAKISTAN'S BIOLOGICAL DIVERSITY AND ITS SIGNIFICANCE

Biodiversity is the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems. Due to a great range of geographical and climatic factors, Pakistan is truly remarkable in its biogeoclimatic character. From the permanent snowfields and glaciers in the north and north-west, where three great mountain ranges converge, to the expansive plains of the Punjab, the Indus delta, the mangroves along the Arabian Sea coastline, and the deserts of Baluchistan, the country possesses a remarkable variety of habitats and associated biodiversity. Twelve major types of land cover have been identified in Pakistan. Country's numerous wetlands provide important waterfowl wintering habitat and resting areas for migratory bird species. The Indus Valley's wetlands are a major wintering ground for many central and northern Asian species. Pakistan spans a remarkable number of the world's ecological regions. These range from the mangrove forests fringing the Arabian Sea to the spectacular mountain tops where the western Himalayas, Hindu Kush and Karakoram ranges meet. These habitats support a rich variety of species which contribute to the overall biological diversity of the country (GoP, WWF and IUCN Biodiversity Action Plan, 2000).

Northern mountainous region of Pakistan include the Himalayas, Great Karakoram and Hindu Kush located in Khyber Pakhtunkhwa province, Malakand and Hazara; Gilgit-Baltistan; Azad Jammu and Kashmir, the Murree hill ranges of the Punjab Province and Margalla Hills range of Islamabad Capital Territory (Chaudhry and Qureshi, 2012). The region support 113 mammalian species, belonging to 92 genera, 24 families and 9

orders as against a total of 174 species, 104 genera and 10 orders from Pakistan (Roberts 1997). The Northern mountains supports 525 species of birds belonging to 242 genera, 76 families and 22 orders against a Pakistan total of 668 species, 300 genera, 85 families and 23 orders (Roberts 1991, 1992). Fifty species of reptiles reported from the region as against 177 in Pakistan, 32 are lizards and 18 snakes. Of 22 amphibian species reported from Pakistan 15 have been reported from the region (Chaudhry and Qureshi, 2012). The region has sport hunting species including Himalayan Ibex, Flare-horned markhor, Blue sheep, Grey goral, Marco Polo sheep, Ladakh urial or shapu, Musk deer, and Barking deer (Chaudhry and Qureshi, 2012). Due to uncontrolled hunting in the past their population has greatly declined. Trophy hunting of markhor, ibex and blue sheep started to help communities affording protection to these wild animals and has helped conserve their population. Snow leopard, Common leopard and wolf are important carnivores. There are 61 protected areas covering about 24,761 km² (19% of protected area of Pakistan including 9 Wildlife Sanctuaries, 15 National Parks and 37 game reserves. Moreover 100 CCAs/Private Game Reserve have also been established in the Northern mountain areas (Chaudhry and Qureshi, 2012).

2. BASELINE OF FLORA

2.1 METHODOLOGY OF PLANT INVESTIGATIONS

(1) Floristic enumeration:

The floristic study was conducted from July to September, 2012 to record the flora and their native uses. The study area was thoroughly surveyed to compile an aggregate checklist of plant species by walk through method (Nazar *et al.*, 2008). For this purpose, plant specimens were collected and brought to taxonomy laboratory, dried, pressed and mounted on herbarium sheets and identified with the help of Flora of Pakistan (Nasir and Ali 1970-1989; Ali and Nasir 1989-1991; Ali and Qaiser, 1993-1995, 2000-2009). After identification the plant specimens were deposited in the Herbarium of Pir Mehr Ali Shah Arid Agriculture University Rawalpindi for future record.

(2) Delineation of Vegetation and Forest Types:

Forest types are broadly characterized based on physiognomy and structure differentiating from other units (Champion *et al.*, 1965). While describing forest types, further subdivisions were made on geographic basis. This approach was used since a recognizable forest type varies at different localities owing to differences in the floristics and minor variations in climatic site occurring within the range of associated vegetation. Normally, it is dealt with main tree layers or on the most emergent vegetation. Furthermore, microhabitats were delineated based on geomorphological features i.e. slope angle and soil substrate (Qureshi & Bhatti, 2008, 2007). Since, Project is distributed in a large area; a test site approach is applied for the quantification of vegetation. Based on geomorphology, soils and vegetation, various typical sites were selected. In order to seek distribution pattern of species associated with different habitat types, floral composition including abundance and cover of plant species was determined. In addition, habit of plants such as herbs, shrubs, subshrubs and trees were also determined. Life-form classes were determined following Raunkiaer (1934) and Abd el-ghani (2000).

(3) Plants with Economic Value:

Local people including herders, village leaders, herbalists (hakeems) were interviewed to collect indigenous knowledge of plants and non-timber forest products (NTFPs) and information recorded on a semi-structured questionnaire (Appendix 1.3) in line with standard methodologies (Qureshi 2004, 2012). The plant species were splitted into medicinal, fuel, fodder, timber, agricultural implements, vegetables, fruits and other diverse uses.



Figure 2.1: Ethnobotanical Investigation/ Consultations in DHP

2.2 NATURAL CONDITIONS AND VEGETATION COVER

The project area is located along the Indus River which is flanked by desolate valleys and high mountain ranges. Terrain is rocky and barren in nature with scattered vegetation. Due to high wind velocity, white sandy particles are deposited in the valley

bottoms and adjacent mountain slopes. The river beds are characterized by rocky outcrops with stony cliffs, large boulders and washed gravels. There is no littoral zone outside the nullahs. There is soil erosion along steep slopes. The perennial flow of water from springs/streams and nullahs maintain the lifeline of the Indus River. In valleys near the human settlements, there is frequent irrigation and cultivation along the nullahs/streams along with deep soil depositions. In summer season; cool air moves from higher elevations to the low lying valley on both sides of the Indus River. This contributes to a mild local climate in the valleys.



Figure 2.2: Typical View of the Dasu Mountains and Community Settlements

There are certain permanent wet beds along the perennial nullahs that appear as narrow meadow strips and alluvial fans. These meadows and streams are main outlets for migration and distribution of plant species. This kind of alluvial zone is also a preferable area for breeding/nesting of insects, birds, amphibians and reptiles. Some of the nullahs are perennial in nature and supply water during summer and snow melting period, while other remains dry during winter.

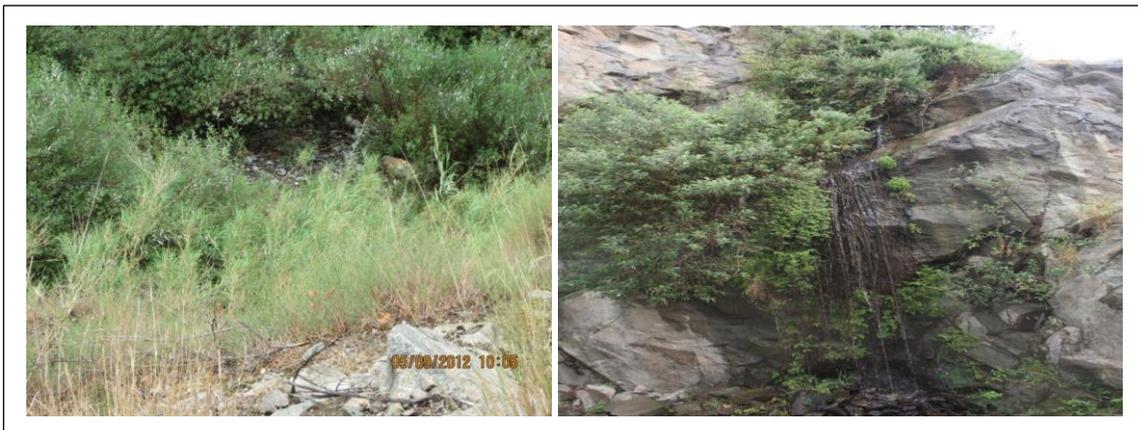


Figure 2.3: Permanent Wet Beds along the Perennial Nullahs

2.3 LANDUSE PATTERN IN THE PROJECT FOOTPRINTS

Landuse map of the project foot print area (within 1000 m elevation), based on analysis of satellite imagery, is shown in Figure 2.4. and summarized in Table 2.1. The main classes of the land use includes river/ nullahs, clump of trees representing forest patches, cultivated or agricultural land, grazing land/ pastures; barren slopes/ rocks; exposed sand; and houses or buildings. Most of the area is falling in the category of barren slopes and rocks. Therefore the potential impacts are assessed as low or

minimal risk in nature. The other representative classes are river and nullahs along with some representation of grazing land and cultivated fields.

Table 2.1: Landuse Pattern in the Dasu Project Area

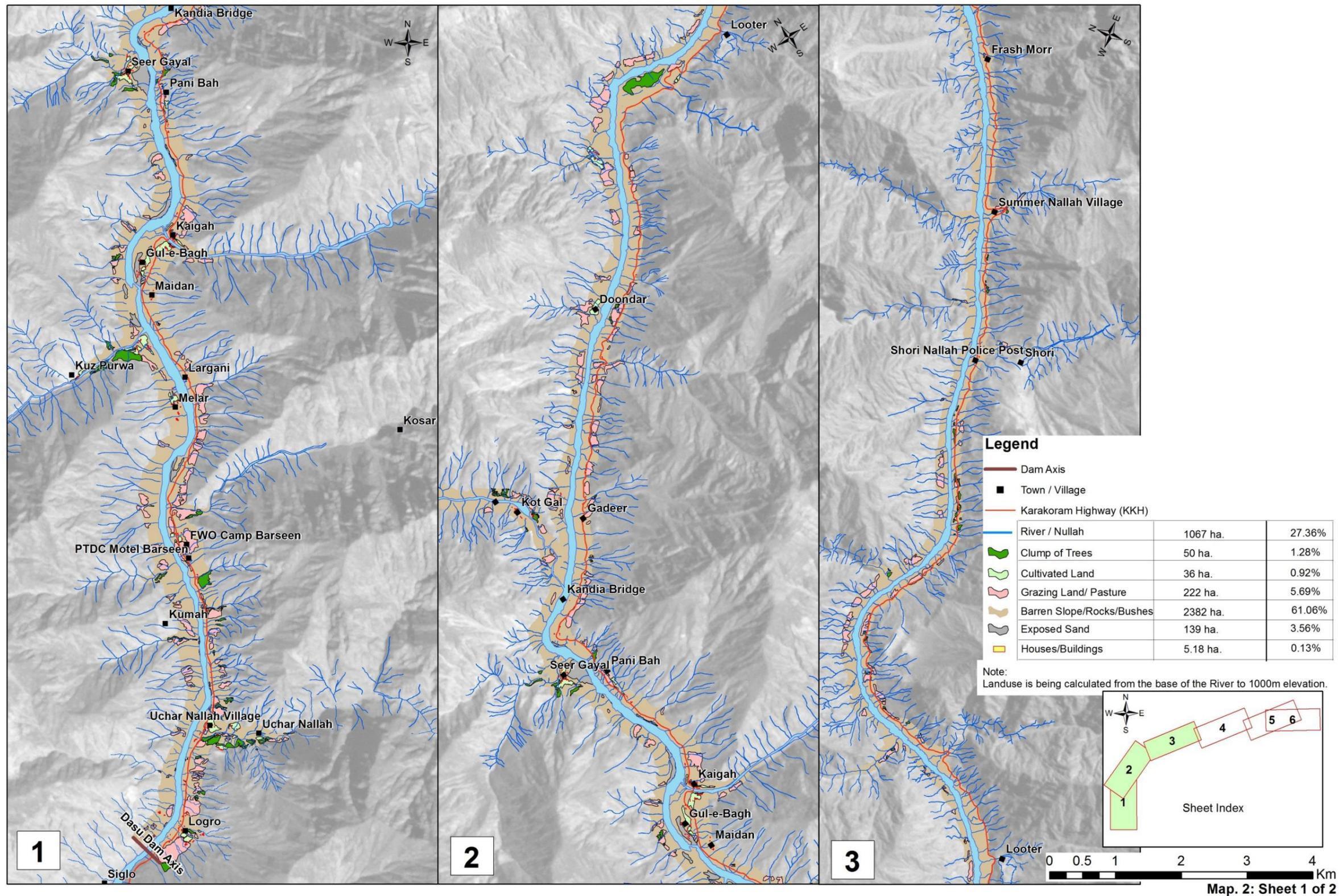
Land Use Type	Total Area (ha)	Percentage
River/ Nullah	1067	27.36
Clump of Trees	50	1.28
Cultivated Land	36	0.92
Grazing Land/ Pasture	222	5.69
Barren Slopes/ Rocks	2382	61.06
Exposed Sand	139	3.56
Houses/ Buildings	5.18	0.13
Total	3901.18	100%

Source: GIS mapping of satellite imagery

2.4 VEGETATION ECOLOGY

Vegetation ecology map of overall project area showing various forests types, ecological features, and settlements is shown in Figure 2.5. The coverage of vegetation map was extended to mountain ridges (up to altitude of 4,000m) on both sides of the Project foot print area. On average the map cover 5-8 kilometres on right and left bank from the centre of Indus. Various authors such as Schweinfurth (1957), Baig (1975) Champion *et al.* (1965) and Roberts (1991 and 1997) have provided baseline for classifying the ecological zones of Pakistan. The delineation of the forest types was carried out in accordance with these documents. The forests are located at elevations above 2,000 m well above the project impact area.

Dasu Hydropower Project LANDUSE MAP OF PROJECT AREA



Dasu Hydropower Project LANDUSE MAP OF PROJECT AREA

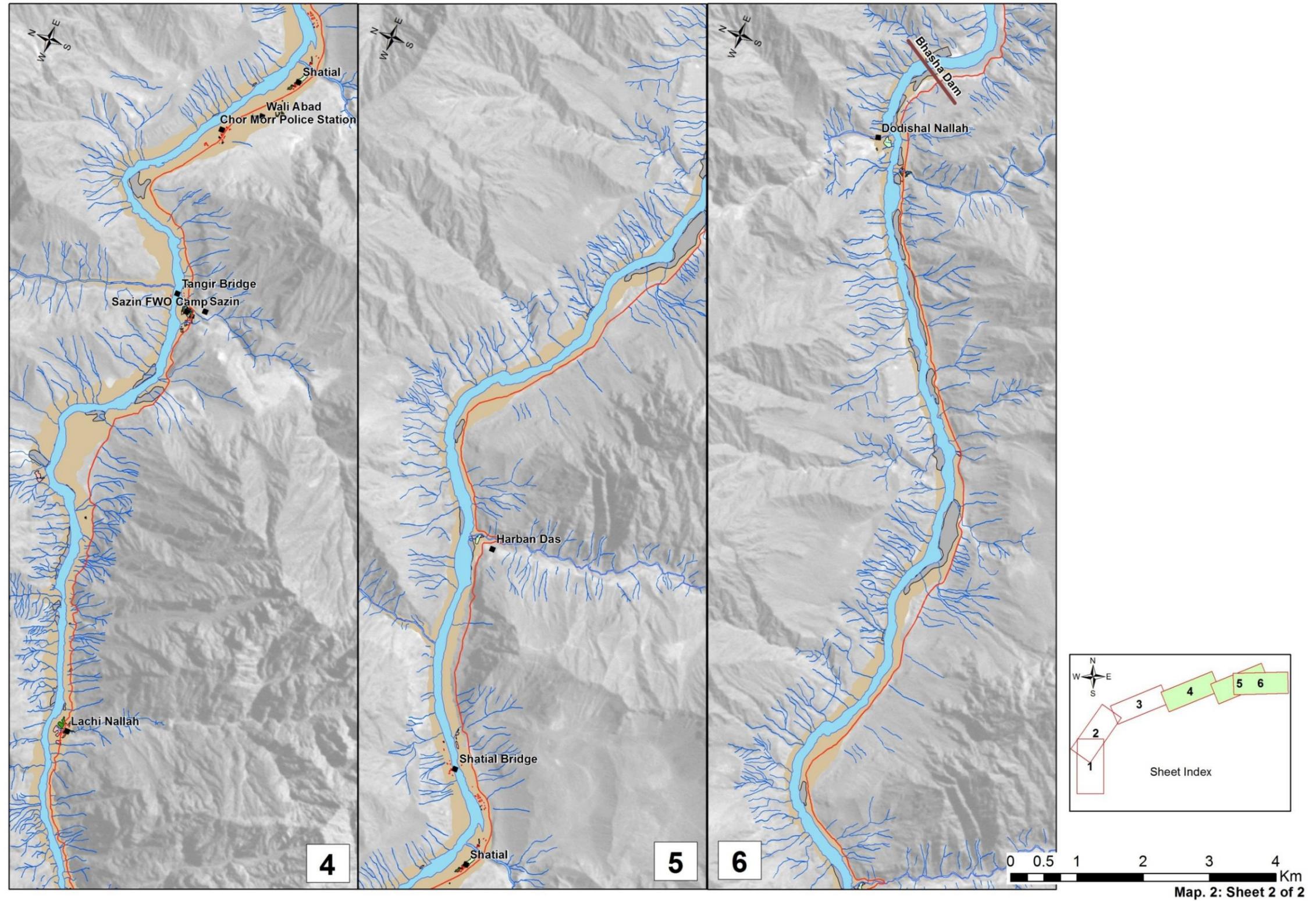
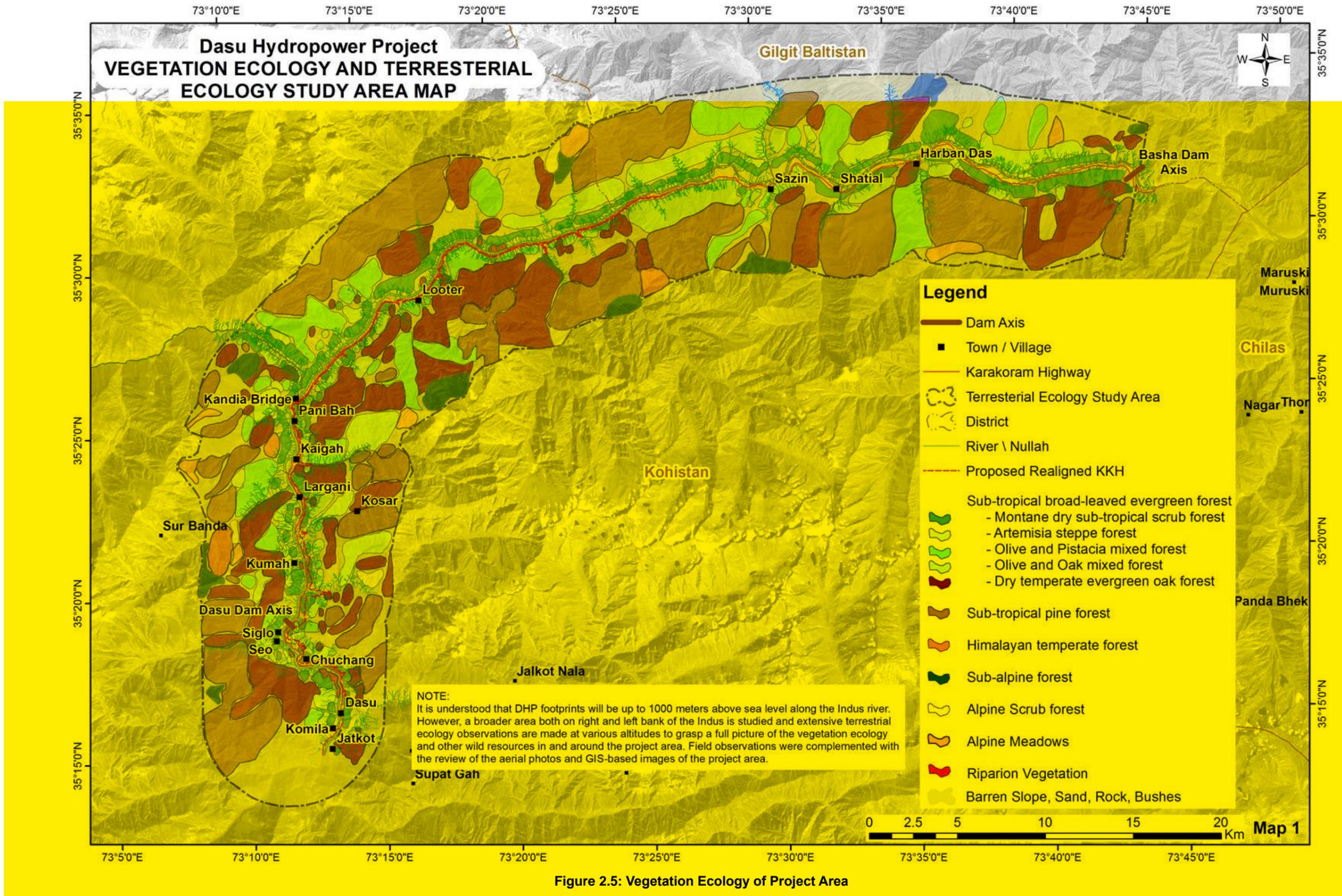


Figure 2.4: Landuse map of Project Area



2.5 VEGETATION COVER AND EXISTING PLANT COMMUNITIES

The key investigations for terrestrial ecology were carried out from the river (850+ meters to 2000 meters above sea level and the vegetation is sparsely distributed all over the study area. Figure 2.6 illustrates seven major habitats. The vegetation in these habitats was recorded by using quadrat methods. Rocky steep slope habitat with 31% is most dominantly found in the study area followed by stony foothills with 15%. In the project area trees are very thinly distributed and are mainly found near the settlements or on the gentle slopes along with fair distribution of shrubs and bushes. Major plant communities identified in these habitats from the project area is provided in the Table 2.3.

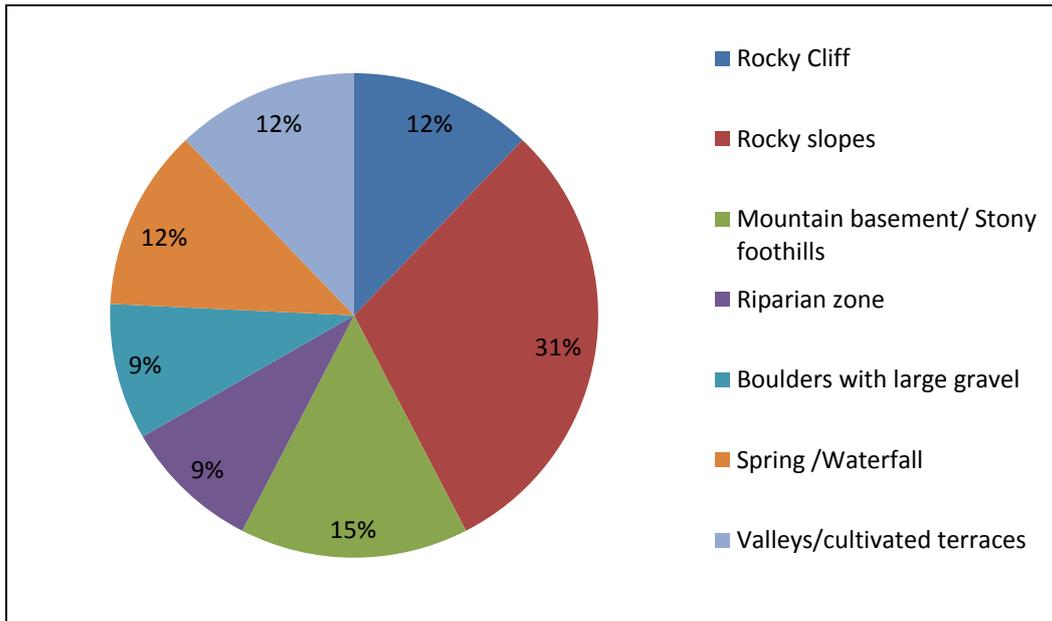


Figure 2.6: Major Habitat Types in study area

2.6 MAJOR HABITATS AND ASSOCIATED VEGETATION TYPES IN THE PROJECT AREA

Various habitats have been identified based on geomorphologic features of the terrain associated with typical vegetation types. These habitats and vegetation types are distributed throughout the project area and are described below;

2.6.1 Mountain peaks/ cliffs/canyons woodland

This habitat is located on higher altitudes such as the mountain peaks, canyons with very steep and rocky slopes (Figure 2.7). The upper reaches of this habitat has very little and scanty vegetation. This terrain is largely occupied by sparsely distributed woody species such as *Quercus baloot*, *Cotinus coggygia*, *Olea ferruginea*, *Rhus mysurnesis* and *Cotoneaster* spp.

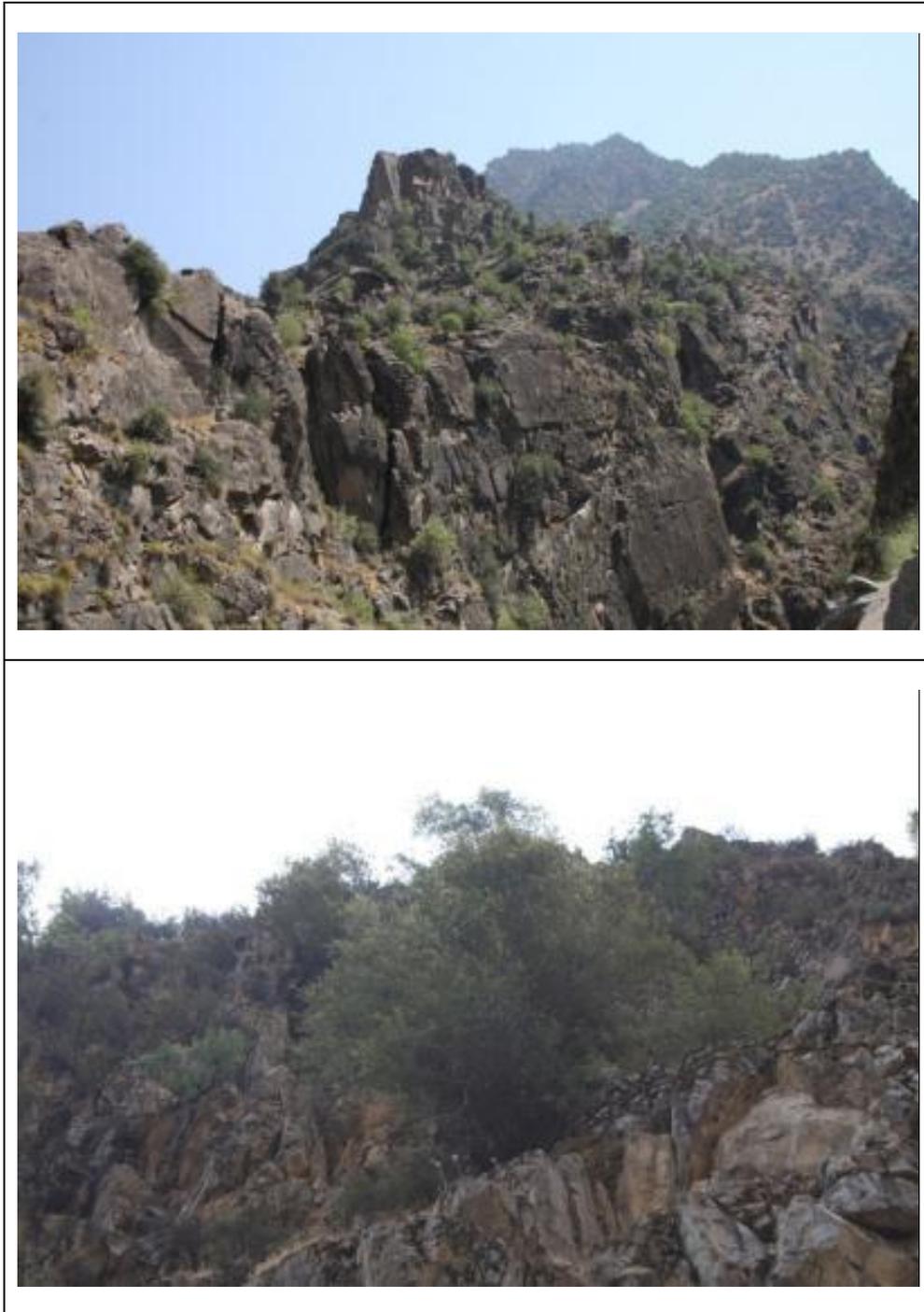


Figure 2.7: Mountain tops

2.6.2 Rocky Slopes Woodlands:

This habitat is widely distributed and relatively abundant in the study area with typical steep to moderate slopes on relatively higher elevations characterized by massive rocks (Figure 2.8). The vegetation consists of woody species with small trees, often with dense shrub layers and many herbs and grasses that are abundantly found in upper slopes. Key vegetation comprised of *Olea europaea*, *Quercus baloot*, *Pistacia chinensis*, *Cotoneaster microphyllus*, *C. affinis*, *Maytenus royleanus*, *Cotinus coggygia* and *Rhus mysurensis*.

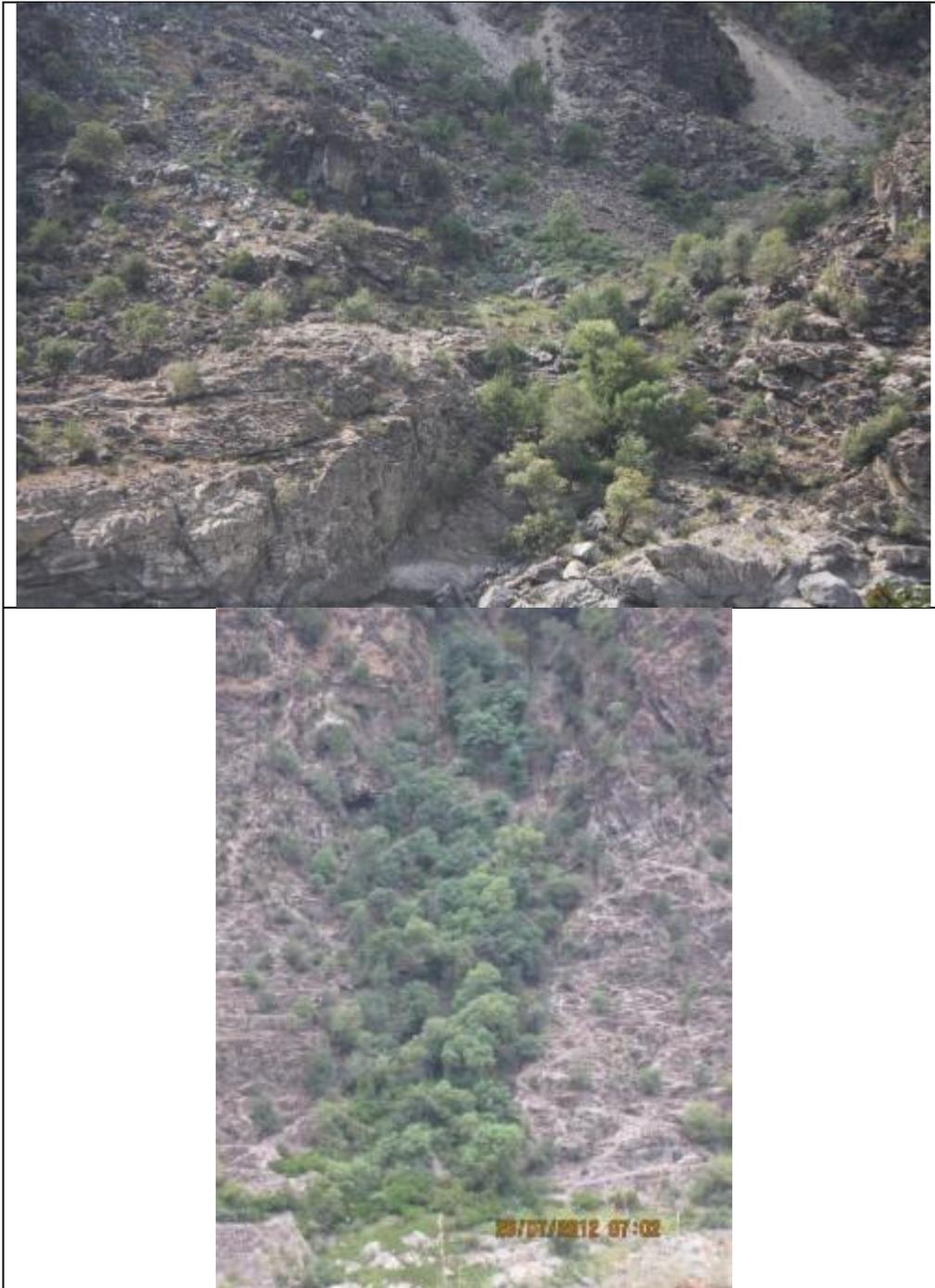


Figure 2.8: Rocky Slopes Woodland habitat

2.6.3 Mountain basement/ Stony foothills Woodlands

This habitat is found adjacent to Indus River including its tributaries called nullahs. It possesses a range of geomorphologic and geological features, mostly composed of rocks and gravels along steep to gentle slopes at lower altitudes (Figure 2.9). Though this is the most abundant community type in the project area, however, it contains relatively less number of species and has low species richness as well as total vegetation coverage. The representative species of this community include *Rumex hastatus*, *Dodonea viscosa* and *Maytenus royleanus*.

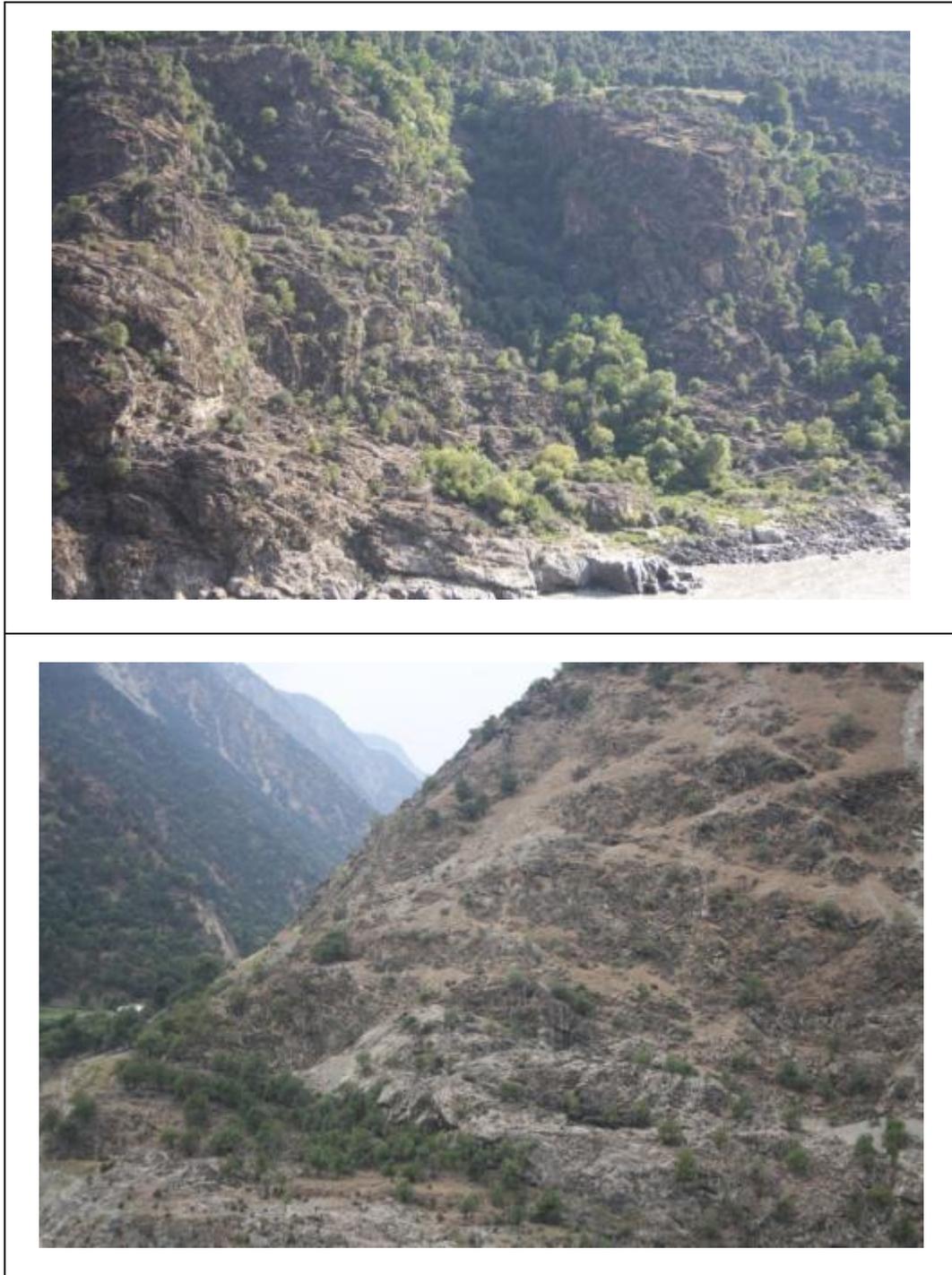


Figure 2.9: Foothill Woodlands Habitat

2.6.4 Riparian shrublands

The riparian habitat is found in the lowland floodplains of Project area. This habitat is scattered in the project area along River Indus and its major tributaries (Figure 2.10). The habitat possesses sandy soil intermixed with gravels adjacent to the river and nullahs. The most common species found are *Dodonaea viscosa*, *Nerium oleander*, *Debregeasia salicifolia* and *Maytenus royleanus*.



Figure 2.10: Riparian Shrublands

2.6.5 Rocky Outcrops and Boulders Shrubland

This habitat type is located in transitional zone between the mountains and riparian habitats on both banks of the river Indus (Figure 2.11). This habitat possesses sparse vegetation with stunted shrubs and bushes. It is found on intermediate altitudes, where there is mixture of soils and rocky gravel. In this habitat, vegetation cover is very low. The most common species found are *Maytenus royleanus*, *Olea ferruginea*, *Rumex hastatus*, *Artemisia maritima*, *Heliotropium* sp. and *Periploca aphylla*.



Figure 2.11: Rocky outcrops and boulders Shrubland

2.6.6 Spring /Waterfall

This is a distinct habitat formed by running water from the mountain tops. In this habitat, there is plenty of water and moisture content and plant species are thriving (Figure 2.12). The most common plant species include: *Debregeasia salicifolia*, *Adiantum capillus-veneris*, *Persicaria glabra*, *Mentha longifolia*, *Aialnthus altissima*, *Ficus carica* and *Themeda anathera*.

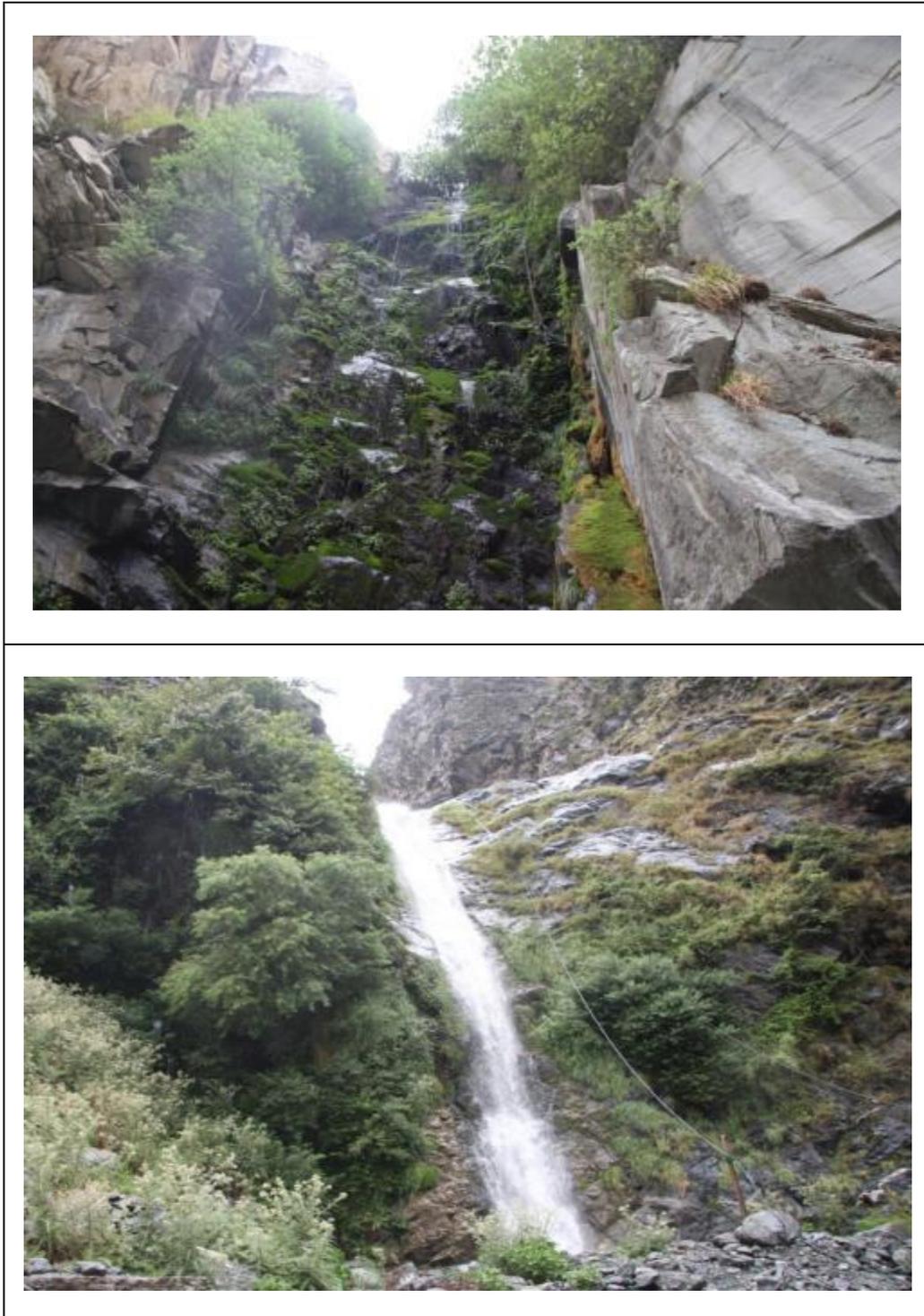


Figure 2.12: Spring/Water fall

2.6.7 Valleys/ cultivated land terraces

Some high altitude plain grounds/valleys/cultivated terraces are located on the higher slopes and often encircled by rocky mountains. These areas are inhabited by human settlements. This kind of habitat is composed of sandy loamy soils with gravels and is best suited especially for the cultivation of maize and wheat (Figure 2.13). This habitat showed common weeds as well as grasses with potential for foraging. Common weed species include: *Amaranthus caudatus*, *A. ovalifolius*, *Portulaca oleracea*, *Physalis peruviana*, *Euphrasia himalyica*, *Cleome viscosa*, *Trianthema portulacastrum*, *Coronopus didymus*, *Chenopodium ambrisoides*, *Euphorbia indica*, *Bidense chinensis*, *Oxalis corniculata*, *Achyranthes aspera*, *Conyza bonariensis*, *Oxalis corniculata*, *Verbena officinale* along with grasses such as *Brachiaria distachya* and *Cynodon dactylon*.



Figure 2.13: Valleys and Cultivated Land Terraces

2.7 DESCRIPTION OF FLORA

There is wide range of floral diversity found in the project area which is a characteristic of a distinctive mountain area setting in northern Pakistan. A detailed list of all plant species is provided in Appendix 2.1. A total of 232 plant species were identified. These belong to 173 genera and 70 families. 119 species were annual (51.29%); followed by 107 perennial species (46.12%); whereas, biennials are low with 6 (2.59%).

Table 2.2: Composition of Floral Families in the Dasu Project Area

Sr. No.	Family	No. of Plant species	Sr. No.	Family	No. of Plant species
1	<i>Poaceae</i>	30	36	<i>Geraniaceae</i>	2
2	<i>Asteraceae</i>	26	37	<i>Myrtaceae</i>	2
3	<i>Rosaceae</i>	10	38	<i>Rubiaceae</i>	2
4	<i>Lamiaceae</i>	9	39	<i>Salicaceae</i>	2
5	<i>Amaranthaceae</i>	8	40	<i>Urticaceae</i>	2
6	<i>Euphorbiaceae</i>	8	41	<i>Valerianaceae</i>	2
7	<i>Polygonaceae</i>	7	42	<i>Aizoaceae</i>	1
8	<i>Fabaceae</i>	6	43	<i>Apocynaceae</i>	1
9	<i>Solanaceae</i>	6	44	<i>Asparagaceae</i>	1
10	<i>Brassicaceae</i>	5	45	<i>Betulaceae</i>	1
11	<i>Chenopodiaceae</i>	5	46	<i>Caesalpiniaceae</i>	1
12	<i>Cucurbitaceae</i>	5	47	<i>Cannabaceae</i>	1
13	<i>Scrophulariaceae</i>	5	48	<i>Commelineaceae</i>	1
14	<i>Malvaceae</i>	4	49	<i>Convolvulaceae</i>	1
15	<i>Moraceae</i>	4	50	<i>Cuscutaceae</i>	1
16	<i>Pteridaceae</i>	4	51	<i>Ebenaceae</i>	1
17	<i>Acanthaceae</i>	3	52	<i>Fumariaceae</i>	1
18	<i>Anacardiaceae</i>	3	53	<i>Gentianaceae</i>	1
19	<i>Boraginaceae</i>	3	54	<i>Juglandaceae</i>	1
20	<i>Caryophyllaceae</i>	3	55	<i>Juncaceae</i>	1
21	<i>Cyperaceae</i>	3	56	<i>Meliaceae</i>	1
22	<i>Pinaceae</i>	3	57	<i>Mimosaceae</i>	1
23	<i>Plantaginaceae</i>	3	58	<i>Nyctaginaceae</i>	1
24	<i>Ranunculaceae</i>	3	59	<i>Oleaceae</i>	1
25	<i>Verbenaceae</i>	3	60	<i>Oxalidaceae</i>	1
26	<i>Vitaceae</i>	3	61	<i>Portulacaceae</i>	1
27	<i>Zygophyllaceae</i>	3	62	<i>Primulaceae</i>	1
28	<i>Adiantaceae</i>	2	63	<i>Punicaceae</i>	1
29	<i>Apiaceae</i>	2	64	<i>Rhamnaceae</i>	1
30	<i>Asclepiadaceae</i>	2	65	<i>Sapindaceae</i>	1
31	<i>Capparidaceae</i>	2	66	<i>Saxifragaceae</i>	1
32	<i>Celastraceae</i>	2	67	<i>Simarubaceae</i>	1
33	<i>Coniferaceae</i>	2	68	<i>Tamaricaceae</i>	1
34	<i>Ephederaceae</i>	2	69	<i>Tiliaceae</i>	1
35	<i>Fagaceae</i>	2	70	<i>Ulmaceae</i>	1
Total			232		

2.8 GENERAL COMPOSITION OF THE FLORA

Using Raunkiaer approach, life form of all the identified species were determined and is presented in Figure 2.14. There were five life form categories in which therophytes were most prominent (97 spp., 41.81%), followed by phanerophytes (67 spp., 28.88%), hemicryptophytes (39 spp., 16.81%), cryptophytes (16 spp., 6.90%) and chamaephytes (13 spp., 5.60%).

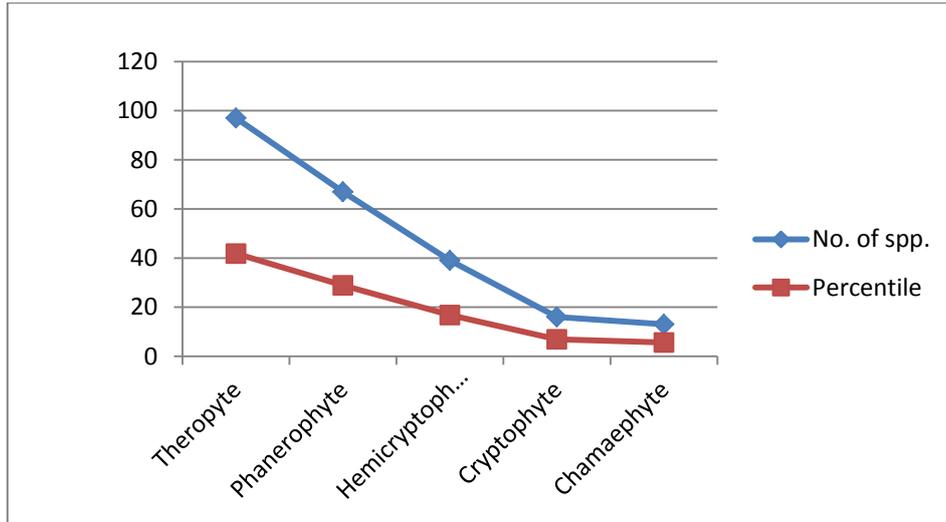


Figure 2.14: Raunkiaer's life form classification of the flora of project area

Table 2.3: Habitats and Plant Communities

Microhabitat	Characteristic Area	Plant Composition	Natural and Environmental Conditions
Rocky Cliff	Very Steep up to 80-90 degree angle	<i>Olea ferruginea</i> , <i>Dodonaea viscosa</i> and <i>Cotoneaster microphylla</i>	Summer drought, vegetation is sparse.
Rocky slopes	Steep, almost up to 80 degree angle	<i>Olea ferruginea</i> , <i>Juncus spp.</i> , <i>Themeda anathera</i> , <i>Carex spp.</i> , <i>Pistacia chinensis</i> and <i>Dodonaea viscosa</i>	Rock slopes, sand deposits, summer drought, severe permanent grazing, severely degraded, severe winter grazing
Mountain basement/ Stony foothills	Rocky and gravelly area	Low species richness as well as total vegetation coverage. The community include <i>Rumex hastatus</i> , <i>Dodonaea viscosa</i> and <i>Maytenus royleanus</i>	Severe grazing due to easy approach
Riparian zone	Sandy and gravelly areas	dominant plant species are <i>Cotinus coggygria</i> , <i>Nerium oleander</i> , <i>Dodonaea viscosa</i> and <i>Maytenus royleanus</i>	Highly degraded by grazing, overall vegetation is very poor
Boulders with large gravel	Rocky areas	Tree like <i>Pistacia chinensis</i> along with grasses such as <i>Themeda anathera</i> , <i>Phragmites australis</i> , and <i>Artemisia maritima</i>	Rock, only very little sand deposits, little soil, summer drought, severe permanent grazing, severely degraded.
Spring /Waterfall	Formed by running water from the mountain tops.	Rarely tree like <i>Ficus carica</i> along with <i>Debregeasia salicifolia</i> , <i>Adiantum capillus-veneris</i> , <i>Mentha longifolia</i> and <i>Themeda anathera</i>	Vegetation is quite healthy
Valleys/cultivated terraces	plain grounds/valleys/cultivated terraces composed of sandy loamy soils along with gravels	Covered by grasses and weeds of cultivation that include: <i>Amaranthus caudatus</i> , <i>A. ovalifolius</i> , <i>Conyza bonariensis</i> , <i>Oxalis corniculata</i> and grasses such as <i>Brachiaria distachya</i> , <i>Cynodon dactylon</i> , etc.	Highly degraded vegetation

2.9 VEGETATION ECOLOGY OF TRIBUTARIES/ NULLAHS¹ AND VILLAGES

2.9.1 Vegetation of Nullahs

The study area has a large number of tributaries locally termed as nullahs. These nullahs represent an important feature of the overall topography and ecological features. There are in total 17 major nullahs recorded on both side of the Indus from Dasu to Basha dam. Detailed ecology of nullahs along with their location, habitat type and floral representation is provided below.

(1) Ucchar Nullah

Ucchar *nullah* is located at 35° 19' 57" N and 73° 12' 13.4" E at the elevation of 877 meters. The area represents rocky substrate with steep slopes and cliffs (Fig. 2.15). The right bank of this nullah is dominated by *Dodonaea viscosa*, *Olea ferruginea* and interspersed with *Cotinus coggyria*. Common herbs include *Echinops cornigerus*, *Tribulus terrestris* along with grasses like *Themeda anathera*, *Aristida cynatha*, *Cymbopogon* sp. and *Carex* sedge. The left bank possesses relatively sparse vegetation consisting of *Olea ferruginea*, *Fcus carica* and *Echinops cornigerus*.

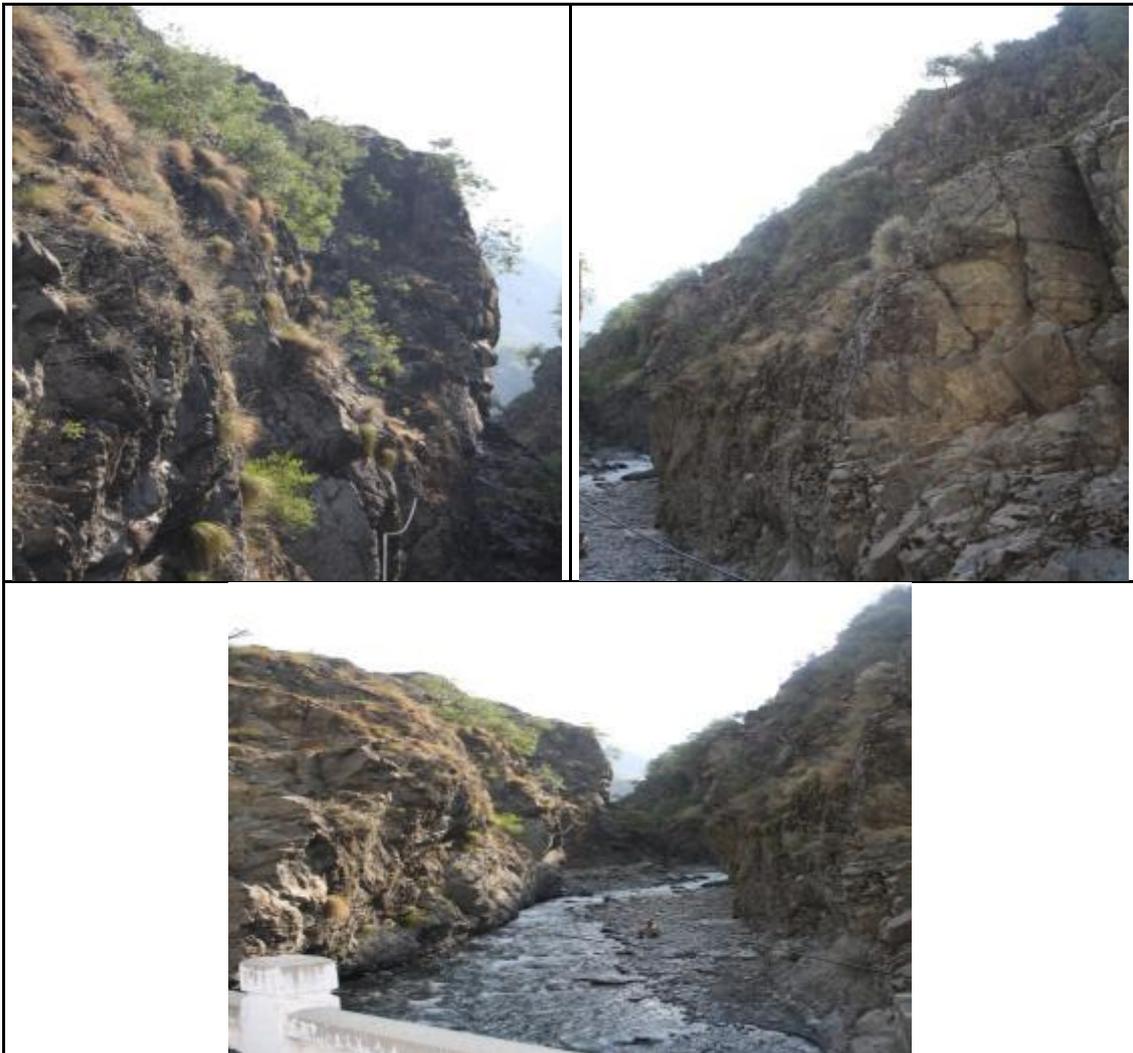


Figure 2.15: Ucchar Nullah

¹ Term Nullahs is used instead of Tributaries throughout the text since it is commonly understood by all stakeholders.

(2) Barseen Nullah

This nullah lies at 35° 21' 51.7" North and 73° 12' 01.8" East at the elevation of 870 meters (Figure 2.16). The topography of the area is dominated with cliffs, steep slopes and plain rocks. The right bank of nullah is thinly vegetated with some shrubby species such as *Olea ferruginea*, *Dodonaea viscosa* and *Cotoneaster microphylla*. The foothills and ground is covered by *Rumex hastatus*, *Chenopodium botrys*, *Echinops cornigerus*, *Amaranthus viridis*, *Heliotropium europeum*. The nullah bed is represented by *Nerium oleander*, *Mentha longifolia* and *Debregeasia salicifolia*. The left bank possess relatively thick lush green vegetation than the left bank which is possibly due to ongoing water from the waterfall. The left bank represents mixture of species composition such as *Debregeasia salicifolia* followed by *Maytenus royleanus* and *Cotoneaster nummularia* as dominating species. The hill tops are dominated by *Cotinus coggyria*, *Ailanthus altissima* and *Brousonetia papyrifera*. The ground cover at foothills was dominated by *Persicaria glabra*, *Setaria* spp., *Cyperus niveus*. The water channel is fairly dominated by *Mentha longifolia*, *Adiantum venustum*, *Nasturtium officinale*, *Eclipta prostrata* and *Pteris critica*. The common grasses in that site include *Cynodon dactylon*, *Cenchrus pennisetiformis*, *Setaria pumila* and *Digitaria sanguinalis*.

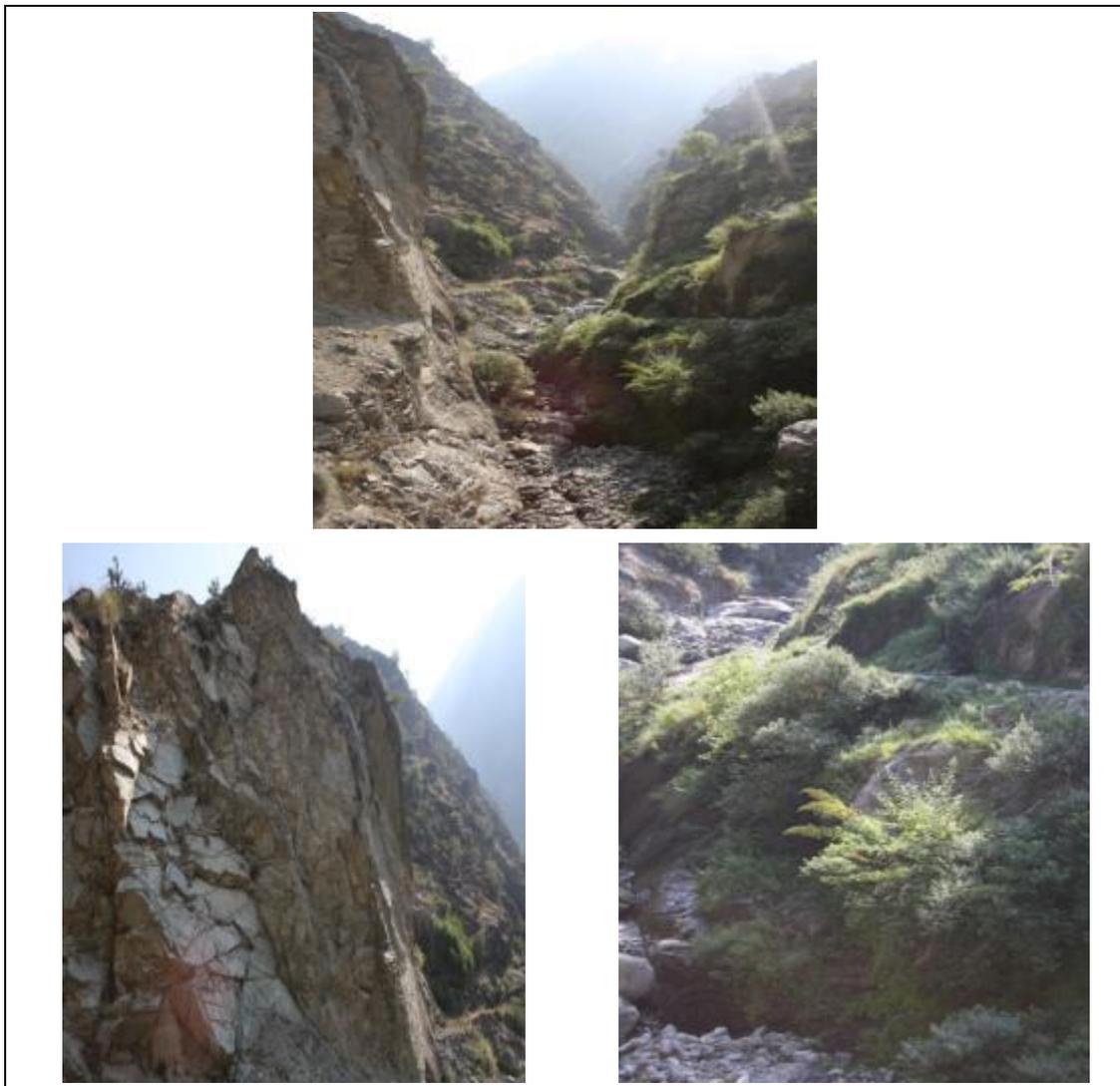


Figure 2.16: Barseen Nullah

(3) Dooga Nullah:

This nullah lies at 35° 23' 23.0" North and 73° 11' 56.4" East at the elevation of 887 meters (Figure 2.17). It is mostly comprised of rocky gentle slopes. The right bank of this nullah is thickly populated with *Quercus baloot* as a single vegetation stand, whereas, the left side is densely packed with *Olea ferruginea* and *Cotinus coggygia* at intermediate to top hills.

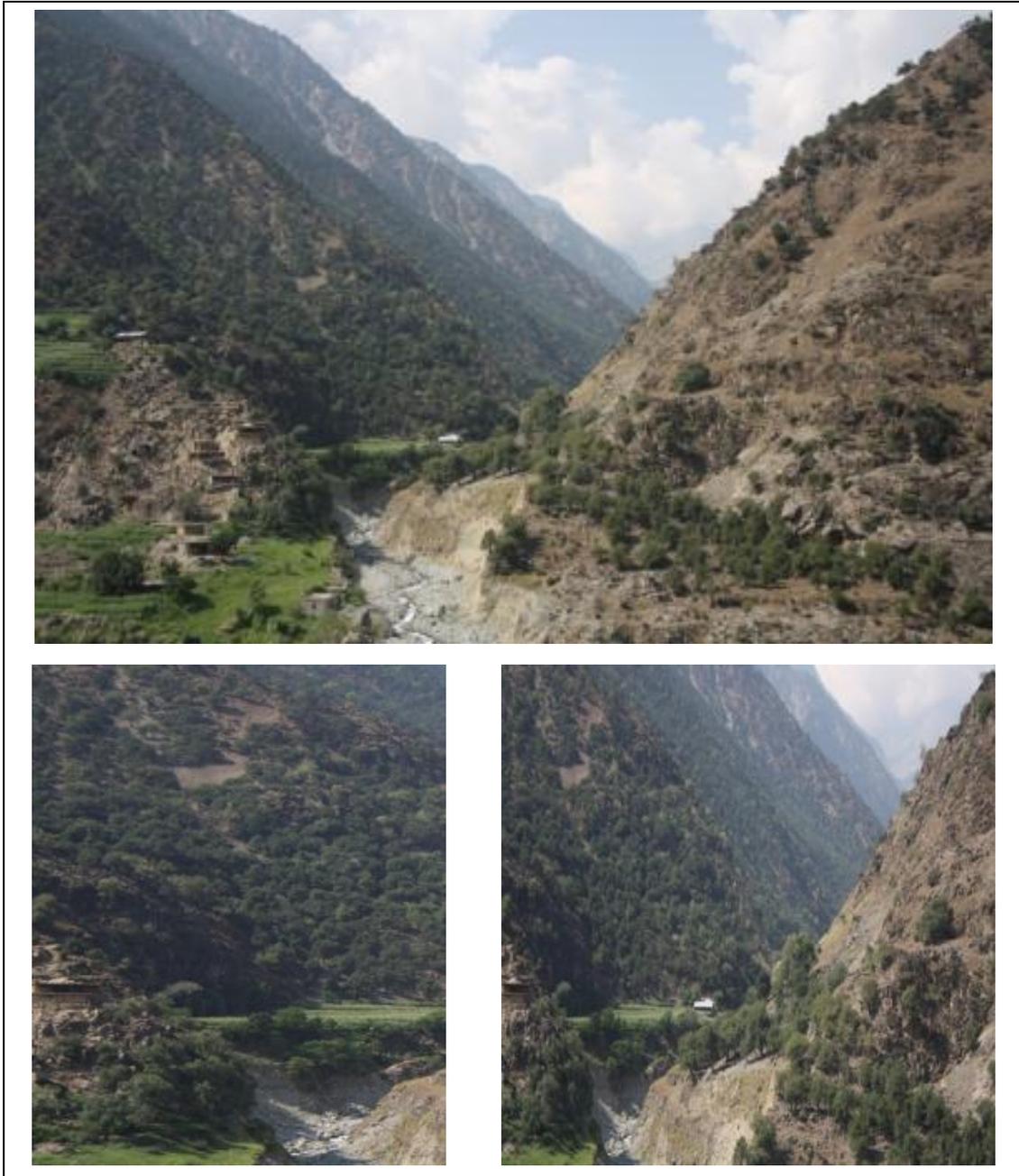


Figure 2.17: Dooga Nullah

(4) Kaigah Nullah:

This nullah is situated at 35° 24' 03.0" North and 73° 12' 08.4" East at the elevation of 866 meters (Figure 2.18). The area appears as a rocky boulder with vertical cliffs. On the intermediate steep slope of the right bank, the dominating species are comprised of *Quercus baloot*, *Olea ferruginea* and *Ficus carica*. Near settlements *Ailanthus altissima*, *Populus deltoides* and *Salix acmophylla* are planted. In and around nullah, mostly *Debregeasia salicifolia* and *Nerium oleander* are seen as moisture loving plant and riparian vegetation. The associated ground flora include: *Mentha longifolia*, *Adiantum venustum*, *Persicaria glabra*, *Rumex hastatus* and *Maytenus royleanus*. The left bank of nullah is sparsely represented in terms of vegetation consisting of *Quercus baloot*, *Olea ferruginea*, *Cotinus coggygria*, however, *Ficus carica* is seen common along with *Ailanthus altissima*.



Figure 2.18: Kaigah Nullah

(5) Kandian Nullah/ River:

This is a fast flowing nullah located at 35° 26' 04.7" North and 73° 12' 20.8" East and starts at the elevation of 861 meters (Figure 2.19). Both river banks possess rocky cliffs and are dominated by *Olea ferruginea*, *Dodonaea viscosa*, *Carex chitralensis*, *Rhus mysurensis* and *Cotoneaster microphylla*. *Periploca aphylla* and *Rumex hastatus* were also found as infrequent species. The foothills are dominated by herbs such as *Chenopodium botrys*, *Solanum surattense*, *S. villosum*, *Amaranthus caudatus*, *Amaranthus graecizense*, *Cannabis sativa*, *Conyza bonariensis* and *Polygonum effusum*.

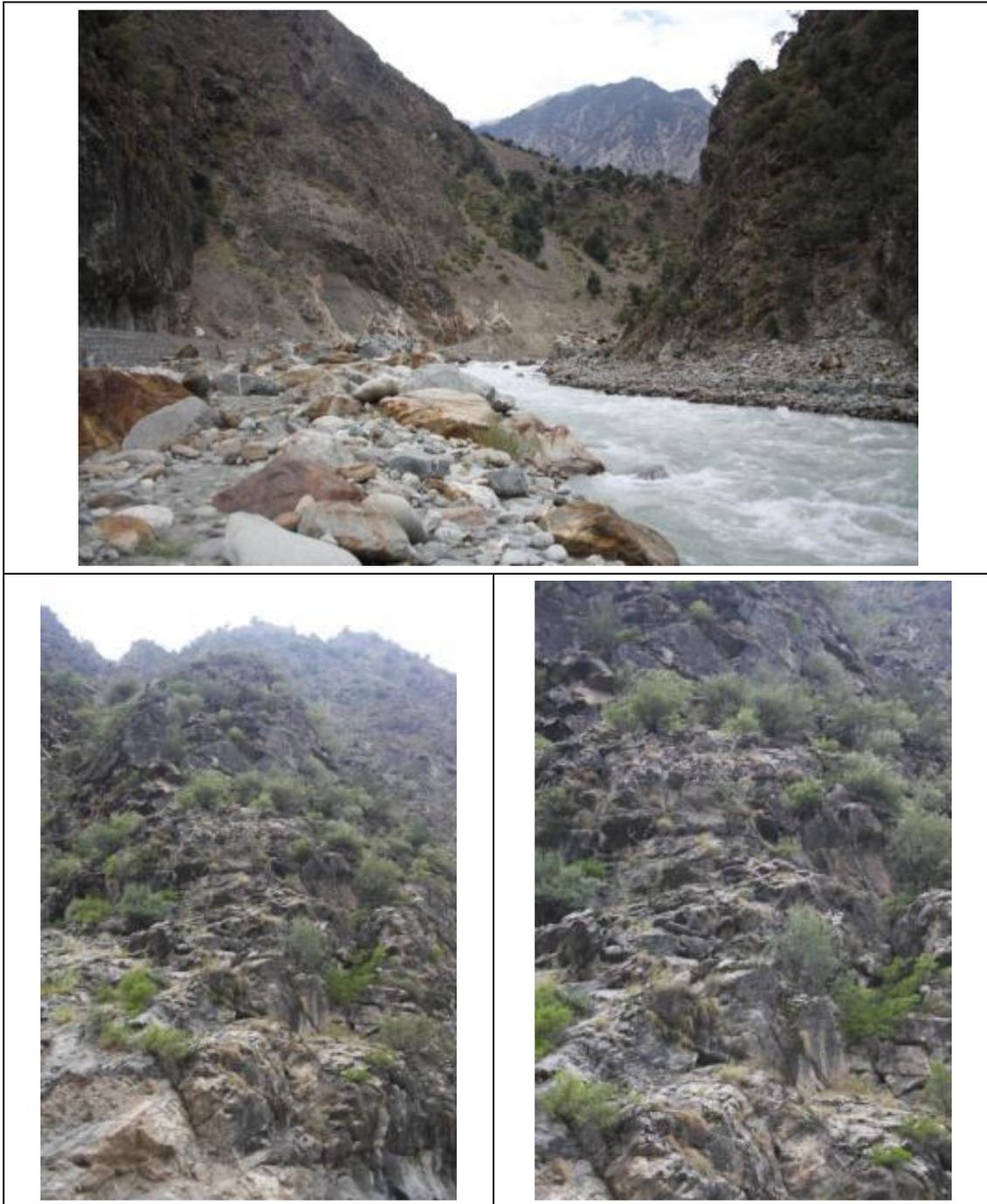


Figure 2.19: Kandian River/ Nullah:

(6) Lootar Nullah

This nullah is situated at 35° 28' 42.0" North and 73° 16' 19.1" East and starts at the elevation of 959 meters (Figure 2.20). It is surrounded by high rocky mountain peaks with vertical slopes and is supported by scattered vegetation of shrubs. The right bank appears as undulated gentle slope with rocks and is comparatively greener than the left bank. Two streams are also located in this site supporting moisture loving plants to grow. The most noticeable species are *Olea ferruginea* and *Cotinus coggygia* along with *Zizyphus sativa* and *Celtis australis*. On the stream, *Debregeasia salicifolia* is found as dominating species. *Themeda anathera* and *Aristida cynatha* were common grasses on this site. The most common herbs include: *Adiantum venustum*, *Pteris vittata*, *Micromeria biflora*, *Oxalis corniculata*, *Setaria viridis*, *Cleome viscosa*, *Tribulus terrestris*, *Potulaca oleracea*, *Plantago lanceolata*, *Mentha longifolia*, *Asparagus fillicinus*, *Conyza bonariensis* and *Solanum villosum*. The left side of the nullah is a steep slope and sparsely distributed by *Quercus baloot*, *Olea ferruginea*, *Cotinus coggygia*, *Rhus mysurensis* on the top as well as intermediate slopes.

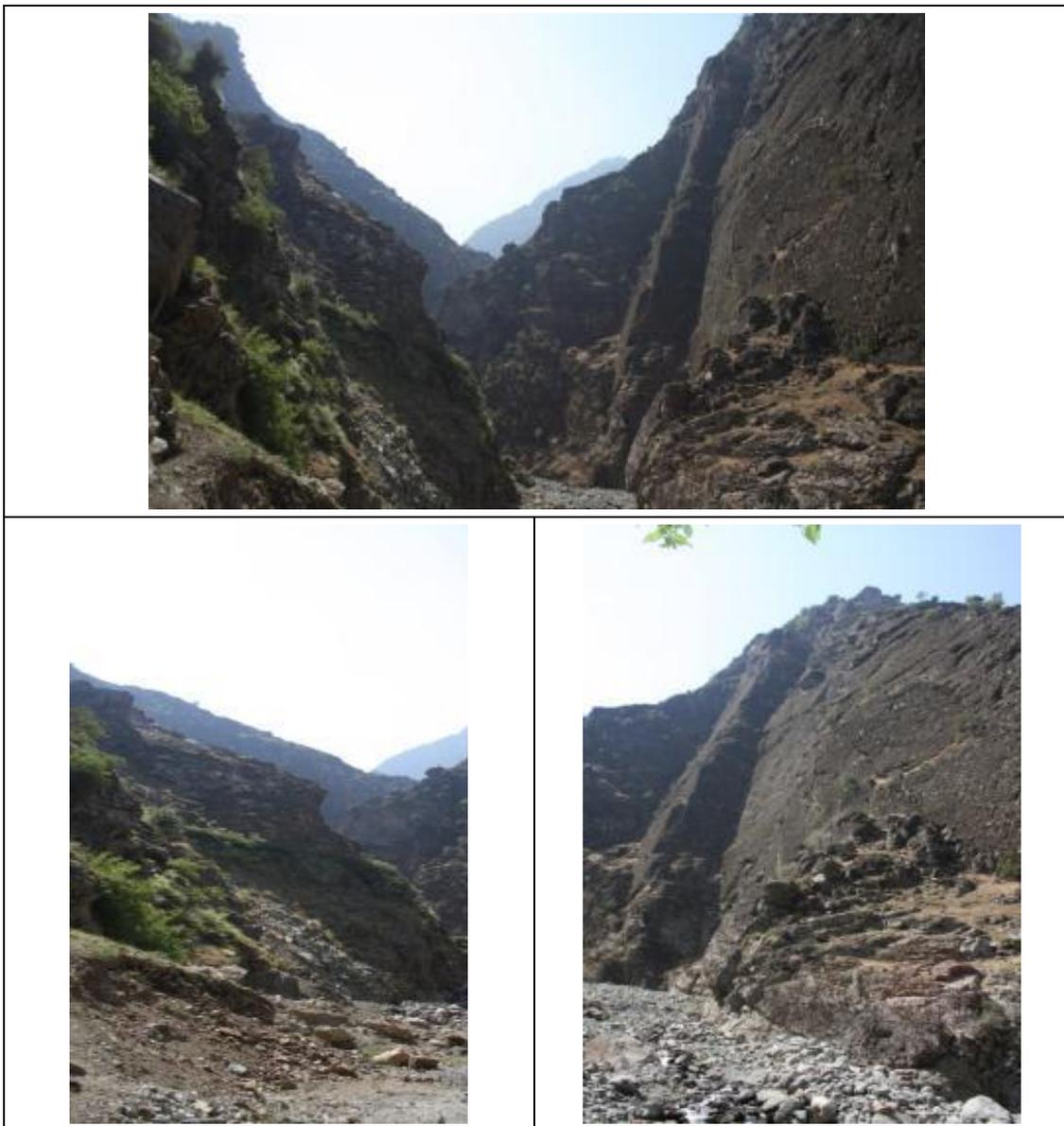


Figure 2.20: Lootar Nullah

(7) Gobar Nullah:

This nullah is situated between 35° 29' 30.3" North and 73° 17' 53.9" East at the elevation of 949 meters (Figure 2.21). The right bank is plain rocks with steep slope and the left one is rocky gentle slope. The vegetation on the right bank is sparse consisting of *Cotinus coggygria* and *Rhus mysurensis* with rare occurrence of *Olea ferruginea*. The herbs comprised of *Echinops cornigerus*, *Juncus chitralensis*, *Kickxia ramosissima* along with grasses like *Themeda anathera* and *Aristida cyanatha*. Some of the species like *Periploca aphylla*, *Cotoneaster affinis* and *Ficus carica* were occasionally recorded. The left bank foothills of nullah are mostly covered by grasses along with herbs such as *Solanum surattense*, *Rumex hastatus*, *Asparagus filicinus* and *Tribulus terrestris*. On the intermediate hilltops, mix vegetation exists with *Quercus baloot* and *Olea ferruginea* and sparse distribution of *Cotinus coggygria*.



Figure 2.21: Gobar Nullah

(8) Uthar Nullah:

This nullah lies between 35° 29' 52.2" North and 73° 17' 56.4" East at the elevation of 911 meters (Figure 2.22). The area represents gentle rocky slopes. On the foothills of right bank, *Cotoneaster nummularia*, *Dodonaea viscosa*, *Cotinus coggygria*, *Celtis australis*, *Rhus mysurensis* and *Olea ferruginea* form major vegetation types. Pure stand of *Quercus baloot* exist on intermediate hilltops. The left bank is represented by scattered vegetation consisting of *Rhus mysurensis*, *Cotoneaster microphylla* and *cotinus coggygria* with sparse distribution of *Quercus baloot* and *Olea ferruginea*. The riparian vegetation is comprised of *Dodonaea viscosa* and *Debregeasia salicifolia*.

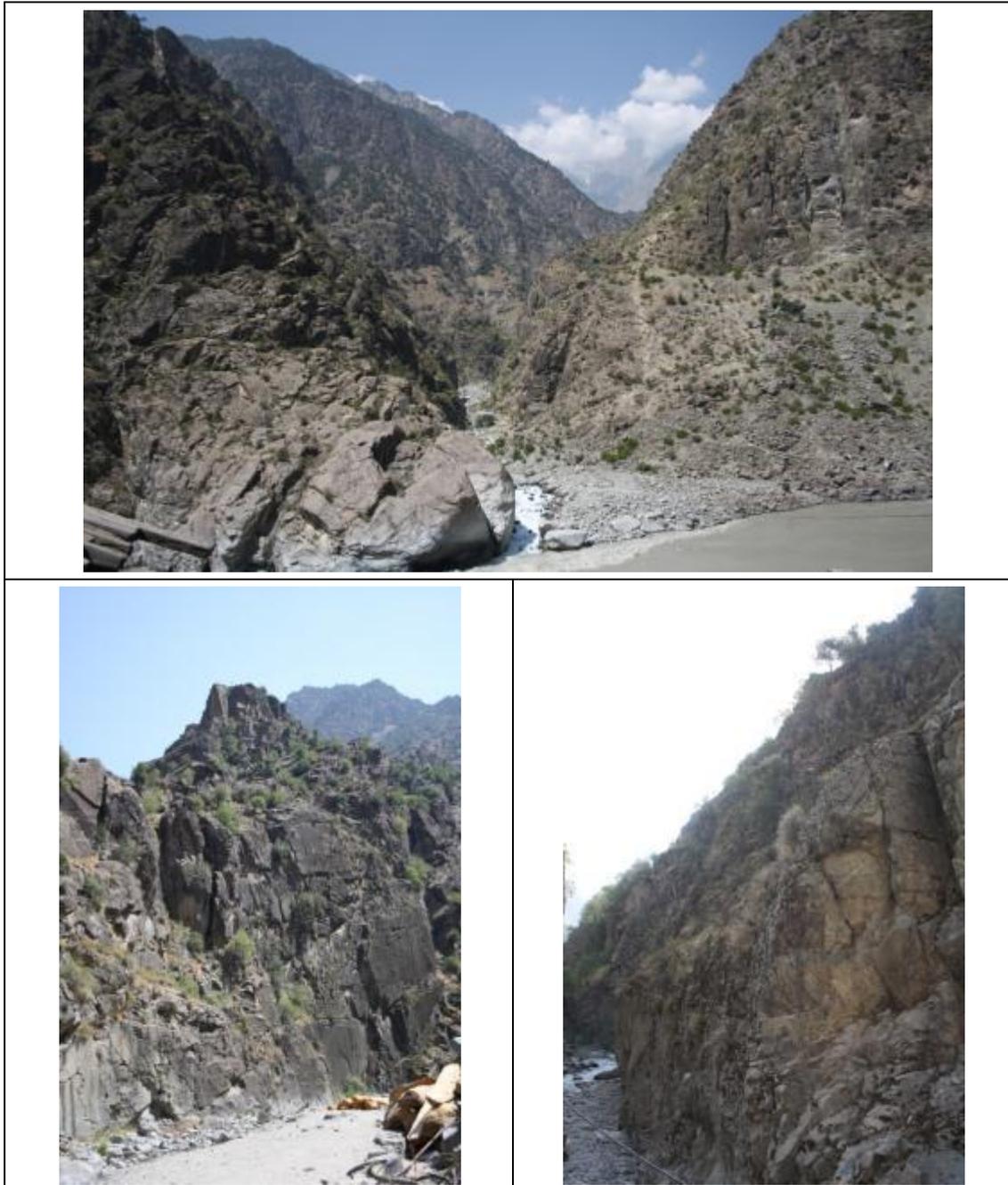


Figure 2.22: Uthar Nullah

(9) Shori Nullah:

This nullah is located at 35° 30' 32.5" North and 73° 21' 45.3" East at the elevation of 1069 meters (Figure 2.23). This site is rocky steep slope on both banks. There is sparse vegetation on both flanks comprising of *Cotinus coggygia*, *Olea ferruginea*, *Rhus mysurensis*, *Celtis australis*, *Cotoneaster affinis* and *Rosa foetida*. The other associated and occasional species include *Periploca aphylla*, *Juncus* sp., *Carex chitralensis* and *Themeda anathera*.

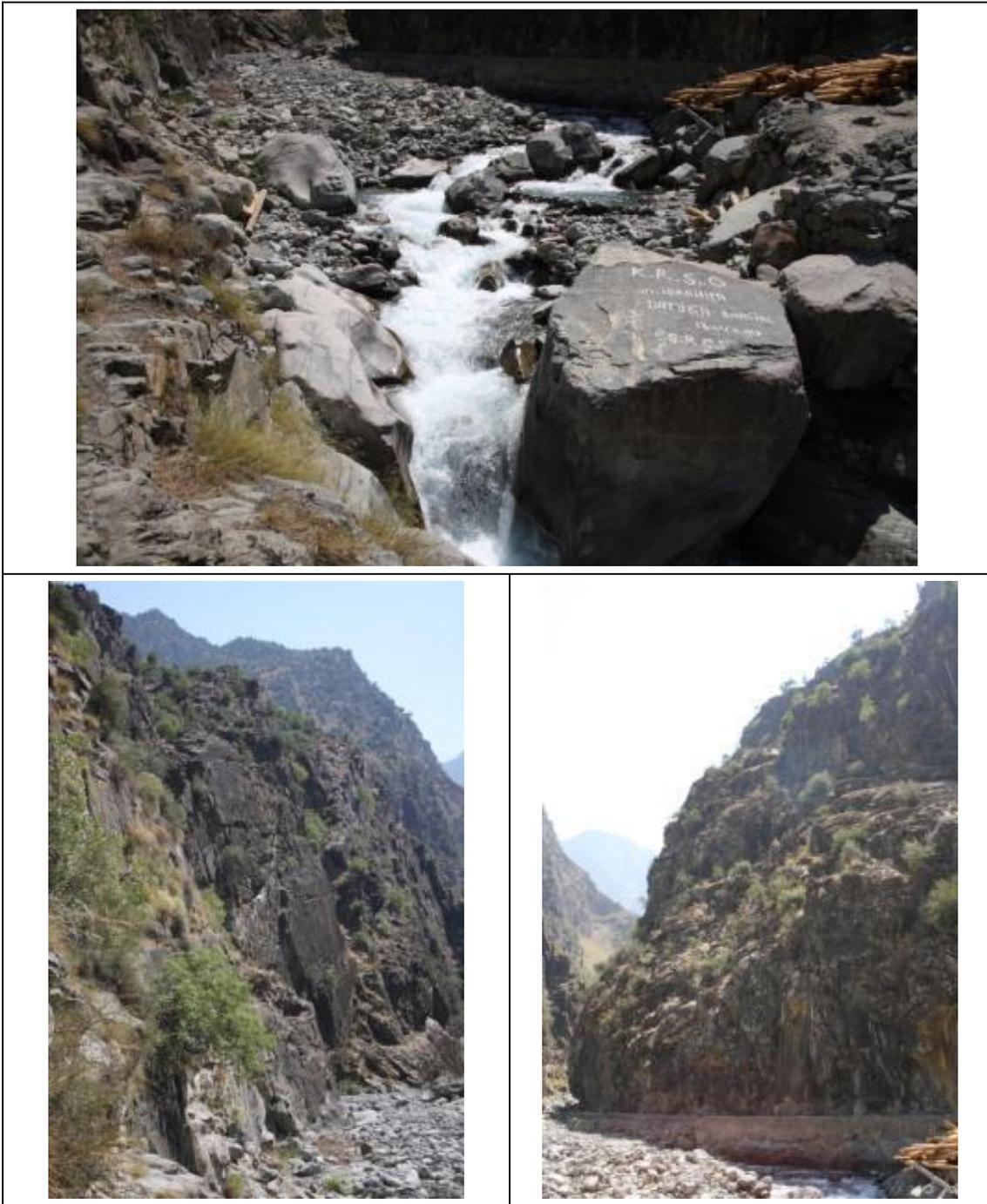


Figure 2.23: Shori Nullah

(10) Summar Nullah:

The nullah lies at 35° 30' 33.9" North 73° 23' 10.9" East at 945 meters elevation (Figure 2.24). This nullah is situated on the left bank of River Indus. The habitat is steep rocky mountains and the foothills of right bank are mostly covered by *Rumex hastatus* and *Themeda anathera*. The intermediate slopes are dominated by sporadic species such as *Cotinus coggygría* and *Cotinus nummularia*. The hilltops are represented by scattered *Quercus baloot*. The foothill of left flank is dominated by *Debregeasia salicifolia*, *Olea ferruginea*, *Quercus baloot*, *Salix acmophyla* and *Cotinus coggygría*. The intermediate to hilltop is relatively thick in terms of vegetation that comprised of *Olea ferruginea*, *Cotinus coggygría*, *Dodonaea viscosa* and *Themeda anathera*.

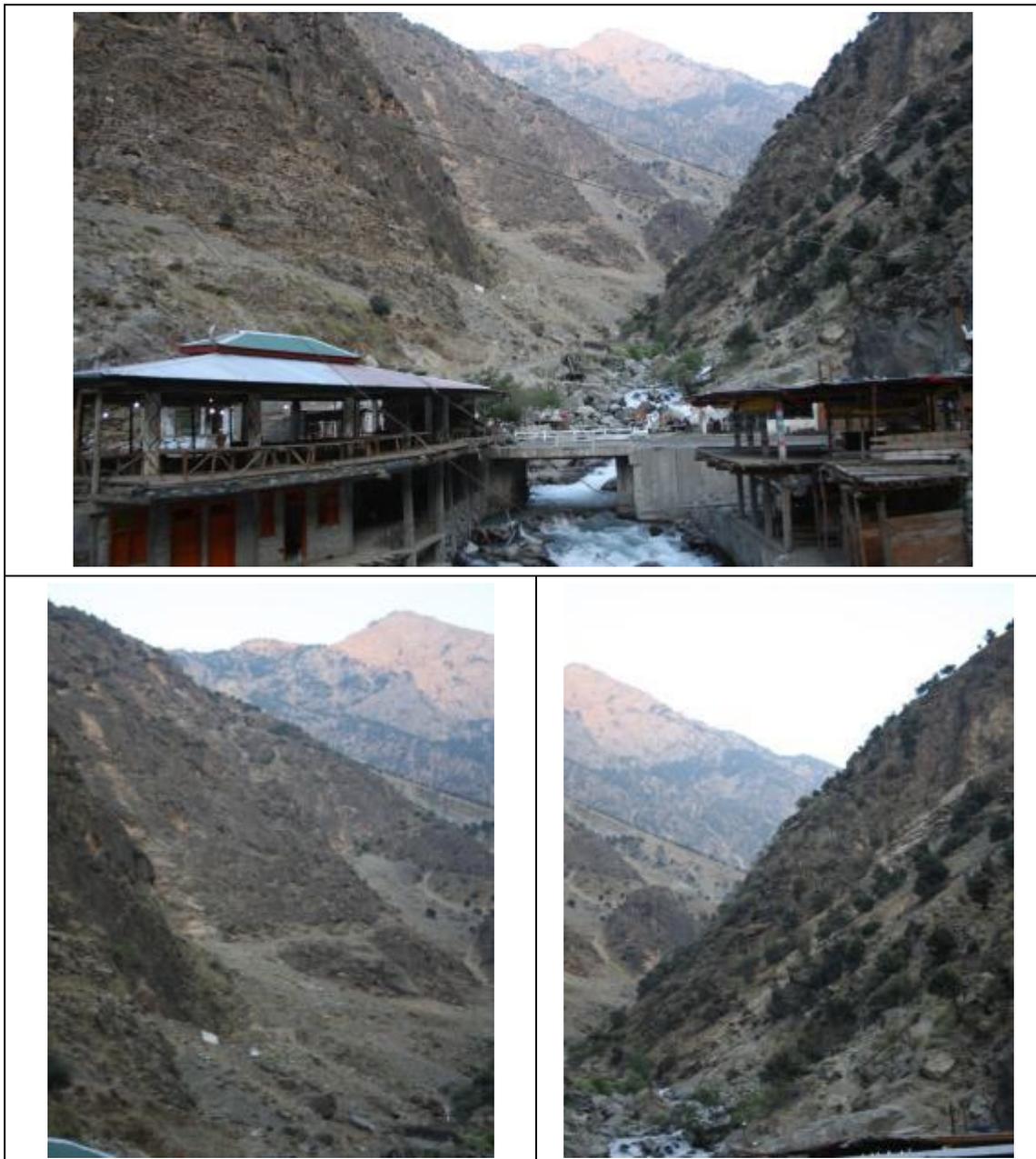


Figure 2.24: Summar Nullah

(11) Laachi Nullah

This nullah is situated at 35° 31' 37.1" North and 73° 26' 07.5" East at the elevation of 964 meters elevation (Figure 2.25). This site is named *Laachi* due to the presence of *Myrtus communis* commonly called as *Lachi* (called as Allaichi in Urdu language for Cardimum). Its aromatic leaves are used as substitute of Cardimum. The habitat is has gentle slopes and thickly populated with *Myrtus communis*, *Olea ferruginea*, *Ficus carica*, *Rhus mysurensis* with an occasional species of *Cotinus coggygria*. Along the side, silt based soil is dominated by *Debregeasia salicifolia*, *Rumex hastatus*, *Themada anathera* and *Myatenus royleanus*. The other associated species include *Mentha longifolia*, *Solanum surattense* and *Cotoneaster affinis*.



Figure 2.25: Laachi Nullah

(12) Angoori Nullah:

This nullah lies on 35° 31' 54.2" North and 73° 27' 23.9" East at the elevation of 1017 meters elevation (Figure 2.26). The habitat is a steep slope and dominated by undulating terrain. The foothill is dominated by *Dodonaea viscosa* and hilltops have major representation of *Quercus baloot* and *Cotoneaster nummularia*. The riparian vegetation include *Nerium oleander*, *Debregeasia salicifolia* along with rare distribution of *Rumex hastatus*, *Olea ferruginea* and *Salix acmophylla*.

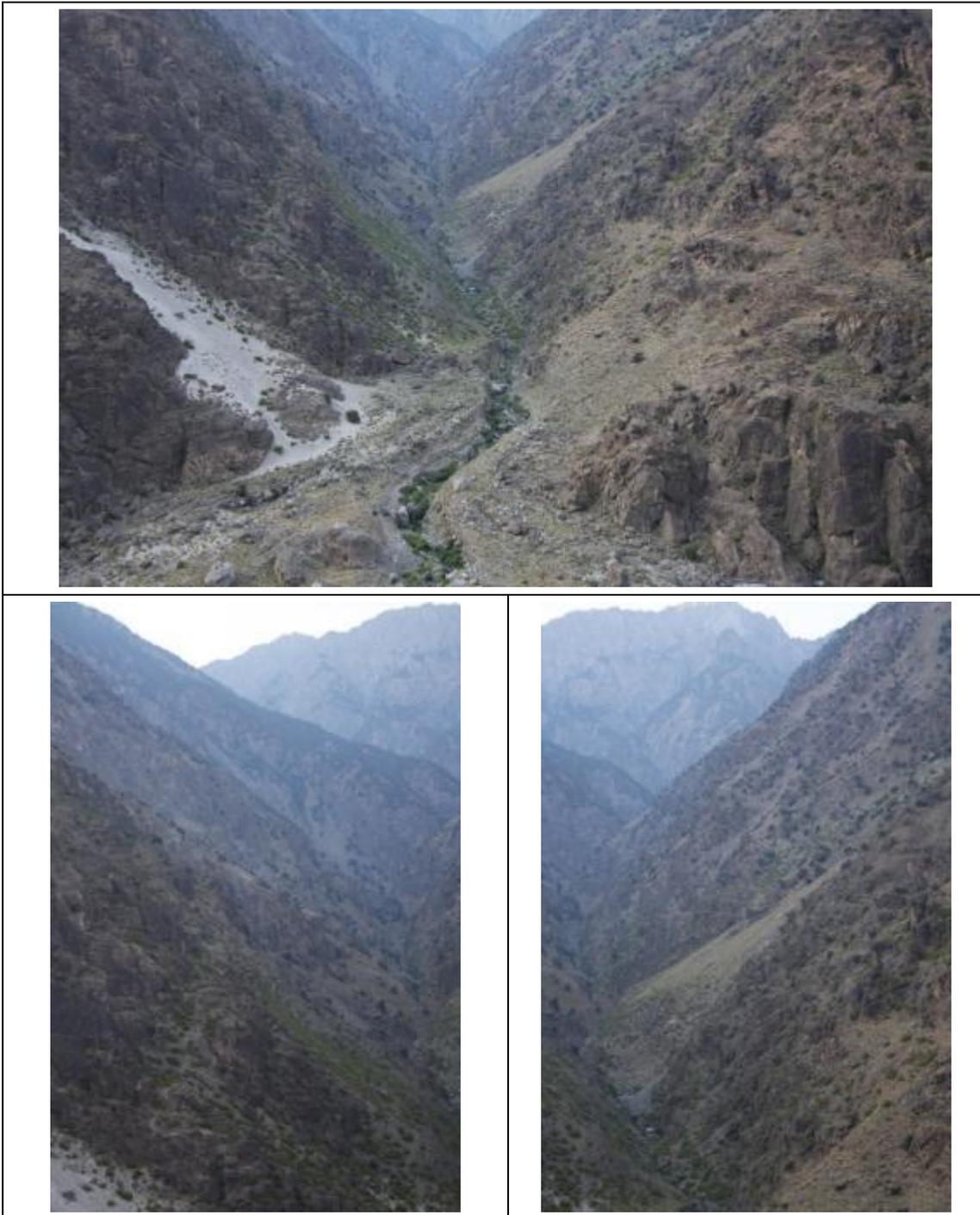


Figure 2.26: Angoori Nullah

(13) Sazin Nullah:

This nullah lies on 35° 31' 45.1" North and 73° 30' 27.6" East and starts at the elevation of 996 meters (Figure 2.27). This site represents gravel and silt substrate with gentle slope on the right bank and rocky steep slope on left bank. There is sparse bushland in this location mostly covered by *Artemesia maritima*, *Juncus* sp., *Cotoneaster microphylla* along with introduced species such as *Punica granatum* and *Morus alba*. Small population of *Cotinus coggygria* is also recorded in this nullah.



Figure 2.27: Sazin Nullah

(14) Tangir Nullah:

This nullah is situated between 35° 31' 50.9" North and 73° 30' 39.9" East and starts at the elevation of 998 meters elevation (Figure 2.28). The habitat is a gentle slope with sandy soil. The area is a shrubland mostly represented by *Dodonaea viscosa* and *Cotoneaster nummularia*. *Debregeasia salicifolia* is marked as a moisture loving plant from the riparian zone of this habitat.



Figure 2.28: Tangir Nullah

(15) Shatial Nullah:

This nullah is located at 35° 31' 26.9" North and 73° 33' 07.7" East and starts at the elevation of 1008 meters (Figure 2.29). The soil substrate of this area is filled with gravel and sand. This habitat is a steppic forest dominated by *Artemesia maritima* along with *Capparis spinosa*, *Cotinus coggygia* and *Periploca aphylla* scattered and hanging in crevices. The right bank is fairly represented with thick vegetation, while the left bank is almost devoid of any vegetation. The riparian vegetation includes *Debregeasia salicifolia*, *Rumex hastatus* and *Mentha longifolia*. The planted trees around the nullah comprised *Ailanthus altissima* and *Ppolus deltoides*.



Figure 2.29: Shatial Nullah

(16) Darel Nullah:

This nullah is situated at 35° 32' 10.4" North and 73° 34' 48.9" East at the elevation of 1063 meters elevation (Figure 2.30). The habitat is dominated with steep slopes and allayed rocky substrate. Most of the area is a barren mountain dominated by bushes of *Artemesia maritima* on hilltop, whereas thin population of *Dodonea viscosa* and *Cotoneaster microphylla* *Themeda anathera* is also recorded on the foothills.

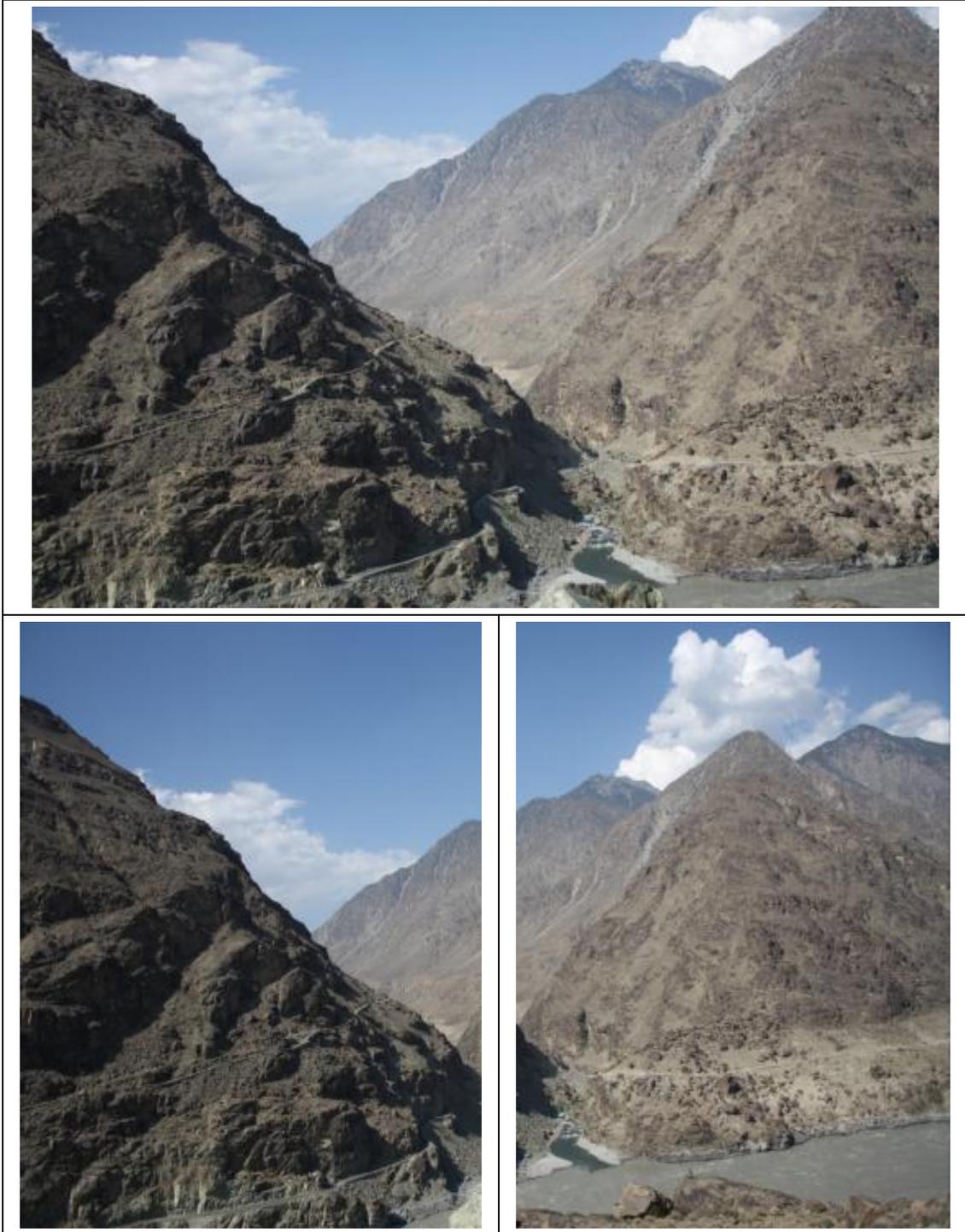


Figure 2.30: Darel Nullah

(17) Harban Nullah:

This nullah lies 35° 32' 09.1" North and 73° 36' 06.3" East at the elevation of 1024 meters elevation (Figure 2.31). The area is predominantly rocky steep slopes with large buildup of gravel. The habitat is scattered in terms of shrubby vegetation which is mostly shrubby in nature. The right bank represented the most common bushes such as *Artemisia maritima*, *Capparis spinosa* and *Rumex hastatus*. The occasional species include *Cotoneaster nummularia*, *Echinops cornigerus* and *Periploca aphylla*. Few species of herbs exist on the foothills e.g. *Chrozophora tinctoria* and *Solanum surattense*. The left bank represented *Rumex hastatus*, *Cotoneaster nummularia*, *Cotinus coggygria*, *Periploca aphylla*, *Echinops cornigerus*, *Capparis spinosa*, *Debregeasia salicifolia* along with the common grass *Themeda anathera*. The foothills are mostly covered with herbs like *Chrozophora tinctoria*, *Asparagus filicinus*, *Aristida cyanatha*, *Amaranthus graecizans* and *Heliotropium europaeum*.



Figure 2.31: Harban Nullah

2.9.2 Vegetation Ecology of Dasu Villages

(1) Upstream villages from Dasu Dam:

Ten upstream villages and their surroundings were surveyed to study the composition of local vegetation. Details are provided in Table 2.4 and particular vegetation communities are described below.

Table 2.4: Upstream Villages in Study Area and close to Damsite

Sr. No.	Village name	North	East	Elevation (m) asl
1	Dooga Gah	35° 15' 04.5"	73° 13' 04.9"	891
3	Choochang	35° 17' 51.9"	73° 12' 16.7"	1049
4	Khoshi	35° 18' 10.2"	73° 11' 55.3"	855
5	Siglu	35° 20' 25.1"	73° 12' 15.9"	836
6	Seer Gayal	35° 25' 37.6"	73° 12' 01.4"	1155
7	Toothi	35° 28' 06.6"	73° 09' 10.7"	1333
8	Seo	35° 18' 11.6"	73° 11' 31.3"	867
9	Malyar	35° 22' 45.7"	73° 12' 06.6"	860
10	Kaigah	35° 24' 2.2"	73° 12' 05.2"	872
11	Panibah	35° 24' 57"	73° 12' 09.5"	899

(a) Dooga Gah

The area is a steep rocky slope mostly represented by scanty vegetation. The hilltops are fairly distributed with *Quercus baloot* interspersed with *Olea ferruginea* and *Cotinus coggygria*. The foothills as well as intermediate slopes are dominated by *Dodonaea viscosa*, *Carex chitralensis*, *Echinops cornigerus*, *Asparagus filicinus* and *Themeda anathera*.

(b) Choochang village

This village is located on the left bank of River Indus at 35° 17' 51.9"N and 73° 12' 16.7" E on an elevation of 1049 meters. This is rocky terrain having steep to moderate slopes. The foothill are rocky and filled with gravel represented by *Malva parviflora*, *Plantago lanceolata*, *Xanthium indicum*, *Persicaria glabra*, *Lactuca seriola*, *Amaranthus* spp., *Solanum surattense*, *S. villosum*, *Euphorbia indica* and *Verbascum Thapsus* species. The intermediate slopes to hilltops are occupied by *Olea ferruginea*, *Quercus baloot*, *Cotoneaster nummularia*, *Maytenus royleanus* with rare species like *Cotinus coggygria*. The hilltops possessed alluvial loamy soil which is to cultivate maize crop by the dwellers. Nearby there is grasslands that are comprised of *Cynodon dactylon* interspersed with *Cymbopogon distans*, *Dianthus* sp., *Conyza bonariensis* and *Lespedeza elegans*.

(c) Khoshi

The Khoshi area is located on a gentle slope with sand and large gravel. The riparian vegetation is consisted of *Nerium oleander*, *Mentha longifolia*, *Aristida cyanatha* and *Themeda anathera*. The planted trees in this village are *Ailanthus altissima* and *Morus alba*. The hilltop and steep slopes are represented by scattered shrubs and trees such as *Zizyphus sativa*, *Cotoneaster microphylla*, *Olea ferruginea* and *Quercus baloot*.

(d) Seglu

This village is situated 35° 20' 25.1" N and 73° 12' 15.9" E at the elevation of 836 meters elevation on the right bank of River Indus. The area is a gentle slope with sandy gravelly substrate. Vegetation on the foothills is composed of annual plants and grasses mainly consisting of *Heliotropium europaeum*, *Cleome viscosa*, *Verbascum Thapsus*, *Tribulus terrestris*, *Metha longifolia*, *Micromeria biflora*, *Echinops cornigerus*, *Solanum surattense*, *Cymbopogon distans*, *Brachiaria reptans*, *Tragus* spp. and *Juncus* spp. The hilltop is covered by *Olea ferruginea*, *Quercus baloot*, *Cotinus coggygria* and *Dodonaea viscosa*.

(e) Seer Gayal

This village is located on the right bank of River Indus at 35° 25' 37.6" N and 73° 12' 01.4" E at the elevation of 1155 meters elevation. This is mountainous rocky habitat with steep to intermediate mountain slopes. Most of the area is covered by bushes and shrubs intermixed with some trees. The most common species in this area are *Olea ferruginea*, *Cotoneaster microphylla*, *Artimesia maritima*, *Cotinus coggygia* and *Juncus* spp. Some of infrequent species include *Dodonaea viscosa*, *Echinops cornigerus*, *Boerhavia procumbense*, *Verbascum Thapsus*, *Conyza bonariensis*, *Kickxia ramosissima*, *Aristida cyanatha*, *Cymbopogon distans* and *Themeda anathera*.

(f) Toothi

This village is located on the right bank of the Indus River on 35° 28' 06.6" N and 73° 09' 10.7" E at 1333 meters elevation. The area is rocky steep slopes and hilltops are dominated by *Quercus baloot*, *Cotinus coggygia* and rarely with *Olea ferruginea*. The other common species were included: *Asparagus filicinus*, *Echinops cornigerus*, *Cotoneaster nummularia* and *Aristida cyanatha*.

(g) Seo

At the right bank of River Indus, this village is located at 35° 18' 11.6" N 73° 11' 31.3" E at 867 meters. Maize is most commonly cultivated along with some other vegetables near the banks of this village. The area is rocky gentle slope covered by *Maytenus royleanus*, *Olea ferruginea* and *Nerium oleander*.

(h) Malyar

Malyar is situated on the right bank of River Indus at 35° 22' 45.7" N and 73° 12' 06.6" E with 860 meters. The terrain is rocky steep slope composed of *Quercus baloot*, *Olea ferruginea* along with some shrubs like *Maytenus royleanus*, *Cotoneaster microphyllus* and *Ribes alpestre*. Along the water stream, moisture loving plants such as *Debregeasia salicifolia*, *Persicaria glabra*, *Mentha longifolia*, *Verbena officinale*, *Cyperus rotundus*, *Setaria pumila*, *S. viridis*, *Amaranthus* spp., *Digitaria sanguinalis*, *Xanthium indicum*, *Bistortia affinis* are commonly present. In the cultivated fields of maize crop some of the prominent weeds included *Amaranthus caudatus*, *A. ovalifolius*, *Portulaca oleracea*, *Physalis peruviana*, *Euphrasia himalyica*, *Cleome viscosa*, *Trianthema portulacastrum*, *Coronopus didymus*, *Chenopodium ambrisoides*, *Euphorbia indica*, *Bidense chinensis*, *Oxalis corniculata*, *Achyranthes aspera*, *Conyza bonariensis*, *Oxalis corniculata*, *Verbena officinale* along with grasses such as *Brachiaria distachya* and *Cynodon dactylon*.

(i) Kaigah

This village is situated at 35° 24' 2.2" N and 73° 12' 05.2" E with 899 meters elevation elevation at the left bank of River Indus. The area is gentle rocky slope with the associated very sparse and scattered vegetation, mostly comprised on *Ficus carica*, *Melia azadarach* and *Ailanthus altissima*. Due to seepage of water from hilltops, some ferns such as *Adiantum* spp., *Micromeria biflora*, *Kickxia ramosissima*, *Mentha longifolia*, *Carex himalyica*, *Persicaria barbata*, *Plantago major*, *P. lanceolata*, *Debregeasia salicifolia* and *Maytenus royleanus* were very common along with *Rumex hastatus*.

(j) Panibah

This village is positioned at the left bank of River Indus on 35° 24' 57" N 73° 12' 09.5" E at the elevation of 899 meters elevation. The area is rocky dominated with gravel and large boulders along with very sparse vegetation. It is our assumption that due to high grazing pressure some of the tree species are found in stunted form due to lopping for the livestock purpose. *Olea ferruginea* and *Ailanthus altissima* are rarely found along with some shrubs like *Celtis australe*, *Maytenus royleanus* and *Cotoneaster microphylla*, *C. nummularia*, *Cotinus coggygia* and *Rumex hastatus*. Near village, *Zizyphus sativa* and *Quercus baloot* are very common along with *Olea ferruginea*. Herbs and grasses were very common that include *Heliotropium europium*,

Chenopodium ficifolium, *Conyza bonariensis*, *Mentha longifolia*, *Persicaria glabra*, *Plantago lanceolata*, *Oxalis corniculata*, *Solanum surattense*, *S. villosum*, *Chenopodium botrys*, *Echinops cornigerus*, *Achyranthes aspera*, *Cucumis melo* var. *agrestis*, *Xanthium indicum*, *Brachiaria eruciformis*, *Cynodon dactylon*, *Cyperus rotundus*, *Digitaria sanguinalis*, *Echinochloa colona*, and *Setraia pumila*.

(2) Downstream Villages:

The summary of inventory of habitat types and vegetation along with coordinates and elevation is provided in Table 2.5. It shows that most of the species are commonly present in downstream area are more or less similar to upstream vegetation. Starting from Sapat to Shishal Kayal, there is uniform distribution of major habitat types as well associated vegetation, however, near Pattan; there was a bit variation in vegetation with an addition of *Selaginella indica*, *Mallotus philipinsis* and *Rubus ellipticus*. From Besham to Tha Kot, the area is marked as scrub forest mostly covered by *Adhadota zeylanica*, *Dodonea viscosa*, *Acaica modesta* along with *Rubus ellipticus*, *Zanthoxyllum alatum*.

Table 2.5: Summary of Vegetation Distribution in the Downstream Villages and Their Surroundings

No.	Nullah	Coordinates		Elevation m amsl	Habitat type	Major Plant community
		N	E			
1	Goshali	35° 13' 38.9"	73° 12' 14.9"	837	Rocky gentle slope	<i>Quercus baloot</i> , <i>Olea ferruginea</i> along with shrubs like <i>Maytenus royleanus</i> , <i>Zizyphus sativa</i> , <i>Cotinus coggygria</i> and <i>Cotoneaster nummularia</i>
2	Sapat/ left bank	35° 14' 41. 5"	73° 14' 46.5"	774	Rock steep slopes	<i>Olea ferruginea</i> , <i>Quercus baloot</i> interspersed with <i>Cotinus coggygria</i>
3	Waterfall/Right bank	35° 14' 33. 9"	73° 10' 59.3"	777	Rock steep slopes and cliffs	<i>Olea ferruginea</i> , <i>Debregeasia salicifolia</i> , <i>Adiantum capillus-veneris</i> , <i>Ficus carica</i> , <i>Rumex hastatus</i>
4	Zaid Khard/Right bank	35° 14' 41. 4"	73° 10' 46.1"	806	Rocky steep slope	<i>Olea ferruginea</i> , <i>Maytenus royleanus</i> , <i>Dodonaea viscosa</i> , <i>Cotoneaster nummularia</i> , <i>Ficus carica</i> and <i>Cotinus coggygria</i>
5	Mandraza/waterfall	35° 13' 18. 2"	73° 09' 24.3"	805	Rocky cliff	<i>Olea ferruginea</i> , <i>Cotinus coggygria</i> , <i>Rhus mysurensis</i> , <i>Cotoneaster microphylla</i> and <i>Dodonaea viscosa</i> . Along the waterfall, <i>Aialnthus altissima</i> , <i>Debregeasia salicifolia</i> , <i>Adiantum capillus-veneris</i> , <i>Persicaria glabra</i> , <i>Metha longifolia</i> and <i>Themeda anathera</i>
6	Waterfall/Left bank	35° 12' 50. 1"	73° 08' 46.9"	864	Rocky cliff	<i>Olea ferruginea</i> , <i>Cotinus coggygria</i> , <i>Zizyphus sativa</i> and <i>Debregeasia salicifolia</i>
7	Keeru village	35° 11' 03. 8"	73° 06' 35.0"	949	Steep slope	<i>Olea ferruginea</i> , <i>Cotinus coggygria</i> <i>Rumex hastatus</i> , <i>Themeda anathera</i> , <i>Dodonaea viscosa</i> , <i>Artemesia maritima</i> and <i>Cotoneaster affinis</i> .
8	Waterfall	35° 09' 46. 8"	73° 05' 54.5"	1142	Rocky gentle slope	<i>Adiantum capillus-veneris</i> , <i>Ficus carica</i> , <i>Salix acmophylla</i> , <i>Cirsium falconerii</i> , <i>Clemetis montana</i> and <i>Rumex nepalensis</i>
9	Palas	35° 08' 55. 0"	73° 05' 08.3"	1064	Rocky steep slope	<i>Olea ferruginea</i> , <i>Qeurchus baloot</i> , <i>Cotoneaster nummularia</i> , <i>Artemesia maritima</i> and <i>Themeda anathera</i>
10	Waterfall/Right bank near Leu	35° 08' 37. 3"	73° 03' 34.4"	969	Rocky steep slope	<i>Debregeasia salicifolia</i> , <i>Cotinus coggygria</i> , <i>Artemisia maritima</i> , <i>Rumex hastatus</i> and <i>Themeda anathera</i>

No.	Nullah	Coordinates		Elevation m amsl	Habitat type	Major Plant community
		N	E			
	village					
11	Shishal Kayal nullah (Pattan)	35° 08' 38. 1"	73° 02' 38.5"	949	Rocky steep slope	<i>Quercus baloot</i> , <i>Olea ferruginea</i> , <i>Maytenus royleanus</i> , <i>Cotoneaster affinis</i> , <i>Rumex hastatus</i> and <i>Artemisia maritima</i>
12	Near Shishal Kayal nullah (Pattan)	35° 08' 25. 5"	73° 03' 19.0"	973	Rocky gentle slope	<i>Olea ferruginea</i> , <i>Cotoneaster affinis</i> , <i>Artemisia maritima</i> , <i>Gentiana</i> spp., <i>Themeda anathera</i> and
13	Pattan bridge	35° 06' 48. 3"	72°59' 52.3"	820	Rocky gentle slope	<i>Rumex hastatus</i> , <i>Selegnilla</i> sp., <i>Artemisia maritima</i> , <i>hemed a anathera</i> , <i>Asparagus filicine</i> , <i>Cenchrus pennesitifomis</i> , <i>Mallotus philipinsis</i> , <i>Debregeasia salicifolia</i> , <i>Rubus ellipticus</i> , <i>Maytenus royleanus</i>
14	Jijat	35° 02' 26. 6"	72° 55 26.6"	857	Rocky steep slope	<i>Quercus baloot</i> , <i>Olea ferruginea</i> , <i>Rumex hastatus</i> , <i>Dodonaea viscosa</i> ,, <i>Cotoneaster microphylla</i> and <i>Echinops cornigerus</i>
15	Dubair	35° 02' 25. 3"	72° 53 46.1"	693	Rocky gentle slope	<i>Dodonaea viscosa</i> , <i>Ailanthus altissima</i> , <i>Celtis australe</i> , <i>Mallotus philipinsis</i> <i>Quercus baloot</i> , <i>Olea europaea</i> , <i>Adhatoda zeylanica</i> , <i>Maytenus royleanus</i> , <i>Debregeasia salicifolia</i> , <i>Rubus ellipticus</i>
16	Besham	34° 57 ' 36. 8"	72° 53 24.9"	796	Rocky gentle slope	<i>Adhadota zeylanica</i> , <i>Olea ferruginea</i> , <i>Maytenus royleanus</i> , <i>Acaica modesta</i> , <i>Cotoneaster affinis</i> , <i>Celtis australe</i> , <i>Origanum vulgare</i> , <i>Dianthus crinata</i>
17	Way to Thakot	34° 51 ' 01. 6"	72° 57 57.4"	691	Rocky gentle slope	<i>Adhadota zeylanica</i> ,, <i>Dodonea viscosa</i> , <i>Acaica modesta</i> , <i>Ailanthus altissima</i> , <i>Ficus carica</i> , <i>Otostegia limbata</i> , <i>Zanthoxyllum alatum</i> , <i>Ziziphus oxyphylla</i> , <i>Rubus ellipticus</i>
18	Thakot	34° 48 ' 04. 0"	72° 56 01.5"	558	Rocky gentle slope	<i>Acaica modesta</i> , <i>Adhadota zeylanica</i> ,, <i>Dodonea viscosa</i> , <i>Zizyphus nummularia</i> ,, <i>Maytenus royleanus</i> , <i>Rumex hastatus</i>

2.10 STUDIES ON PLANTS OF ECONOMIC VALUE

The existing flora comprised of trees, agricultural crops, vegetables, fruits, medicinal plants and wild species. These species are utilized by local communities in fulfilling their daily life requirement. Ethnobotany plays a prominent role in discovering all sorts of use categories from the remote areas pertaining to plant resources. The detailed inventory of all plants with economic value is summarized in Appendix 2.2. Overall, ten use categories are reported from the project area. These economic value categories include medicinal, ethno-veterinary, fodder, fuel wood, agricultural implements, fruits, vegetables, weeds and timber.

2.10.1 Medicinal Plants:

Medicinal plants attract local people as well as the attention of scientific communities for the treatment of various diseases and ailments. These are not only utilized for acute cases of human being but also for the cure of domesticated animals. Table 2.6 presents the inventory of medicinal uses of 61 plant species used as crude medicine by the local inhabitants for treating various diseases (Appendix 2.3).

2.10.2 Fruiting Plants:

The detailed inventory of fruiting plants from the project area is provided in Appendix 2.4. There were 24 plant species which are being used as fruit including 13 wild species.

2.10.3 Vegetables/ Potherbs:

Vegetables constitute an important part of the daily diet. There is variety of wild plants in the project area whose edible parts are cooked for preparing local meals. These vegetables include roots, leaves, flowers and even unripe fruits. Altogether, 27 species are used as cooking vegetable, out of which 16 species are cultivated and 11 species are wild collected from the natural vegetation (Appendix 2.5).

2.10.4 Fuel wood

Wood is the major source of energy for cooking and heating purpose. Trees and shrubs are mostly used as fuel wood source by local communities. About 78 species are used for this purpose (Appendix 2.6).

Table 2.6: Inventory of Medicinal Plants with Local Names, Parts Used, Method of Preparations and Medicinal Uses

No.	Family/Plant Species	Local Name	Parts used	Preparation	Medicinal use
	Adiantaceae				
1	<i>Adiantumcapillus-veneris</i> L.		Whole plant	Juice	The plant is boiled in water and is given to treat flue and cough.
2	<i>Adiantumvenustum</i> D. Don	Jathoori	Leaves	Powder	Powder of leaves is mixed with butter and applied on burnt wounds.
	Amaranthaceae				
3	<i>Achyranthesaspera</i> L.	Malkuni	Whole plant	Ash	The ash of plant is mixed with honey and taken orally to treat flue and cough. Juice of plant is given in chest burning.
4	<i>Amaranthuscaudatus</i> L.	Ghanar	leaves	Vegetable	Leaves are cooked as vegetable and given to treat constipation.
	Anacardiaceae				
5	<i>Pistaciachinensis</i> Bunge	Kangar	Fruits	Powder	The powder of fruit mixed with honey is given to treat cough, cold and asthma.
	Apiaceae				
6	<i>Carum carvi</i> L.	Zeera	Seeds	Roasted seeds	Seeds are slightly roasted on fire and given to treat hiccough.
7	<i>Centella asiatica</i> (L.) Urban	Tikroo	Leaves	Powder	One gram powder of leaves is orally given with milk to sharpen memory.
	Asclepiadaceae				
8	<i>Calotropis procera</i> (Wild.) R. Br.	Ak	Leaves	Powder	The powder of leaves is externally applied on boils and wounds. The ash of root is mixed with honey and used in cough.
	Asparagaceae				
9	<i>Asparagus filicinus</i> Buch.-Ham. ex D. Don	Zao	Roots	Powder	The powder of dried roots is given with milk and used as tonic. The dried plant is burnt as fumigant to treat evil deeds (<i>Nazar bad</i>).
	Asteraceae				
10	<i>Artemesia maritima</i> L.	Daroon	Whole plant	Juice	The plant is boiled in water and the obtained juice (<i>Pyala</i>) is given to treat diabetes.
11	<i>Conyza bonariensis</i>	Phuljo	Leaves	Paste	Leaves are crushed and slightly warmed on fire and applied on wounds.
12	<i>Eclipta prostrata</i> (L.) L.	Bhangra			
	Boraginaceae				
13	<i>Heliotropium europaeum</i> L.		Leaves	Oil	Leaves are burnt in sesame oil and applied on pimples and skin eruption.

No.	Family/Plant Species	Local Name	Parts used	Preparation	Medicinal use
	Brassicaceae				
14	<i>Nasturtium officinale</i> R. Br.	Zalzaal	Leaves	Vegetable	Leaves are cooked as vegetable during winter season to prevent from cold and cough supposed as hot natural diet.
	Caesalpiniaceae				
15	<i>Bauhinia variegata</i> L.		Bark	Decoction	The decoction of the bark is given to treat diarrhoea and dysentery.
	Cannabinaceae				
16	<i>Cannabis sativa</i> L.	Bhang	Aerial part	Fodder	The plant is given as fodder to livestock in the case of external worms (Chichr) to fall on ground acting as sedative.
	Chenopodiaceae				
17	<i>Chenopodium album</i> L.	Kanwan	Aerial part	Potherb	The plant is used as potherb and given to constipation patients to relieve.
18	<i>Chenopodium ambrosioides</i> L.	Tahoo	Leaves	Juice	Leaves are crushed and applied on headache.
19	<i>Chenopodium botrys</i> L.	Buti	Aerial part	Juice	Juice of plant in 50ml quantity is given early morning before breakfast to treat boils and pimples.
	Euphorbiaceae				
20	<i>Euphorbia prostrata</i> (L.) Ait	ChhiraTahoo	Aerial part	Poultice	Poultice of ripened plant is applied on boils of head to treat chicken pox (Khasra).
21	<i>Ricinis communis</i> L.	Arind	Leaves	Oil	The oil is given to children in constipation. The leaves coated with sesame oil and slightly warmed over fire and applied on painful sites.
	Fabaceae				
22	<i>Indigofera heterantha</i> Wall. ex Brand	Kachhi	Roots	Juice	Juice of root is given to goat to treat influenza.
	Fagaceae				
23	<i>Quercus baloot</i> Griffith	Bani/Jaand	Seeds	Powder	The powder of seeds are dusted on wounds to heal. The decoction of seeds is orally given to heal injured wounds. The fresh bark is boiled in water and sugar is added that is given as diuretic.
	Fumariaceae				
24	<i>Fumaria indica</i> (Hauskn.) H.N. Pugsley		Whole plant	Decoction	The plant is boiled in water and is given as blood purifier.

No.	Family/Plant Species	Local Name	Parts used	Preparation	Medicinal use
	Juglandaceae				
25	<i>Juglans regia</i> L.	Chhoe	Bark, fruit	Miswak, Chatni	The bark is used to brush for strengthening gums and to check pyorrhea. The endocarp of fruit is grinded with <i>Mentha longifolia</i> and mixed with curd to make <i>Chatni</i> that is used in stomach problems such as nausea, vomiting, diarrhea, etc.
	Lamiaceae				
26	<i>Ajuga bracteosa</i> Wall. ex Bth.	Kauri buti	Aerial part	Vegetable	The use of plant as vegetable seems to be useful in constipation and piles. It is supposed as cooling effect.
27	<i>Ajuga parviflora</i> Bth.	Kauri buti	Aerial part	Vegetable	As previous species.
28	<i>Mentha longifolia</i> (L.) Huds.	Feeru	Whole plant, leaves	Decoction, powder	The decoction of plant is given in stomach problems like nausea, vomiting, diarrhea and dysentery. The juice/decoction of leaves is given in abdominal pain. The powder of the plant is also given for the same purpose. The decoction of dried leaves, sonf (<i>Foeniculum vulgare</i>) and salt is given to treat vomiting.
29	<i>Salvia moorcroftiana</i> Wall. ex Bth.		Leaves	Leaf past	The paste of leaves slightly warmed mixing with Brassica oil and applied on inflamed parts.
30	<i>Thymus serpyllum</i>	Isperki	Whole plant	Paste	Paste of plant is applied on joints pain to heal.
	Meliaceae				
31	<i>Melia azedarach</i> L.		Leaves	Decoction, fodder	The decoction of leaves is given in pimples and boils as well as in diabetes. Leaves are given as fodder to cows in the case of fever.
	Moraceae				
32	<i>Ficus carica</i> L.	Pha	Fruit, floral buds	Raw fruit, decoction	Fruit is used in constipation and in cough. Floral buds are boiled in water and given in abdominal pain, diarrhea and dysentery.
33	<i>Morus alba</i> L.	Marath	Fruit	Raw fruit	Dried fruits are given in constipation to treat. During winter season, the dried fruits are used as tonic for energy source.
34	<i>Morus nigra</i> L.	Marath	Bark, leaves	Gargle	Bark of stem and leaves are boiled in water and used to gargle the throat and to cure toothache. Fruit mixing with potash alum is boiled in water and given as gargle to treat throat pain and inflammation. Plant is supposed to cause allergy during flowering stage.

No.	Family/Plant Species	Local Name	Parts used	Preparation	Medicinal use
	Myrtaceae				
35	<i>Myrtus communis</i> L.	Amboo/Lachi	Leaves	Tea	The dried leaves are boiled with milk as substitute of tea and used as tonic.
	Oleaceae				
36	<i>Olea ferruginea</i> Royle	Kao	Leaves	Tea, juice	A tea of leaves, sonf (<i>Foeniculum vulgare</i>), ajwain (<i>Trachyspermum ammi</i>), podina (<i>Mentha longifolia</i>) and sugar is taken against cough and flue. Its leaves are rubbed to obtain juice that is used against inflammation.
	Pinaceae				
37	<i>Pinus gerardiana</i> Wall. non Lamb.	Thulesh	Rasin	Rasin	The resin is externally applied on painful boils.
	Plantaginaceae				
38	<i>Plantago lanceolata</i> L.	Shileet/Chulo or	Aerial part	Paste	Paste of plant is applied on boils.
39	<i>Plantago ovata</i> Frossk.	Shileet/Chuloor	Aerial part	Paste	As previous species.
	Polygonaceae				
40	<i>Persicaria barbata</i> (L.) Hara	Myth	Aerial part	Juice	Juice of plant is given to goat for treating constipation.
41	<i>Rumex nepalensis</i> Spreng	Hababil	Leaves	Juice	Leaves are antidote of <i>Urticaria dioica</i> and rubbed on affected parts caused by touching of the plants. Juice of root is given to treat constipation of goat. The same is given to cattle as tonic and cooling agent.
	Punicaceae				
42	<i>Punica granatum</i> L.	Dangoo	Bark	Powder	Bark mixed with seeds of <i>Mangifera indica</i> is made into powder that is used to treat diarrhea and dysentery.
	Ranunculaceae				
43	<i>Ranunculus scleratus</i> L.		Leaves	Past	Paste of leaves applied on boils for hastening.
	Rhamnaceae				
44	<i>Zizyphus sativa</i> Gaertn	Sizin/Sigiun	Fruit	Tonic	Fruit is used as tonic.
	Rosaceae				
45	<i>Prunus amygdalus</i> Batsch		Fruit	Tonic	Fruit is used as tonic.
46	<i>Prunus armeniaca</i> L.	Ashae	Fruit	Tonic	Fruit is used as tonic.

No.	Family/Plant Species	Local Name	Parts used	Preparation	Medicinal use
47	<i>Prunus domestica</i> L.	Aroo	Fruit	Tonic	Fruit is used as tonic.
48	<i>Pyrus mallus</i> L.	Bhaap	Fruit	Tonic	Fruit is used as tonic.
49	<i>Ribes alpestre</i> Dcne. ex Jacq.	Shigay	Flowers	Decoction	Fruits used as digestive.
	Saxifragaceae				
50	<i>Bergenia ciliata</i> (Haw.) Sternb.	Korat	Roots	Past	The paste of roots is applied on boils.
	Scrophulariaceae				
51	<i>Kickxia ramosissima</i> (Wall.) Janchen		Whole plant	Powder	The powder of plat is dusted on wounds and sores.
52	<i>Verbascum thapsus</i> L.	Khاردak/Kheros	Roots	Decoction	Roots are boiled in water and given in migraine. The decoction of leaves is used to remove body pain and also in sleeplessness.
	Solanaceae				
53	<i>Datura innoxia</i> Mill.		Leaves, seeds	Powder	The powder of leaves and seeds mixed with <i>Cannabis sativa</i> smoked to relieve asthma, and cough.
54	<i>Datura stramonium</i> L.		Leaves, seeds	Powder, poltice	Powder of seeds is used for cattle worms acting as anthelmintic property.
55	<i>Solanum nigrum</i> L.		Aerial part, leaves	Decoction, juice, potherb	Plant is used for digestive problems. Juice of the leaves is given in hiccups and inflammation of eye. Leaves are cooked as vegetable to cure swelling, dropsy and digestive problems. Leaves are soaked in water and are kept overnight. These leaves are squeezed and extract is used against jaundice.
56	<i>Solanum surattense</i> Burm.f.	Shuroogae/manogae	Fruit	Powder	Fruit juice is applied on decayed teeth to expel germs and relieve toothache. The decoction of plant is snuffed to expel blood sucking worm (<i>Jaunk</i>).
57	<i>Withania coagulens</i> Dunal		Leaves, Roots	Powder, fumes	Powder of leaves is used against inflammation. Fumes (<i>Hukka</i>) of roots used for toothache and headache. Roots are powdered taken with milk for nervous system.
	Verbenaceae				
58	<i>Phyla nodiflora</i> (L.) Greene	Ispabuti	Leaves	Leaves past	Leaves in 2 gram mixed with seven black pepper are grinded in water and given before breakfast for the removal of kidney stone.
59	<i>Vitex negundo</i> L.		Leaves	Powder	Leaves are grinded with black pepper and made into pills to treat piles.
	Vitaceae				

No.	Family/Plant Species	Local Name	Parts used	Preparation	Medicinal use
60	<i>Vitis vinifera</i> L.	Jach	Fruit	Tonic	Fruit is used as tonic.
	Zygophyllaceae				
61	<i>Tribulus terrestris</i> L.	Shiwokuroo	Whole plant, fruit	Powder, decoction	Powder of plant is given for regulating menstruation period. The whole plant is boiled in water and is given in constipation during pregnancy. It is also given to ease delivery. Fruit powder is taken orally to cure leucorrhoea and backache. The powder of fruit is given in piles. Roots are used as tooth stick.

2.11 FORESTRY

Forests are located at altitudes more than 2,000 masl, well above the Project impact area. According to the constitution of Pakistan, forestry is a provincial mandate and the provinces can make and implement their own forest policies within the framework of the national forest policy. In this context the forest policy of the KP was announced in 2001, in which the new participatory approach in forest management finally achieved legalized status. Participation of local communities, promotion of private sector investment, and recommendations for the revision of the forestry legislation has been included. Illegal harvesting and the local need for fuel wood and construction timber have been recognized as core problems. The policy for the first time not only addressed the traditional forests but also the management of rangelands, wastelands, watersheds and farm forestry (Shahbaz et al 2002). The Pakistan National Forest Policy (2001) dictates that mountain forests are critically important to Pakistan. They provide a carbon sink to mitigate global warming, are repositories of invaluable biodiversity, safeguard water supplies, retard loss of soil and water from watersheds thereby reducing the siltation of waterways and water storage reservoirs, and afford sustenance to large human communities and their livestock.

Forests and non-timber forestry products are playing a key role in the life of local community. They serve as fuel wood, home construction, furniture and traded to Gilgit Baltistan (GB) and the down country to meet commercial and business objectives. In Dasu, local people are heavily dependent on the forests and forestry products (Table 2.7, Appendix 2.7).

Table 2.7: Timber Yielding Trees Recorded from Project Area

S. No.	Plant Species	Family	Local name
1	<i>Abies pindrow</i> Royle.	Pinaceae	Chur
2	<i>Cedrus deodara</i> (Roxb. Ex Lamb.) G. Don	Pinaceae	Beesh
3	<i>Dalbergia sissoo</i> Roxb.	Fabaceae	Shesham
4	<i>Diospyros lotus</i> L.	Ebenaceae	Amlok
5	<i>Juglans regia</i> L.	Juglandaceae	Achhoe
6	<i>Leucaena leucocephala</i> (Lam.) de-Wit	Mimosaceae	-
7	<i>Morus alba</i> L.	Moraceae	Marath
8	<i>Morus nigra</i> L.	Moraceae	Marath
9	<i>Pinus gerardiana</i> Wall. non Lamb.	Pinaceae	Thulesh
10	<i>Pinus wallichiana</i> A.B. Jackson	Pinaceae	Chhar
11	<i>Populus deltoides</i> Bartram ex Marsh.	Salicaceae	Sufaida
12	<i>Quercus baloot</i> Griffith	Fagaceae	Bani/Jaand
13	<i>Quercus dilatata</i> Lindl. ex Royle	Fagaceae	Kagani/Zharyun

Forests in the Project area can be classified as 'Private Forests' owned by the local community. Forests are quite a significant source of income for local communities as private owners, woodchoppers and timber cutting thereby selling through government leasing. The forest royalty ratio is 80:20 i.e. 80% share goes to community and 20% share goes to the government treasury of KP. Selling of fuel wood is an important business in the Project area and common practices on KKH. People harvest Oak tree, Wild Olive and other fuel wood trees from hill sides and store in the form of wood toll on main KKH. Collection of pine nut (Chalghooza) is also important seasonal business of the area.

3. BASELINE OF ANIMAL BIODIVERSITY (FAUNA)

3.1 METHODS

An animal Biodiversity reconnaissance survey was conducted in July 2012. To further investigate on the fauna of the area, three surveys (5-11 days) were conducted in July, August and September 2012. Walking transects (Bibby and Burgess, 1992; William and Sutherland, 1996) were studied from dawn to dusk of variable length depending on nature of terrain. All direct and indirect traces (footprints, droppings, hair and skeleton) showing the presences of species were noted. Defined vantage points (Table 3.1) at suitable and accessible sites were selected after discussion with the hunters, wildlife guards and villagers. The species were identified with the help of spotting scope (15x60) and binocular (12x50). The birds were identified following Woodcok (1980), Mirza (2007) and Grimmett *et al.* (2008). Caution was observed regarding the position of sun which was usually on the back of the observer, so that the plumage patterns of birds could be distinguished. The mammals and reptiles were identified following Roberts (2007) and Khan (2006). Data were recorded on pre-designed data sheets.

Secondary data were collected from various resource centres and institutions to complete the inventory of species. A variety of respondents (students, school teachers, farmers and hunters) from different villages and nullahs were interviewed regarding the occurrence and distribution of species. Once a clue was provided, the indicated nullahs and valleys were visited/ studied accordingly. In few cases stuffed specimens of recently hunted birds and mammals were recorded from various parts of the study area. Consultations and group discussions were made with officials of Forest, Wildlife and related institutes/departments as well as local community members regarding the possible impact of dam on animals and their mitigation measures. Moreover, observations were also made during field surveys about the impacts and mitigation measures. To study the impacts of the dam and permanent structures on the species; the impacts were assessed visually and in close consultations with concerned officials and professionals.

Table 3.1: Locations of Few Vantage Points in Project Area

Sr. No.	Name	North	East	Elevation (m)	River Bank
Downstream					
1	Karoo	35° 11' 04.0"	73° 06' 34.9"	949	Right
2	Zaid Khar	35° 14' 40.8"	73° 10' 47.1"	806	Right
3	Zaid Khar 2	35° 14' 38.9"	73° 10' 59.9"	777	Right
4	Goshali	35° 13' 39.9"	73° 12' 13.9"	837	Left
Upstream					
5	Choochang	35° 17' 50.9"	73° 12' 17.7"	1049	Left
6	Khoshi	35° 18' 10.6"	73° 11' 56.3"	855	Left
7	Seo	35° 18' 12.6"	73° 11' 30.3"	867	Right
8	Siglu	35° 20' 24.9"	73° 12' 14.9"	836	Right
9	Razika	35° 18' 15.8"	73° 06' 43.3"	2050	Right
10	Malyar	35° 22' 44.7"	73° 12' 07.6"	860	Right
11	Kaigah	35° 24' 03.2"	73° 12' 06.2"	872	Left
12	Panibah	35° 24' 57.4"	73° 12' 09.9"	899	Left
13	Thoti (Kandia)	35° 28' 07.6"	73° 09' 10.9"	1333	Right
14	Aliel (Kandia)	35° 27' 53.9"	73° 07' 34.9"	1367	Right
15	Laachi	35° 31' 15.4"	73° 25' 26.9"	1390	Left
16	Sazin	35° 31' 45.9"	73° 30' 28.1"	997	Right
17	Shatial	35° 31' 27.0"	73° 33' 08.1"	1009	Left

Note: In total 26 Vantage points were used for animal biodiversity surveys.

3.2 BIRDS/ ORNITHOLOGY

Table 3.2 provides an overview of the species diversity occurring in the study area along with the season of occurrence and their population status. Overall, there are 199 birds species reported from Indus Kohistan (Roberts, 1991, 1992; Mirza, 2007) districts; however, in field surveys 58 species belonging to 28 families/subfamilies were recorded (Table 3.3). The largest family recorded is *Turdidae* with 11 species followed by *Columbidae* and *Corvidae* (five species each). Among the recorded birds about 62% species were found to be resident in the area, 24% summer breeder and wintering and 14% passage migrant. Status of 72% species is Abundant and Common (Fig. 3.2) while other are frequent, and scarce; only Western-horned Tragopan is listed as Vulnerable (Birdlife International, 2012) species from the study area, while Monal Pheasant and Rufous-tailed Rock Thrush were Rare (Roberts, 1991, 1992). Local communities think that Tragopan is found in the upper reaches on the left bank; however, we did not record any individuals during field study. Grey-necked Bunting and White-bellied Redstart are scarce species (Roberts, 1992). All other birds are common and abundant in population.



Figure 3.1: Eurasian Kestrel *Falco tinnunculus*

Table 3.3 presents the avifauna recorded in the field surveys from project area; however, Appendix 3.1 provides a complete list of bird species that are reported in literature. Most frequently encountered species were White-cheeked Bulbul, Shrikes, Tits, Wagtails, Jungle Crow, Common Myna, House Sparrow, Thrushes, and Blue Rock Pigeon. The least encountered species were Marsh Harrier, Indian Roller, Common Kingfisher, White-bellied Redstart and Eagle Owl. The habitat preferences of birds are provided in Appendix 3.2 and 3.3. Analysis of the interview data shows that 30-40% population of Monal and Tragopan have decreased in last 20-30 years.

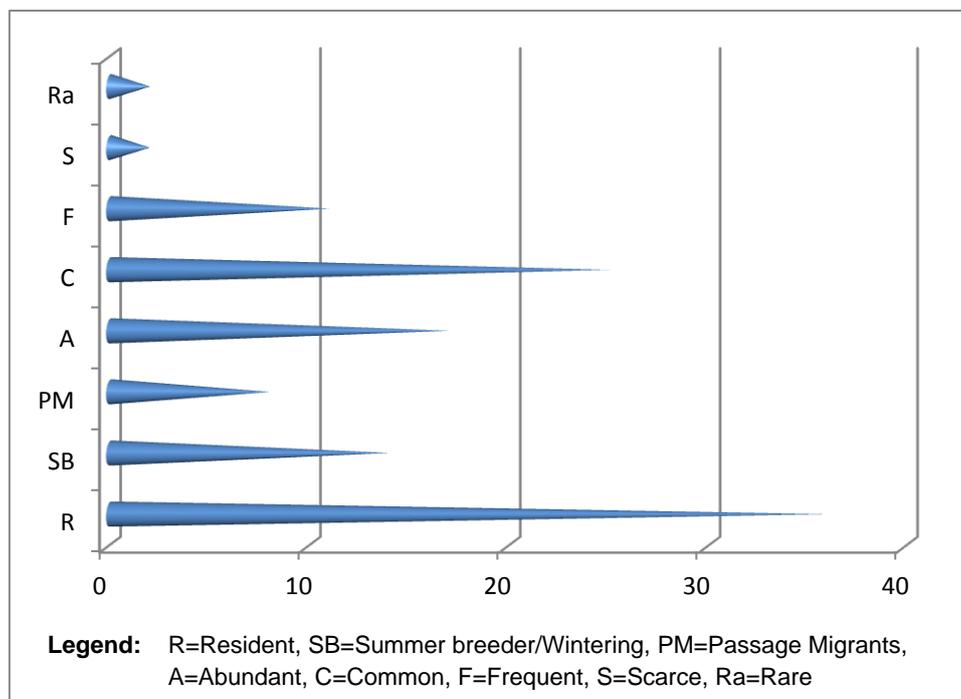


Figure 3.2: Diversity of Avifauna Recorded in Project Area from July-September 2012

Table 3.2: Species Diversity of Avifauna

Common Name	Scientific Name	Period of Occurrence												Status		
		J	F	M	A	M	J	J	A	S	O	N	D			
Eurasian Cormorant	<i>Phalacrocorax carbo sinensis</i>															PM, A
Chukar	<i>Alectoris chukar</i>															R, C
Grey Partridge/Francolin	<i>Francolinus pondicerianus</i>															R, C
Himalayan Monal	<i>Lophophorus impejanus</i>															R, Ra
Western Tragopan	<i>Tragopan melanocephalus</i>															R, V
Marsh harrier	<i>Circus aeruginosus</i>															PM, C
Black kite	<i>Milvus migrans</i>															R, A
Shikra	<i>Accipiter badius</i>															R, F
Common Kestrel	<i>Falco tinnunculus</i>															R, C
Water rail	<i>Rallus aquaticus</i>															PM, F
Red-wattled lapwing	<i>Vanellus indicus</i>															R, A
Sandpiper	<i>Actitis hypoleucos</i>															SB, C
Blue rock pigeon	<i>Columba livia</i>															R, A
Indian ring dove	<i>Streptopelia decaocto</i>															R, A
Oriental turtle dove	<i>Streptopelia orientalis</i>															R, C
Little brown dove	<i>Streptopelia senegalensis</i>															R, A
Spotted dove	<i>Streptopelia chinensis</i>															SB,C
Northern eagle owl	<i>Bubo bubo</i>															R, F
Common kingfisher	<i>Alcedo atthis</i>															R, F
Indian roller	<i>Coracias benghalensis</i>															R, C
Hoopoe	<i>Upupa epops</i>															R, C
Asian Koe	<i>Eudynamys scolopacea</i>															SB, C
Passerine Birds																
Crested lark	<i>Galerida cristate</i>															R, A
Yellow wagtail	<i>Motacilla flava</i>															PM, C
Grey wagtail	<i>Motacilla cinera</i>															SB, C

Common Name	Scientific Name	Period of Occurrence												Status		
		J	F	M	A	M	J	J	A	S	O	N	D			
White/pied wagtail	<i>Motacilla alba</i>															SB, A
Large wagtail	<i>Motacilla maderaspatensis</i>															R, C
White-cheeked bulbul	<i>Pycnonotus leucogenys</i>															R, A
Brown dipper	<i>Cinclus pallasii</i>															R, C
Blue throat	<i>Luscinia svecia</i>															SB, F
Indian blue robin	<i>Luscinia brunnea</i>															SB, C
Blue-headed redstart	<i>Phoenicurus caeruleocephalus</i>															SB, C
Black redstart	<i>Phoenicurus ochruros</i>															SB, C
White-bellied Redstart	<i>Hodgsonius phoenicuroides</i>															R, S
Plumbeous water Redstart	<i>Rhyacornis fuliginosus</i>															SB, C
Common Stonechat	<i>Saxicola torquate</i>															SB, C
Pied Bushchat	<i>Saxicola caprata</i>															R, C
Rufous-tailed Rock Thrush	<i>Monticola saxatilis</i>															PM, Ra
Blue whistling thrush	<i>Myiophoneus cacruleus</i>															SB, C
Eurasian blackbird	<i>Turdus merula</i>															R, F
Grey-hooded flycatcher	<i>Seicercus xanthoschistos</i>															SB, C
White-cheeked nuthatch	<i>Sitta leucopsis</i>															R, C
Eurasian nuthatch	<i>Sitta europaea</i>															SB, F
Isabelline shrike	<i>Lanius isbellinus</i>															SB, F
Bay-backed shrike	<i>Lanius vittatus</i>															R, C
Jungle crow	<i>Corvus macrorhynchos</i>															R, C
House crow	<i>Corvus splendens</i>															R, A
Common Raven	<i>Corvus corax</i>															R, F
Lanceolated/Black-headed Jay	<i>Garrulus lanceolatus</i>															R, F
Yellow-billed Chough	<i>Phyrhacorax phyrhacorax</i>															R, A
Common myna	<i>Acridothores tristis</i>															R,A
Jungle myna	<i>Acridothores fuscus</i>															R, F

Table 3.3: Birds Recorded from the Study Area

S/No	Common Name	Scientific Name	Family	Status	Remarks
1.	Great or Eurasian Cormorant **	<i>Phalacrocorax carbo sinensis</i>	Phalacrocoracidae	A	Kandia river-shallow water
2.	Chukar *	<i>Alectoris chukar</i>	Phasianidae	C	8 observed in Laachi Nullah mountain slopes,
3.	Grey Partridge/ Francolin*	<i>Francolinus pondicerianus</i>	Phasianidae	C	Crossed the KKH near Kandia Suspended bridge; also reported from Laachi nullah
4.	Himalayan Monal*	<i>Lophophorus impejanus</i>	Phasianidae	Ra	Stuffed bird at Dasu town hunted from Kandia Valley few month ago; reported from Kaigah, Laachi, Sazin
5.	Western Tragopan*	<i>Tragopan melanocephalus</i>	Phasianidae	V	Reported from higher valleys of Kandia, Laachi, Sazin Kot, Kaigah
6.	Marsh harrier**	<i>Circus aeruginosus</i>	Accipitridae	C	Kandia Valley
7.	Black kite*	<i>Milvus migrans</i>	Accipitridae	A	Kandia valley, Shatial, Laachi
8.	Shikra *	<i>Accipiter badius</i>	Accipitridae	F	Laachi Nullah
9.	Common Kestrel*	<i>Falco tinnunculus</i>	Falconidae	C	Laachi, Kandia, Waliabad, Razika village, Down-stream near Zaid Khar Nullah
10.	Water rail**	<i>Rallus aquaticus</i>	Rallidae	F	Kandia Valley
11.	Red-wattled lapwing*	<i>Vanellus indicus</i>	Charadriidae	A	Choochang Village
12.	Common sandpiper***	<i>Actitis hypoleucos</i>	Tringinae	C	Near Dasu on the Right bank
13.	Blue rock pigeon*	<i>Columba livia</i>	Columbidae	A	Common from Kandia suspended bridge up to Basha
14.	Indian ring dove*	<i>Streptopelia decaocto</i>	Columbidae	A	Dasu, Kandia
15.	Oriental turtle dove*	<i>Streptopelia orientalis</i>	Columbidae	C	Kandia Valley
16.	Little brown dove*	<i>Streptopelia senegalensis</i>	Columbidae	A	Dasu, downstream before the Zaid Khar Nullah
17.	Spotted dove***	<i>Streptopelia chinensis</i>	Columbidae	C	Dasu, Choochang
18.	Northern eagle owl*	<i>Bubo bubo</i>	Strigidae	F	Laachi Nullah area
19.	Common kingfisher*	<i>Aledo atthis</i>	Apodidae	F	Kandia Valley
20.	Indian roller*	<i>Coracias benghalensis</i>	Meropidae	C	Choochang, Dasu
21.	Hoopoe*	<i>Upupa epops</i>	Upupidae	C	Waliabad, Choochang, Kandia valley

S/No	Common Name	Scientific Name	Family	Status	Remarks
22.	Asian Koe***I	<i>Eudynamys scolopacea</i>	Cuculidae	C	Near Seo Village
23.	Crested lark*	<i>Galerida cristate</i>	Alaudidae	A	Waliabad, sandy and gravel area along the left bank of Indus
24.	Yellow wagtail**	<i>Motacilla flava</i>	Motacillidae	C	Dasu
25.	Grey wagtail***	<i>Motacilla cinera</i>	Motacillidae	C	Malyar
26.	White/pied wagtail***	<i>Motacilla alba</i>	Motacillidae	A	Summar Nullah, Kandia valley, Dasu, Laachi
27.	Large wagtail*	<i>Motacilla maderaspatensis</i>	Motacillidae	C	Kandia Valley, Dasu
28.	White-cheeked bulbul*	<i>Pycnonotus leucogenys</i>	Pycnonotidae	A	Malyar, Panibagh, Choochang, Kandia Valley, Dasu
29.	Brown dipper*	<i>Cinclus pallasii</i>	Cinclidae	C	Kandia river –shallow river area
30.	Blue throat**/**	<i>Luscinia svecia</i>	Turdidae	F	Choochang, Kandia
31.	Indian blue robin**/**	<i>Luscinia brunnea</i>	Turdidae	C	Laachi nullah
32.	Blue-headed redstart***	<i>Phoenicurus caeruleocephalus</i>	Turdidae	C	Laachi nullah
33.	Black redstart***	<i>Phoenicurus ochruros</i>	Turdidae	C	Dasu, Kandia valley, Laachi
34.	White-bellied Redstart*	<i>Hodgsonius phoenicuroides</i>	Turdidae	S	Goshali Village-on left bank of supit nullah-downstream
35.	Plumbeous water Redstart***	<i>Rhyacornis fuliginosus</i>	Turdidae	C	Kandia river, Shallow water
36.	Common Stonechat**/**	<i>Saxicola torquate</i>	Turdidae	C	Laachi nullah
37.	Pied Bushchat*	<i>Saxicola caprata</i>	Turdidae	C	Kandia river's bank, Razika
38.	Rufous-tailed Rock Thrush**	<i>Monticola saxatilis</i>	Turdidae	Ra	Razika
39.	Blue whistling thrush***	<i>Myiophonus cacruleus</i>	Turdidae	C	Dasu, Malyar, Kandia valley, Barseen Nullah, Seo
40.	Eurasian blackbird*	<i>Turdus merula</i>	Turdidae	F	Near Pattan
41.	Grey-hooded flycatcher***	<i>Seicercus xanthoschistos</i>	Sylviidae	C	Malyar, Choochang
42.	White-cheeked nuthatch*	<i>Sitta leucopsis</i>	Sittidae	C	Dasu, Shatial, Malyar, Barseen Nullah, Choochang, Laachi, Kandia valley
43.	Eurasian nuthatch***	<i>Sitta europaea</i>	Sittidae	F	Sazin kot, Dasu
44.	Isabelline shrike***	<i>Lanius isbellinus</i>	Laniidae	F	Dasu, Panibagh, Malyar
45.	Bay-backed shrike*	<i>Lanius vittatus</i>	Laniidae	C	Dasu, Panibagh, Malyar
46.	Jungle crow*	<i>Corvus macrorhynchos</i>	Corvidae	C	Common in all the area from Dasu to

S/No	Common Name	Scientific Name	Family	Status	Remarks
					Basha
47.	House crow*	<i>Corvus splendens</i>	Corvidae	A	Around Dasu town
48.	Common Raven*	<i>Corvus corax</i>	Corvidae	F	Laachi, Kandia valley
49.	Lanceolated/Black-headed Jay*	<i>Garrulus lanceolatus</i>	Corvidae	F	Malyar, Panibagh
50.	Yellow-billed Cough*	<i>Phyrhacorax phyrhacorax</i>	Corvidae	A	Razika village
51.	Common myna*	<i>Acridotheres tristis</i>	Sturnidae	A	Common in all the area from Dasu to Basha
52.	Jungle myna*	<i>Acridotheres fuscus</i>	Sturnidae	F	Chochug, Kandia, Laachi Nullah
53.	House sparrow *	<i>Passer domesticus</i>	Passeridae	A	Common in all the area from Dasu to Basha especially near human settlements
54.	Red-fronted serin*	<i>Serinus pusillus</i>	Carduelinae	A	Kandia valley, Razika village
55.	Rock bunting ***	<i>Emberiza cia</i>	Emberizinae	C	Choochang, Kandia, Laachi, Sazin
56.	Grey necked bunting***	<i>Emberiza buchanani</i>	Emberizinae	S	Kandia, Laachi
57.	Black Drongo*	<i>Dicrurus macrocercus</i>	Dicruridae	A	Dasu
58.	Great Tit*	<i>Parus major</i>	Paridae	C	Panibagh, Waliabad

Legend: *Resident; **Passage migrant; ***Summer breeder/wintering; A=Abundant; C=Common; F=Frequent; S=Scarce; V=Vulnerable; Ra=Rare (status described by Roberts, 1991, 1992)

3.3 MIGRATORY BIRDS, WATERFOWL, AND WETLAND BIRDS

Table 3.4 presents the diversity of wetland birds in the Project Area. Fifteen wetland birds were recorded during field surveys from July to September. However, it is anticipated that more wetland birds will be recorded during winter, early migration and breeding season. Keeping a conservative approach, only 24 species are added in the list of potential wetland birds from the project area.

High Altitude Wetlands of Pakistan in general and of Gilgit-Baltistan (Naltar, Hunza, Khunjerab, Deosai) in particular, being along the Indus Flyway are ecologically very important. These lakes and adjacent streams provide habitats, temporary and permanent staging, feeding and breeding grounds to migratory as well as resident water birds. Majority of the winter visitors enter the subcontinent via the Indus river valley and its northern tributaries. Although a significant number avoid the high mountains; Cranes, Snipe and Pelicans come by the Kurrum River valley (Roberts, 1992). However, of the total birds species recorded from the territorial limits of Pakistan about 30 % visit for a significant period as long distance migrants and 28% are regular winter visitors to Pakistan. The insect life and vegetation cover becomes abundant after the monsoon in this area and so offer rich feeding conditions to the wintering birds. Significant species like Kestrel, Lammergeyer and Golden eagle live and breed here while Demoiselle crane, ferruginous duck, Marbled teal and Red breasted merganser use the lakes for wintering, staging and feeding.

Table 3.4: Aquatic/ Wetland Birds in Project Area¹

Sr./No	Common Name	Scientific name	Family	Remarks
1.	Great or Eurasian Cormorant	<i>Phalacrocorax carbo sinensis</i>	Phalacrocoracidae	Kandia river-shallow water
2.	Water rail	<i>Rallus aquaticus</i>	Rallidae	Kandia Valley
3.	Red-wattled lapwing	<i>Vanellus indicus</i>	Charadriidae	Choochang Village
4.	Common sandpiper	<i>Actitis hypoleucos</i>	Tringinae	Near Dasu on Right bank
5.	Common kingfisher	<i>Alcedo atthis</i>	Alcedinidae	Kandia Valley
6.	White-breasted kingfisher	<i>Halcyon smyrensis</i>	Alcedinidae	Near Dasu on Right bank
7.	Marsh harrier	<i>Circus aeruginosus</i>	Accipitridae	Kandia Valley
8.	Yellow wagtail	<i>Motacilla flava</i>	Motacillidae	Dasu
9.	Grey wagtail	<i>Motacilla cinera</i>	Motacillidae	Malyar
10.	White/pied wagtail	<i>Motacilla alba</i>	Motacillidae	Summar Nullah, Kandia valley, Dasu, Laachi
11.	Large wagtail	<i>Motacilla maderaspatensis</i>	Motacillidae	Kandia Valley, Dasu
12.	Brown dipper	<i>Cinclus pallasii</i>	Cinclidae	Kandia river –shallow river area
13.	Black redstart	<i>Phoenicurus ochruros</i>	Turdidae	Dasu, Kandia valley, Laachi
14.	White-bellied Redstart	<i>Hodgsonius phoenicuroides</i>	Turdidae	Goshali Village-on left bank of supit nullah d/s.
15.	Plumbeous water Redstart	<i>Rhyacornis fuliginosus</i>	Turdidae	Kandia river, Shallow water
16.	Grey Heron	<i>Ardea Cinerea</i>	Ardeidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
17.	Grelag Goose	<i>Anser anser</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
18.	Ruddy shelduck	<i>Tadorna ferruginea</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
19.	Wigeon	<i>Anas penelope</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
20.	Gadwall	<i>Anas strepera</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
21.	Common teal	<i>Anas crecca</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence

¹ Note: 1-Species listed from 1-15 were recorded during field surveys conducted in July-September 2012
2-Analysis is completed for other potential wetland birds that are already reported to visiting/ staging/ migrating in this area and or they will likely be attracted to the large water body after the construction of the reservoir.
3- It is anticipated that this list will continue to grow as information and data becomes available.

Sr./No	Common Name	Scientific name	Family	Remarks
22.	Mallard	<i>Anas platyrhynchos</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
23.	Ferruginous duck	<i>Aythya nyroca</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
24.	Pintail	<i>Anas acuta</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
25.	Shoveler	<i>Anas clypeata</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
26.	Common Pochard	<i>Aythya ferina</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
27.	Tufted duck	<i>Aythya fuligula</i>	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
28.	Common crane	<i>Grus grus</i>	Gruidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
29.	Demoiselle crane	<i>Anthropoides virgo</i>	Gruidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
30.	Pheasant-tailed Jacana	<i>Hydrophasianus chirugus</i>	Jacanidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
31.	Curlew sandpiper	<i>Calidris ferruginea</i>	Scolopacidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
32.	Ruff	<i>Philomachus pugnax</i>	Scolopacidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
33.	Common snipe	<i>Gallinago gallinago</i>	Gallinagininae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
34.	Red shank	<i>Tringa tetanus</i>	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
35.	Green shank	<i>Tringa nebularia</i>	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence

Sr./No	Common Name	Scientific name	Family	Remarks
36.	Marsh sandpiper	<i>Tringa stagnatilis</i>	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
37.	Common sandpiper	<i>Actitia hypoleucos</i>	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
38.	Caspian tern	<i>Sterna caspica</i>	Sternidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
39.	Water pipit	<i>Anthua spinoletta</i>	Motacillidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence

There are many different migration patterns. The Central Asian Flyway (including Indus flyway region) covers the areas used by a diversity of species of birds with the main migratory routes through Central Asia. The flyway area extends through 21 countries from the Arctic Ocean in the north to the Indian Ocean in the south. It overlaps with both the African-Eurasian flyways in the west and the East Asian Australasian flyways in the East. This famous route from Siberia to various destinations in Pakistan over Karakorum, Hindu Kush and Suleiman Ranges along Indus River down to the Indus delta and is commonly called as international migratory bird route number 4 (Figure 3.3). It is also called as the “Green Route” or more commonly “Indus Flyway”. The birds from north spend entire winters in different wetland of Pakistan, which are distributed almost throughout the country from the high Himalayas to coastal mangroves and mud flats in the Indus delta. After successful wintering they go back to their native habitats for breeding purposes.

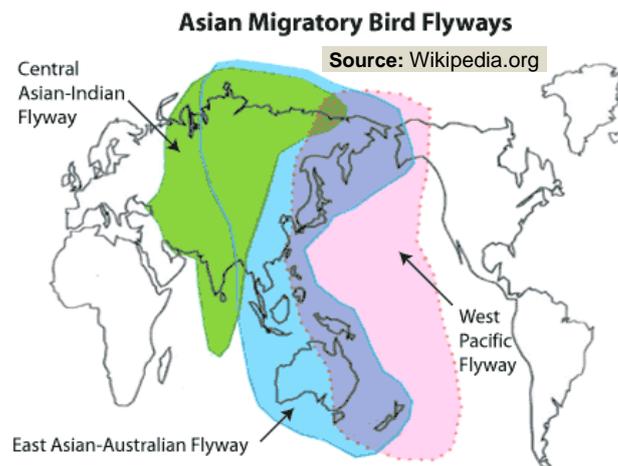


Figure 3.3: Green route shows Indus Flyway passing through the High Altitude Wetlands

3.4 MAMMALS

Thirty one mammalian species are reported from Kohistan area (Appendix 3.4); however, ten species of mammals were recorded from the study area (Table 3.5) during surveys and most of these were confined to the mountain tops at higher altitudes (above 3000 amsl) outside the impact area. Species occurrence was confirmed with direct sightings; study of foot prints, droppings and or through the study of skins and stuffed specimens existing from local populations and hunters. According to IUCN’s Status and Red List of Pakistan Mammals Document (Sheikh & Molur, 2005) two mammalian species are reported Critically Endangered i.e. Common Leopard and Caracal cat; three species are Endangered i.e. Indian Wolf, Himalayan Musk deer and Markhor; one Vulnerable i.e. Asiatic Black Bear; three Near Threatened i.e. Hill fox, Asiatic jackal, Rhesus macaque and one Data deficient i.e. Leopard cat. All these species are adapted to higher elevations of project area and rarely few of them descend during winter season. Occasionally, jackals and cats can be seen in the project area. Rodents and bats are associated with human settlements, though not recorded but in literature are reported from the project area. Rodents are likely to be killed during construction and due to reservoir but these are considered pest throughout the worlds, therefore not important for conservation. Rodents are also fast breeders and likely to compensate these losses in short period. Similarly bats have ability to find roosts and adjust themselves in the nearby areas when their roosts will be destroyed in the project area. Appendix 3.5 gives an overview of the habitat preferences for various mammals.

Table 3.5: Mammals Recorded in the Project Area

S/No	Common Name	Scientific name	Family	Status	Remarks
1.	Asiatic jackal	<i>Canis aureus</i>	Canidae	NT	Pellet Laachi Nullah, Malyar
2.	Indian wolf	<i>Canis lupus</i>	Canidae	EN	Reported by locals from Laachi nullah and Kandia Valley
3.	Hill or Kashmir fox	<i>Vulpes vepes griffithi</i>	Canidae	NT	Pellet near Malyar Village, reported by locals from Kandia valley, Laachi Sazin kot area
4.	Common Leopard	<i>Panthera pardus</i>	Felidae	CR	Reported rarely by locals of Kandia, Laachi
5.	Leopard cat	<i>Prionilurus bengalensis</i>	Felidae	DD	Preserved skin at house-Laachi Nullah
6.	Caracal	<i>Felis caracal</i>	Felidae	CR	Crossed KKH near Kandia suspended bridge in evening time; also reported by locals of Kandia valley
7.	Asiatic Black bear	<i>Ursus thibetanus</i>	Ursidae	V	Reported from higher elevation of Laachi, Kandia, Sazin and Choochang
8.	Himalayan musk deer	<i>Moschus chrysogaster</i>	Moschidae	EN	Young one captured from Palas by local of Dasu and sold in Pakistan Rupees 15000. It is also reported from higher valleys of Kandia, Laachi and Palas valley
9.	Markhor	<i>Capra falconeri falconeri</i>	Bovidae	EN	Stuffed specimens at Laachi nullah, Sazin kot, Kandia valley-Aliel village. Summar Nullah police check post-hunted one female; reported from Kaigah, Laachi, Sazin and Kandia Valley
10.	Rhesus macaque	<i>Macaca mulatta</i>	Cercopithecidae	NT	Reported by locals from Laachi nullah, Kandia, Sazin kot, Choochang, Jalkot areas at higher elevation

NT=Near threatened; EN=Endangered; CR=Critically Endangered; V=Vulnerable; DD=Data deficient
(Source: Sheikh & Molur, 2005)

3.5 AMPHIBIANS AND REPTILES

Eighteen species of amphibians and reptiles are reported from the study area (Appendix 3.6) but only six species are observed during the study period (Table 3.6). Two types of lizards are common in the area between Dasu and Basha while one toad is recorded near Dasu village. Two killed snakes were found; one at Gobar Nullah and other near the dam site. It is a common practice that locals kill the snakes whenever encountered. There is no threatened species among the eighteen reported and six recorded species from Project Area.



Figure 3.4: Lizard *Laudakia pakistanica*

Table 3.6: Amphibian and Reptiles Recorded in DHP

S/No.	Scientific Name	Common Name	Family	Status	Remarks
1.	<i>Bufo viridis</i>	Green Toad	Bufoinae	C	Near Dasu
2.	<i>Laudakia pakistanica</i>		Agamidae	NE	Near Razika
3.	<i>Agama agrorensis</i>	Agrore Valley Agama	-do-	NE	Near Dasu; Shori Nullah
4.	<i>Macrovipera lebetina</i>	Blunt-nosed viper	Viperidae	NE	Killed by someone near Gobar Nullah; identification is tentative as specimen was not in good condition
5.	<i>Ptyas mucosus</i>	Dhaman	Colubridae	NE	Killed near dam site area; identification is tentative as specimen was not in good condition
6.	<i>Varanis</i> sp.	Monitor Lizard	Varanidae	NE	Recorded near Chochung village

C=Common; NE=Not Evaluated

Source: (www.wwf-pak.org/images/reptiles_list.pdf. visited on 4-10-2012)

3.6 INSECT BIODIVERSITY

Both the beneficial and harmful role that insects play in the human environment is well recognized. However, the current state of knowledge about northern Pakistan insect biodiversity is very inadequate and a lot of research is needed. Increased use of pesticides in this region would probably have detrimental effects on many beneficial insects, for example like those that help in the pollination of fruit trees (Virk et al., 2003).

Of the 1.4 million species on earth, over 53% are insects. More than 5,000 species of insects have been reported from Pakistan (BAP, 2000). Though the Pakistan Forest Institute, Peshawar has a good collection of insects, including those from Northern Pakistan, still little information is available on insect diversity in this region. However, there have been efforts to identify butterfly species and to document their distribution and status. Pakistan Museum of Natural History (PMNH) and the Oxford University museum have been studying insect diversity from Gilgit along Karakoram Highway to the Sino-Pakistan border at Khunjerab pass and several selected valleys. About 100 species of butterflies, with new taxa being added on each visit (Smith 2001); four of these were new to Pakistan.

Another study documented butterfly diversity in Skardu city, Shigar, Karmang, Sadpara, Kachura and the Deosai plains (Abbas et al., 2002). It collected more than 400 specimens and identified. This resulted in the recognition of 16 species in 14 genera and five families.

Review of literature shows that *Papilio polyctor polyctor* is common in the Himalaya and Hindu Kush foothills between April and September and between March and October at lower altitudes (500-600 amsl.). The monsoon brood is particularly colorful and large. The host plant is *Zanthoxylum armatum*. *Papilio machaon* is common or locally common in mountain areas of northern and western Pakistan. *Hyponephele pulchra* and *Hyponephele pulchra astorica* are two subspecies of *Hyponephele pulchra* and are morphologically quite distinct. While species *pulchra* has a uniform chocolate brown ground color on the upper side of both wings, while species *astorica* has its forewing ground color replaced by a warm shade of orange brown with a thin brown outer margin. Species *pulchra* has been observed on lush meadows near the villages in KP. *Hipparchia parasatis* is common in a range of habitats throughout northern Pakistan.

Some bugs, dung, beetle and weevils have been reported in the Project Area. Multipedes, centipedes and other soil insects are common. Sand Fly is reported of causing nuisance from the project area (Feasibility Report, Volume 9). According to health authorities in KP, the Sand fly commonly exists along Dasu and Chilas range of KKH. Further detailed investigations are required to develop a complete record of insects in the project area.

3.7 HABITAT PREFERENCES OF ANIMAL BIODIVERSITY

Most of the bird species were recorded from agro-ecosystem and around streams/nullahs (Appendix 3.2 and 3.3) due to easy availability to food. Some passerine birds like Bulbul, Redstart, and Jungle crow are more adaptable and found in all types of habitats while other are restricted to one or two habitats. Most of the mammalian species are adapted to higher elevations and rarely visit the riverine area (Appendix 3.5). Occasionally jackals and cats can appear in the project area around croplands and villages.

3.7.1 Significant Wildlife Species

Astor Markhor (*Capra falconeri falconeri*)

Markhor is found in north-eastern Afghanistan, Pakistan, Southern part of Tajikistan and Uzbekistan. Markhor is typically associated with Steppic mountain ranges with elevation of 600m to 3600m and regions of erratic rainfall (Roberts, 1997). It typically inhabits scrub forests primarily of oaks, pines and junipers. In Pakistan, there are six sub-species of Markhor identified on the basis of horn's curves/ spirals. Markhor is diurnal in its habits and mainly active in early morning and late afternoon. Their diet shifts seasonally depending on availability of grasses in spring and summer season. Mating occurs in winter and mostly one or two young ones are produced (Roberts, 1997).

The Astor Markhor (*Capra falconeri falconeri*) is mainly confined to the higher hill ranges of Gilgit, Hunza and Nanga Parbat. Current population estimates are less than 2,500 to 3,000 for the flared horned Markhor in Pakistan (Hess *et al.* 1997). However, this number is strongly disputed by various researchers and conservationists. In Project Area, there are few good habitats of Markhor in upper valleys of Kaigah Nullah, Laachi Nullah, Sazin Kot on left bank, Kandia Valley and area opposite to Shori Nullah on right bank of Indus (Map 3). Stuffed Markhor were observed in few locations in Sazin kot, and Aliel (Kandia) villages. Kaigah Nullah is a Community Conservation Area (CCA) and holds the largest population of Markhor in Indus Kohistan which is about 150 individuals in 2005 population census according to the National Council for Conservation of Wildlife. There are signs of poaching and deforestation is causing damage to the core habitat of this species.



Figure 3.5: A stuffed Markhor at the rooftop of a hotel in Laachi nullah

Musk Deer (*Moschus chrysogaster*)

It mainly survives in upper valleys of Machiara, Neelum valley, Deosai plateau, Gilgit, Baltistan, Hazara district, and remote areas of Indus Kohistan. Mostly it remains at the elevation range of 2700 to 3600 amsl (Roberts, 1997), preferring sub-alpine scrub zone, associated mainly with Birch and dwarf juniper. Musk deer is hunted mainly for its musk pod, declining everywhere in its range, total Himalayan population estimated not more than 30,000 individual in suitable habitat of 50, 000 sq. km (Green, 1986). It is very shy animal and is difficult to locate. In the study area, Musk deer is reported by hunters from higher reaches of valleys of Kaigah Nullah, Sazin kot, Laachi Nullah and Kandia Valley. In Kandia valley, at Aliel village a hunter used its skin as “Ja-namaz” (prayers mat) for many years.



Figure 3.6: Musk deer *Moschus chrysogaster* fawn captured by a local villager from Palas Valley

Common leopard (*Panthera pardus*)

The leopard *Panthera pardus* is the most widespread member of the large cats (Myers, 1986), occurring throughout sub-Saharan Africa, Indian subcontinent and southern Asia (Nowell & Jackson, 1996). This is largely due to its highly adaptable hunting and feeding behaviour (Bertram, 1999). Leopards are catholic in their use of habitat, which ranges from tropical rainforest to arid savanna, and from alpine mountains to the edges of urban areas (Bailey, 1993), illustrating that they can live wherever there is sufficient cover and adequately sized prey animals (Bertram, 1999).

In Pakistan, there are two scattered populations of leopard; one adapted to arid rocky hills and the other to Himalayan forests. It is reported from remote areas of Gilgit, Indus Kohistan, Swat, Kaghan Valley, Azad Kashmir, south Balochistan, Kirthar range, Salt range and Murree hills (Roberts, 1997). It feeds on medium-sized animals as well as rodents; in Murree hills Rhesus monkeys and dogs are hunted by leopard (Roberts, 1997). Common leopard is facing more or less similar situation as snow leopard i.e. shortage of natural prey, and retaliatory killing from locals. Interview based data (38/41)² confirmed its occasional presences in Project Area.

Leopard Cat (*Prionailurus bengalensis*)

The species is mostly confined to forest habitats, associated with Himalayan moist forest temperate forest but has also penetrated in the Himalayan dry coniferous forest and sub-tropical scrub forests in foothills (Roberts, 1997). Its fur is highly prized it is killed whenever encountered by locals making it very uncommon in its range (Roberts, 1997). Like all other small cats it is opportunistic in hunting and mostly depend on rodents, small birds, and occasionally on reptiles, insects and carrion. A villager at Laachi Nullah killed it considering it cub of a leopard while it entered in his house. The stuffed skin of the species was observed with the same individual.

² 38 out of 41 respondents.

Himalayan Monal (*Lophophorus impejanus*)

Most of the year this species is confined to upper limits of coniferous tree-line and in summer forages in alpine meadows up to 4877m elevation while in winter it may be found at 2000m elevation. It is widely distributed in Himalayas in the coniferous forest of Chitral, Dir, Swat, Indus Kohistan, Hazara district, Azad Kashmir and Gilgit. The gorgeous male birds are highly prized for their plumage and crests are used as a badge in the caps in Gilgit Baltistan to proclaim higher social status (Roberts, 1997). Its breeding season ranges from April to August. Mainly it is hunted for meat and skin. Locals also kept stuffed Monal pheasant in their houses.

A stuffed specimen of Himalayan Monal was recovered in Dasu Bazar from a shopkeeper (Figure 3.7). It was hunted from the upper reaches of Project Area few months ago.



Figure 3.7: Himalayan Monal Pheasant *Lophophorus impejanus* recovered in Dasu Bazar

Western-horned Tragopan (*Tragopan melanocephalus*)

The Western Tragopan *Tragopan melanocephalus* is a montane species, restricted in its range to a narrow belt of temperate forests in the western Himalayas of northern Pakistan and north-west India. Tragopan is reported from Indus Kohistan (Duber valley, upper Pattan, Kayal valley, Palas valley), Kaghan Valley, Machiara, Neelum valley, and Kotli district (Roberts, 1997). Mostly found at higher elevation and never comes down below 2000m (Roberts, 1997). In Indus Kohistan its main areas are Kaigah, Laachi Nullah, Sazin kot and Kandia valley. Like Monal it is also hunted for meat and skin.

Asiatic Black Bear (*Ursus thibetanus*)

Black bear is confined to regions of moist, cool Himalayan forest, so that it keep to lower altitudes and does not compete with brown bear. It is reported from Neelum Valley, lower forested valleys of Chitral, Dir, Swat, Astor, Chilas, Gilgit and Hazara district (Roberts, 1997). The population of Black bear is declining in its range due to continuous persecution by human (Roberts, 1997). Bear cubs are captured and sold in local market; tribes known as “Qalandars” train bears for village shows and bear baiting. WWF-Pakistan survey (1993) revealed that there are 1607 captive black bears with Qalandars and those annually 115 bear cubs were captured. Black bear like to eat fruits and maize, hence in conflict with human and killed on encounter. In Project Area, local communities reported it from Kaigah, Sazin kot, Laachi Nullah and Kandia Valley but there has been no recent sightings.

BIRDS OF PREY:

Lammergeyer or bearded vulture, Himalayan griffon vulture, Golden eagle, Long-legged buzzard, White-eyed buzzard, Marsh harrier, Short-toed eagle, Common kestrel, Northern eagle owl, Tawny owl, Collared pygmy owl, Northern hobby, Eurasian sparrow hawk, Shikra and Goshawk are major birds of prey in the Project Area. However, during field studies Marsh harrier, Common kestrel, Northern eagle

owl, and Shikra are also recorded. Common kestrel was encountered frequently at Choochang, Laachi, Nullah, Sazin kot and Kandia valley.

3.8 PROTECTED AND SENSITIVE AREAS

Appendix 3.7 shows overall Protected Areas in Pakistan (PASR, 1998) and Appendix 3.8 presents overall list of the Protected Areas and Community Conservation Areas in the KP province. Kaigah community game reserve is the only protected area (5000 ha) i. e. Community Conservation Area (CCA) close to the project area and it is about 12 km away from the dam site. It is a Community Conservation Area for Markhor covering about 5000 ha. It also provides protection to Musk deer, Tragopan, Monal pheasant and other species at higher elevation.

Other significant/ areas for Markhor, Musk deer, Black bear, Tragopan, Monal pheasant as well as other species in the project area are Laachi Nullah and Sazin kot on left bank of Indus while on right bank Kandia Valley (between the villages Thooti and Aliel) and the area opposite to Shori Nullah (Figure 3.8 and 3.9). These areas have potential to be developed as community conservation areas.



Figure 3.8: Markhor habitat in Laachi Nullah (Left bank of Indus)



Figure 3.9: Markhor habitat opposite to Shori Nullah on the Right bank of Indus

Palas Valley

The Palas valley is an important sensitive area located about 50 km downstream of the project site. The Palas valley supports about 1,000 of Western Tragopan (*Tragopanmelanocephalus* - IUCN vulnerable), an important pheasant in the

Himalayan region. The Palas Valley also supports populations of at least seven other rare bird species, including *Phylloscopus taylori* is classed as near vulnerable and the remaining are restricted range. The Palas Valley is listed by Birdlife International as the most important site for bird conservation in this bio-geographical zone.

Populations of most if not all of the mammals found in the Western Himalayas are found in Palas. These include Brown and Black Bears, Himalayan Ibex, Markhor, Snow Leopards, and Wolves. Inventories now being undertaken of smaller mammals and especially bats. Total area of the Palas valley is about 1400 km² with elevations ranging 700 m to 5200 m amsl. Both the winter and summer ranges of much of the wildlife are included within the valley. The biodiversity of these mountainous ecosystems is under heavy stress from deforestation, firewood collection, overgrazing, over-hunting, over-harvesting of medicinal plants, soil erosion, use of pesticides, and weak law enforcement.

4. POTENTIAL IMPACTS AND MITIGATION MEASURES

Potential impacts of the Project on the terrestrial ecosystem are low and insignificant due to limited biodiversity in the Project impact area (up to 1,000 masl above reservoir area). However, there was a significant biodiversity on the higher altitudes (with location of forests above 2,000 masl and location of wildlife habitat above 3,000 masl) away from the Project impact area. The impacts of the Project are classified into three phases: pre-construction, construction and operation phases, and are explained in the following sections along with the proposed mitigation measures.

4.1 PRE-CONSTRUCTION PHASE IMPACTS

4.1.1 Vegetation

The vegetation is diverse but scattered throughout the Project Area. There are no threatened, endemic or rare plants species recorded during field surveys or were reported in the secondary resources. The impacts during pre-construction phase on flora will result from land acquisition for project facilities and reservoir submergence area, and resettlement of the affected people. The key impacts on vegetation are: loss of about 21,000 trees and shrubs, and loss of about 280 ha of grazing land consisting of various grasses and herbs.

4.1.1.1 Loss of Tress

About 21,000 trees will have to be cut for siting of project facilities and from reservoir submergence area before flooding in order to reduce anoxic conditions and greenhouse gases emissions. The tree numbers to be cut was estimated from GIS mapping of satellite imagery followed by groundtruthing surveys. Generally these trees on the steep slopes of the Indus valley are not very well developed and often consist of stunted trees. They do not represent much natural and commercial value, other than as a source of firewood and fodder. These trees also do not serve the purpose of primary habitat for wildlife species.

Details of major types of trees to be affected are given in Table 4.1. These tree species are: *Cotinus coggygria*, *Olea ferruginea*, *Pistacia chinensis*, *Quercus baloot* and *Rhus mysurensis*. Amongst them, *Quercus baloot* and *Olea ferruginea* distribution and population is much higher than other three species; however, it is noted that generally, all these species are very commonly available and widely distributed throughout the study area including downstream of dam.

Table 4.1: Affected Tree Species

Sr. No.	Village name	Habitat types	Tree Species
1	Dooga Gah	steep rocky slope	<i>Quercus baloot</i> , <i>Olea ferruginea</i> and <i>Cotinus coggygria</i>
2	Choochang	Rocky steep to moderate slopes	<i>Olea ferruginea</i> , <i>Quercus baloot</i> ,
3	Khoshi	Gentle slope	<i>Olea ferruginea</i> and <i>Quercus baloot</i>
4	Siglu	Gentle slope	<i>Olea ferruginea</i> , <i>Quercus baloot</i> and <i>Cotinus coggygria</i>
5	Seer Gayal	Rocky steep to intermediate slopes	<i>Olea ferruginea</i> and <i>Cotinus coggygria</i>
6	Toothi	Rocky steep slopes	<i>Quercus baloot</i> , <i>Cotinus coggygria</i> and <i>Olea ferruginea</i>
7	Seo	Rocky gentle slope	<i>Olea ferruginea</i>
8	Malyar	Rocky steep slope	<i>Quercus baloot</i> and <i>Olea ferruginea</i>
10	Panibah	Rocky gravelly	<i>Olea ferruginea</i> and <i>Quercus baloot</i>

The loss of trees will be compensated by successful plantation of the native species. The lost trees will be replaced at a ratio of 5:1 in the buffer area of the reservoir on the right bank, resettlement sites, DHP office and residential colony, and at higher elevations for forest regeneration with the support of local community. Suitable species of tree plantation are given in the Table 4.2. The community loses on the felling of trees will be compensated by allowing the community to cut and use the wood (in addition to the monetary compensation).

Table 4.2: Recommended Species for Tree Plantation

Sr. No.	Family	Tree species	Local Name
1.	Anacardiaceae	Cotinus coggygia Scop.	Khakoh/Shini
2.	Anacardiaceae	Pistacia chinensis Bunge	Kangar
3.	Anacardiaceae	Rhus mysurensis Heyne.	Kasudur
4.	Fagaceae	Quercus baloot Griffith	Bani/Jaand
5.	Oleaceae	Olea ferruginea Royle	Kao

4.1.1.2 Loss of Grazing Areas

About 280 ha of grazing land consisting of various grasses and herbs will be lost. Ecologically there is no significance for their loss; however it will affect the livestock grazing in winter months. Since the availability of grazing areas are limited in the Project area, the loss of 280 ha of winter grazing land (below 1,000 masl) may affect the livelihood of the herders or forcing them moving in to other areas in search of grazing. Further, winter grazing land between 1,000 m to 1,500 m elevation will be subjected to increased grazing pressure due to relocation of affected villages in to these areas. However, the loss of 280 ha of grazing land comprises only 2.5 percent of the total grazing area (including higher/summer) available to the community (SRMP Vol. 6: Resettlement Action Plan).

In order to mitigate impacts associated with loss of grazing areas, an adequate livelihood restoration program through development of grazing areas at lower and higher altitudes is recommended in order to sustain and improve livestock herding. Government of KP launched a 'Barani Area development Project-II in Kohistan (2004-2009) for Mot Grass cultivation at pilot scale and since 2009 onwards Kohistan Area Development Project is going-on to promote new varieties of Mot Grass. The program can be used as a model to develop the grazing areas in the lands owned by the local community and develop grazing management system.

4.1.1.3 Loss of Riparian Vegetation

There is very limited riparian vegetation in the study area that could potentially affect the buffering function or organic aquatic input to the river. Loss of riparian vegetation mainly affects the community use of the area for grazing. Riparian vegetation can be re-established adjacent to the reservoir margins, by collecting the seed from important species and raising them in the nurseries.

4.1.2 Wildlife

There are no wild life habitats in the project footprint area (from river to 1,000 m elevation) that could be affected by project activities. As explained in Section 3.7, habitat range of wildlife in the region is mostly restricted to higher slopes and mountain tops, generally above 3,000 masl. Since the current studies on baseline wildlife in the Project area was limited to about three months during summer season, further studies are recommended especially in winter season to establish a detailed baseline data (Chapter 5).

4.2 CONSTRUCTION PHASE IMPACTS

4.2.1 Vegetation

The impacts on natural vegetation during construction are (i) increased pressure on forest products due to construction workers and associated in-migrants to Dasu/Komila, (ii) long term exposure of dust from construction works, and (iii) soil erosion from the excavation activities.

4.2.1.1 Pressure on Forest Resources

Forests, though essentially located on high elevation well away from project construction areas, are the most important natural resource of the area. Forests are quite a significant source of income for local community due to timber production through government leasing, with 80 percent of income goes to local community. In addition, selling of fire wood is an important business in the project area and a common practice along KKH mainly in winter season and also partly in summer season. People harvest oak, wild olive and other fuel wood trees from forests and store in the form of wood toll on main KKH. The daily sale of firewood is very high and the people earning a large amount; the local selling rate of the firewood is Rs.260/- per 50 Kg. It is expected that the Project will attract about 9,000 in-migrants (construction workers, their families and service providers). This will create a huge demand for firewood due to increased energy requirements for cooking and space heating during winter, and will finally increase the pressure on forest resources, which is already under heavy pressure from local communities for commercial harvesting, firewood and grazing.

To mitigate the pressure on natural forests, the Project will support the local government to establish market for supply of non-timber fuels such as LPG for cooking and heating to reduce the pressure on firewood. Contractors also shall provide LPG to the construction staff for cooking and heating purposes.

4.2.1.2 Construction Related Impacts on Vegetation

Construction activities will have wide range of impacts on natural vegetation due to (i) vegetation clearance from construction areas, and (ii) soil erosion and dust from large scale excavation activities near the dam site, relocated KKH, access roads and quarry sites. This can occur during clearing and construction activities and the quality of habitat can change to a limited extent.

The above potential effects during construction stage can be mitigated by implementation of mitigation measures outlined in a series of environmental management sub-plans and codes of practices in Volume 8: EMP; and are listed below:

- EMP Sub-Plan 1: Construction Management
- EMP Sub-Plan 3: Physiography and Geology
- EMP Sub-Plan 5: Air Quality Management
- EMP Sub-Plan 10: Terrestrial Ecology Management

Site specific mitigation should include measures to: minimize disturbance to the surrounding vegetation; adopt a stringent system of approval process that is granted only by the supervisor/ consultant for clearance of the vegetation; stabilise the areas immediately after construction, and restoration of vegetation from the disturbed areas.

4.2.1.3 Weed Growth

Invasive species could over-compete local native species and change the character and value of the ecosystem. This can happen through the construction machinery and large number of traffic associated with DHP construction and development of physical infrastructure.

Retention of existing vegetation in the construction area would minimize the amount of vacant habitat available for colonization of exotic weed and invasive species. It is also important to minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. Contractor's equipment should be cleaned and used accordingly to avoid any accidental introduction of exotic and or invasive alien species from other areas. Control the noxious weeds by disposing of at designated dump site or burn on site.

4.2.2 Wildlife

Construction activities such as drilling and blasting create high noise and vibrations, which may have potential to disturb the birds and wildlife on higher elevations. Potential sources of effects on wildlife during various construction activities are summarized in Table 4.3.

Table 4.3: Sources and Types of Potential Effects on Wildlife

Source of Construction Activity	Potential Effects
Dam Construction	Noise and night lighting from construction areas
Tunnel Construction	Noise and vibration from blasting activities
Quarrying of Kaigah	Dust, noise and vibration from drilling and blasting activities may have potential effect on Markhor Community Conservation Area (CCA) at Kaigah
Construction of KKH and access roads	Noise and vibration from drilling activities. Relocation of KKH from lower elevation (800-950masl) to higher elevations (950-1000masl) and construction of access roads at these elevations may provide increased access to wildlife

4.2.2.1 Impact on Birds

As explained in Section 3.3, Indus valley is a migratory route for wintering birds. Hundreds of thousands of birds from northern countries spend entire winters in different wetland of Pakistan, which are distributed almost throughout the country from the high Himalayas to coastal mangroves and mud flats in the Indus delta. After successful wintering they go back to their native habitats for breeding purposes. About 58 species of terrestrial birds and 39 species of aquatic birds were observed in the Project area.

Noise generated through drilling and blasting during construction activities have potential to impact on the birds' hearing and behaviour. The noise impacts on the birds can be classified into the following 3 categories:

- a. **Hearing Damage:** Generally birds are more resistant to both temporary and permanent hearing loss or to hearing damage from acoustic overexposure than are humans and other mammals. Birds are able to regenerate the sensory cells of the inner ear, thereby providing an avenue for recovering from intense acoustic over-exposure. However, a permanent hearing loss occurs if the intensity and duration of the noise is sufficient to damage the delicate inner ear sensory hair cells.
- b. **Temporary Threshold Shift (TTS):** A TTS is a temporary hear loss that lasts from seconds to days depending on the intensity and duration of the noise to which the bird was exposed.
- c. **Masking:** Continuous noise of sufficient intensity may mask signals of birds that are used to communicate between conspecifics or recognize biological signals, and impairing detection of sounds of predators and/or prey.

California Department of Transportation (2007)¹ has recommended interim noise guidelines for potential impact on birds from noise sources from construction and operation of highways. These noise standards are presented in Table 4.4 and will be considered as performance indicators for the environmental monitoring of the Project.

Table 4.4: Interim Guidelines for Potential Effects from Different Noise Sources

Noise Source Type	Hearing Damage	TTS	Masking
Distance to the Source	Very Close	Close	Far
Single Impulse (e.g., blast)	140 dB(A)	NA	NA
Multiple Impulse (e.g., jackhammer, pile driver)	125 dB(A)	NA	ambient dB(A)
Non-Strike Continuous (e.g., construction noise)	None	93 dB(A)	ambient dB(A)
Highway Noise	None	93 dB(A)	ambient dB(A)
Alarms (97 dB/100 ft)	None	NA	NA

Source: California Department of Transportation, 2007

Drilling and blasting activities during construction will generate noise levels in the range of 110 to 140 dB and these activities may cause permanent hearing damage to the birds if they located very close to the noise source. To reduce noise levels from drilling activities, acoustic enclosure will be placed to cover the equipment. During migratory bird season; if there is concentration of birds near high noise generation activities, the contractor can deter the birds from those areas by using light reflective devises, waterfowl simulation gunshots, bird deterrent distress and alarm calls, etc.

It is noticed that many resident birds build nest along KKH despite of noise from high volume of traffic. Hence noise may not have major impact on the breeding and nesting species. These species are found to be very adaptable in different conditions and their populations are commonly found in stable conditions. They are likely to readjust their breeding ranges in nearby areas due to their remarkable adaptive ability.

Birds of Prey such as Lammergeier, Golden Eagle and Kestrel makes their nest in safe mountain cliffs at higher altitudes and are not going to receive any direct or indirect impact from the construction activities. Similarly no impacts are expected on threatened and important bird species like Western tragopan and Monal pheasant as they are usually restricted to higher elevation.

Other potential impacts during construction stage are: clearance of vegetation may impact sheltering and breeding of local birds; night lighting form the construction areas may affect the visibility of night time migratory birds that use the moon and stars for navigation during their migrations; and illegal poaching from the construction workers. Mitigation measures for these impacts, along with other general construction related impacts are explained in Volume 8: EMP (EMP sub-plan 10: Terrestrial Ecology Management and ECP 13: Protection of Fauna).

4.2.2.2 Impact on Kaigah Private Game Reserve

Permanent Impacts

The permanent impacts on the game reserve are (i) Loss of a strip of land (estimated at some 31 ha) from the game reserve due to construction of the new alignment of KKH; and (ii) Loss of land (estimated at some 51 ha) from the game reserve due to submergence by the reservoir. Thus about 1.6% of total area of the game reserve will be permanently affected by the Project. Location of the game reserve, reservoir

¹ Robert J. Dooling¹ and Arthur N. Popper (2007). The Effects of Highway Noise on Birds. Prepared for: The California Department of Transportation

submergence area, quarry site and KKH realignment at Kaigah is shown in the Figure 4.1.

There are four camps (tourist facilities with bed rooms, toilets, etc.) in the game reserve, which are established near the Markhor habitats. The distance between existing KKH to first camp and distance between other camps are given below:

- Distance from existing KKH to Camp 1 is 3 km
- Distance from Camp 1 to Camp 2 is 1 km
- Distance from Camp 2 to Camp 3 is 3 km
- Distance from Camp 3 to Camp 4 is 5 km

Markhors are mainly present in Camp 1 area during winter months of December and January; in Camp 2 during March and April; in Camp 3 during summer months of May, June and July; and in Camp 4 during August to November.

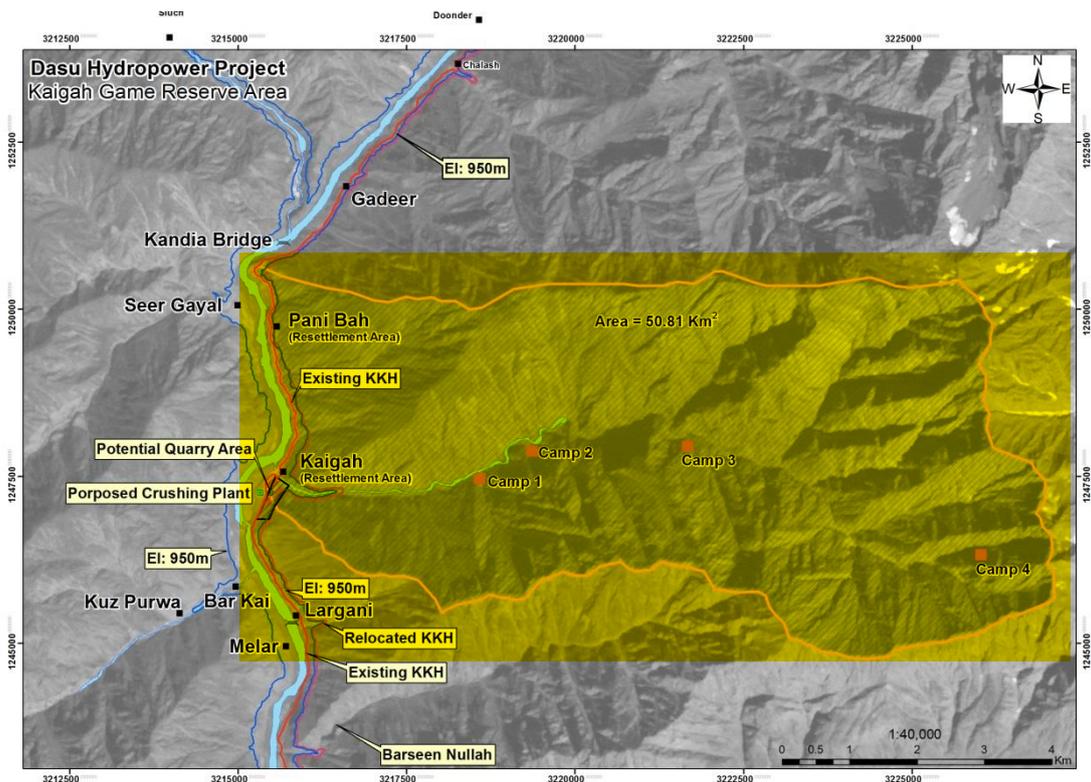


Figure 4.1: Location of Kaigah Game Reserve and Project Facilities

The lower elevations of the game reserve that will be permanently affected by the Project are mainly inhabited the community of **Kaigha** village. No wildlife habitat will be affected by the project. As a compensation measure to the loss of the land, the project will carry out further studies and develop two community conservation areas in the project area and support strengthening of conservation activities in the Kaigha game reserve.

Temporary Impacts

Construction activities in the proposed quarry site at Kaigha (for 2.75 years) and relocated KKH within the game reserve (for about 10 months) may have potential impacts on the wildlife in the game reserve. Blasting and aggregate crushing operations are the major sources of disturbances in the quarry area. The environmental effects most often associated with blasting operations are ground and air vibrations. The intensity of ground vibrations, which is measured in units of peak particle velocity, is defined as the speed of excitation of particles within the ground resulting from vibrating motion. Air vibration or air-blast is a pressure wave travelling

through the air produced by the direct action of the explosive on air or the indirect action of a confining material subjected to explosive loading. Air vibration is measured on decibels (dBL). At low to medium levels, ground vibrations and air-blasts result in annoyance, but at higher levels, it would be expected that wildlife may move away from their habitats to further higher elevations.

Ground vibrations and air blasts for various quantities of blast size at lowest level markhor habitat (located about 3 km from blasting area) are estimated and presented in the Table 4.5. Similarly noise from quarrying and aggregate crushing operations at this location is given in Table 4.6.

Table 4.5: Air and Ground Vibrations at the Nearest Wildlife Habitat of Kaigah CCA

Blast Size used at Kaigah quarry (kg)	Air Blast (dBL)	Ground Vibration (mm/s)
250	100	0.32
500	102	0.51
1,000	105	0.83
International Standards		
USA	133	25
Canada	128	12.5
Australia	115	5

Source: Section 7 of Volume 2 EIA

Table 4.6: Noise Impacts on the nearest Wildlife Habitat of Kaigah CCA

Activity	Leq (1hr)
Quarrying	43
Crushing	47
Equivalent Noise	45
Standard (NEQS)	Silence Zone: 50 dB(A) for day time and 45 Leq (1hr) at night time

Source: Section 7 of Volume 2 EIA

Generally a maximum blasting size of 100 kg to 250 kg will be used for such large scale quarrying activities. Based on the above tables, it can be noted that, an instantaneous blasting up to 1,000 kg produce an air blast of 105 dBL and a ground vibration of 0.83 mm/s at the nearest wildlife habitat of the game reserve. These values are well within the international standards and also within the levels studied by some researchers to understand the impacts of blasting on wildlife². Hence the blasting is not expected to create any impact on the Kaigah game reserve. However, it is difficult to accurately predict potential ground vibration and air-blast impacts for a new site as their propagation is so dependent upon local geology, terrain, meteorological conditions, and type of initiation. Normally a series of small trial blasts are carried out in order to calculate site laws based on measured vibration and airblast levels. It is recommended that the contractor shall carry out trail blasts with various charge amounts and record vibrations levels at the first camp of the game reserve and

² Hall et al. 1988 conducted a study on effects of nearby (as close as 500 ft) blasting noise and vibration on wild animals. At an airblast level of 130 dBL and ground vibration of 6.35 mm/s (0.25 in/s), the tested animals noticed the first blast or two; however, they quickly acclimated to the noise and vibration. In their final conclusions, the researchers found that the tested animals experienced no long-term negative effects from the levels of noise and vibration produced by the construction blasting. The study was conducted at the Washington Park Zoo in Portland, Oregon and the animals studied are black rhinos, naked mole rats, elephants, spotted owls, snow leopards, red pandas, white tailed deer and several other species. In a different study (Gordon, 2006), where blasting regularly occurred near within 1,000 ft of a dairy cows (that produced vibrations of 128 dBL and 2.03 mm/s), despite initial concerns by the dairy operators, all involved parties have finally concurred that blasting did not disturb the cows.

finally chose the optimum amount of blasting per event. Similarly noise levels are also to be monitored and if it exceeds the national standards, acoustic enclosures for noise attenuation are recommended for crushing plant or its operation to be limited to day time. Contractors shall employ appropriate methods to control dust from the blasting, quarrying and crushing activities.

4.2.2.3 Risk of Poaching

Construction of realigned KKH along left bank and access roads along the right bank (within 1,000 masl) will not interfere with any wildlife corridors. However, they may provide increased access to hunting and poaching.

Poaching from construction workers can be affectively curtailed by conducting wildlife awareness programs. Temporary access roads will be decommissioned after completion of the Project. Wildlife personnel of District Wildlife Department are inadequate and not mobile enough to apprehend the hunters/Poachers. The Project can support the district wildlife authorities in conducting awareness programs on wildlife conservation and taking up conservation projects similar to Kaigah CCA. This would also reduce the hunting and poaching pressure and provide some job opportunity to locals.

4.3 OPERATION AND MAINTENANCE PHASE IMPACTS

4.3.1 Impacts on Amphibians and Reptiles

There is a risk that hibernating amphibians and reptiles may be impacted if the first reservoir filling is undertaken in the winter. However, when looking at Indus river ecosystem in Dasu area, it is important to compare and contrast it with other river systems and their associated ecology in northern Pakistan. Compared to Gilgit, Hunza and Naltar rivers (the tributaries of Indus), the Indus river at Dasu is much higher in sediment load and is characterized by relatively low species diversity. For example Hunza and Naltar river which are higher in elevation from Indus have more deposition of soil and alluvial fans on both sides which offer consistence breeding and spawning grounds to amphibians. The Indus in the project area is fast flowing and is mostly comprised of rocky boulders, barren islands and scanty vegetation. Hence amphibian and reptilian population are smaller in number in the reservoir area.

The reptiles may be impacted/ trapped to some extent during the first filling of the reservoir as they are slow moving, cold blooded and have restricted home ranges. Inundation of the lower sections of nullahs/ tributaries (mostly covered by small alluvial plains and meadows often closely located to village settlements) would negatively impact the amphibian populations. Alluvial fans play an important role in amphibian's reproductive season; however, in the natural setting and at lower altitudes in the reservoir area these fans are non-existent or found in very small areas. The first filling of reservoir is planned during summer/high flow season and hence the potential risk on hibernating amphibians and reptiles can be ruled out. Submergence of immediate rock and grass areas could impact agama and gecko species; however it is anticipated that the loss would be minimal.

4.3.2 Reservoir Effect on Migratory Birds

DHP will create a reservoir of 73 km length with average width of 365m. This water body will offer a staging ground for migratory birds. The reservoir will be too deep to produce enough food to hold waterfowl over the winter, but do provide resting areas and refuge from hunting pressure. The actual numbers and diversity of waterfowl attracted to a reservoir greatly depend upon whether or not particular habitat requirements are met and what is the final shape and appearance of the reservoir would be. Based on the preliminary analysis and extensive in-house discussion, it is

projected that large variety of wetland birds will either refuge or stage for a day or two on the Dasu reservoir. The Figure 4.2 shows major existing and emerging reservoirs/dams in Northern Pakistan signifying the importance of these emerging habitats for waterfowl. It is concluded that these new habitats will be of immense value for staging migratory waterfowl and waders. Experience from Tarbela reservoir suggests that these reservoirs will not act as wintering grounds for the migratory birds.

Safety of the migratory birds will have to be necessary during wintering months. Environmental awareness, community-based conservation programs will need to be implemented with appropriate support from local and national conservation agencies.

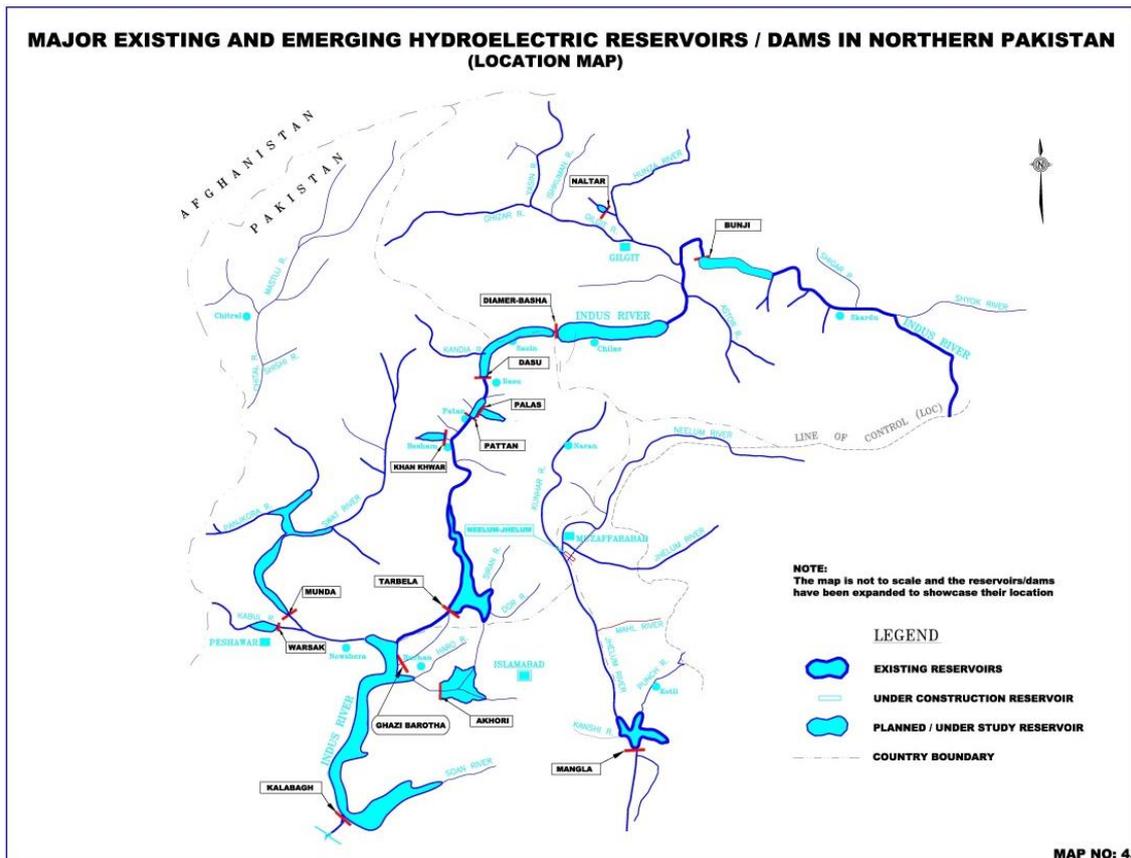


Figure 4.2: Major Existing and Emerging Hydropower Reservoirs in Upper Indus

4.3.3 Risk of Bird Collisions Electrocutation

The Indus valley is a major fly-way for bird migration. Huge flocks of migrating birds follow the Indus valley fly-way twice a year in autumn and in spring passing the narrow Indus valley. Especially for birds with a large wingspan such as storks, cranes, herons and birds of prey there is a risk of bird collision with transmission cables. Fatal collisions occur mostly with cables hanging perpendicular to the flight direction.

Power line structures provide perching, roosting, and nesting substrates for some avian species especially for birds of prey. In open habitats where few natural perches exist, such as agricultural fields and pastures, raptors are attracted to power poles, which provide roosting and nesting sites as well as hunting perches. “Still hunting” from a perch is energy efficient for a bird, provided that good prey habitat is within view. Some structures are preferred by birds because they provide considerable elevation above the surrounding terrain, thereby offering a wide field of view.

The large wingspans of raptors enable them to simultaneously touch energized and/or grounded parts, potentially resulting in electrocution. Although raptors are most often considered when addressing electrocution risk, other birds such as crows, ravens, magpies, small flocking birds and wading birds can also be electrocuted. Closely-spaced exposed equipment, such as jumper wires on transformers, can pose an electrocution risk to small birds.

The electrical design factor most crucial to avian electrocutions is the physical separation between energized and/or grounded structures, conductors, hardware, or equipment that can be bridged by birds to complete a circuit. As a general rule, electrocution can occur on structures with the following:

- Phase conductors separated by less than the wrist-to-wrist or head-to-toe (flesh-to-flesh) distance of a bird. The wrist is the joint toward the middle of the leading edge of a bird's wing. The skin covering the wrist is the outermost fleshy part on the wing.
- Distance between grounded hardware (e.g., grounded wires, metal braces) and any energized phase conductor that is less than the wrist-to-wrist or head-to-toe (flesh-to-flesh) distance of a bird.

Mitigation to prevent or reduce the number of bird fatalities is possible by maintaining a minimum distance of 1.5 meters between the energized parts of the transmission line and attaching visibility enhancement objects such as marker balls, bird deterrents, or diverters.

It is a general international practice that in areas with known populations of raptors or other birds of concern, new lines should be designed with adequate separations for birds' wingspan and height. In addition to the physical separation of the conductors, the exposed coverings and parts of the structure should be insulated.

5. TERRESTRIAL ECOLOGY MANAGEMENT PLAN

5.1 IMPACTS, MITIGATION AND MONITORING MEASURES

The impacts of the Project on terrestrial ecology in the study area and the mitigation measures are summarized in Table 5.1. The Table also shows the responsible institutions for implementation and supervision of the mitigation measures, and monitoring. The plan is also presented in overall EMP of the Project as 'EMP Sub-Plan 10: Terrestrial Ecology Management (see Vol. 8: Environmental Management Plan). Detailed budget estimates of these plans are given in Vol. 8: EMP.

5.1.1 Institutional Framework

Organisation chart of DHP for implementation of EMP is given in Figure 5.1 and brief descriptions of their roles are given below (detailed descriptions of the institutions are given in Volume 8: EMP):

- DHP and its Project Management Unit (PMU) will be responsible for overall implementation of the Project and hiring of contractors and consultants.
- An Environmental Unit will be established in DHP (EU-DHP) to undertake responsibility for routine and random monitoring of implementation of EMP.
- Construction Supervision Consultant (CSC) will also have an environmental unit (EU-CSC) to effectively supervise and monitor the implementation of EMP. EU-CSC will include national and international experts in ecology.
- Contractors will be responsible for implementation of EMP during construction and first year of operation of the project.

Implementation mechanism specific to terrestrial ecology plan is as follows:

- Contractors are responsible for implementation of mitigation measures in accordance with EMP. Contractors shall ensure that staff and subcontractors are trained and empowered to identify, address and report potential problems on terrestrial ecology, and deploying equipment and machinery conforming to environmental parameters (noise, emissions).
- Assistant Director of Ecology in Environmental Unit is responsible for coordination with the environmental specialists of contractor, CSC, and relevant stakeholders such as district and provincial forest and wildlife departments, and local community. He will be responsible for conducting or commissioning additional studies recommended in the EMP and prepare terms of reference for hiring of consultants, if required, to carry out recommended studies.
- Ecological expert of the EU-CSC is responsible for supervision of implementation of mitigation measures proposed for management of impacts on terrestrial ecology, review and audit the adequacy of mitigation measures and update the EMP every six months, and conduct any additional studies if required to update the EMP.
- District Forest and Wildlife Departments will coordinate with DHP for protection and conservation of natural resources in the Project area and to mitigate any indirect impacts on these resources.

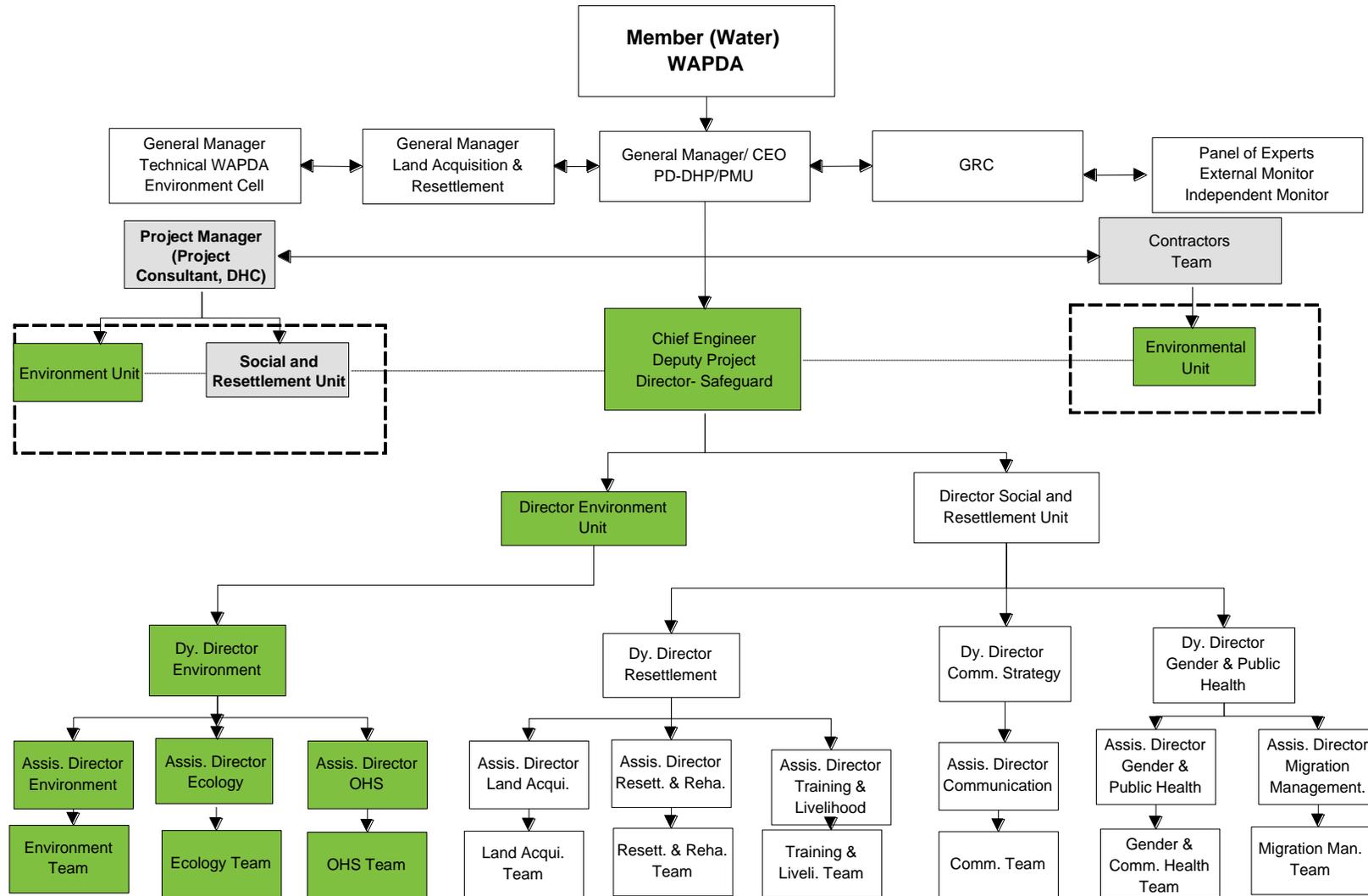


Figure 5.1: DHP Organization Chart and Ecological Unit

Table 5.1: Impacts on Terrestrial Ecology and Mitigation Measures, and Monitoring Schedule

Component	Issue/impact	Mitigation/Enhancement Measures	Responsibility for implementation	Responsibility for Supervision	Timing	Monitoring
Vegetation	<ul style="list-style-type: none"> Loss of 21,000 trees and shrubs 	<ul style="list-style-type: none"> A compensatory tree plantation (105,000 trees) by planting 5 trees for each tree cut. 	AD Ecology of EU-DHP	Director EU-DHP	Pre-Construction/Construction	Monthly
		<ul style="list-style-type: none"> A nursery will be established with local species such as <i>Cotinus coggygia</i> Scop, <i>Pistacia chinensis</i> Bunge, <i>Rhus mysurensis</i> Heyne, <i>Quercus baloot</i> Griffith, and <i>Olea ferruginea</i> Royle with a capacity to produce about 300,000 saplings. Seeds of these species are to be collected prior to removal of trees 	District Forest and Agriculture Department	AD Ecology of EU-DHP	Pre-Construction	Monthly monitoring the saplings raised and delivered
		<ul style="list-style-type: none"> Plantation to be developed in the buffer area of the reservoir on the right bank, resettlement sites, DHP office and residential colony, and at higher elevations for forest regeneration Maintain each sapling for a period of minimum 2 years with the support of local community. Community will be paid for watering and raising the plantation 	District Forest Department with the support of local community	AD Ecology of EU-DHP	Pre-Construction/Construction	Monthly monitoring of trees planted and survived
	<ul style="list-style-type: none"> Loss of 280 ha of grazing land and additional pressure on grazing areas on higher altitudes 	<ul style="list-style-type: none"> Development of grazing areas at lower and higher altitudes in the upper reaches of reservoir buffer area and in the community grazing areas (sites owned by community) Study the established model programs in Kohistan such as 'Barani Area development Project for Mot Grass 	AD Ecology with the support AD Livelihood of Social Unit	Deputy Project Director – Safeguard, DHP	Pre-Construction/Construction	Monthly

Component	Issue/impact	Mitigation/Enhancement Measures	Responsibility for implementation	Responsibility for Supervision	Timing	Monitoring
		cultivation' and follow similar approaches to develop grazing lands with the support of local community				
	<ul style="list-style-type: none"> Loss of riparian vegetation 	<ul style="list-style-type: none"> Riparian vegetation can be re-established adjacent to the reservoir margins, by collecting the seed from important species and raising them in the nurseries 	District Forest and Agriculture Department	AD Ecology of EU-DHP	Pre-Construction	Monthly
	<ul style="list-style-type: none"> Increased requirement of forest products such as fuel wood, fruits and nuts by the in-migrant workforce may create pressure on the local community to cut more trees 	<ul style="list-style-type: none"> Project will assist the District Forest Department in re-generation of forests with the nursery development and plantation of trees 	AD Ecology and District Forest Department	Director EU-DHP	Construction	Monthly
	<ul style="list-style-type: none"> Construction activities will have wide ranges of impacts on flora (vegetation clearance, dust, soil erosion and loss of birds shelters) 	<ul style="list-style-type: none"> Implement mitigation measures proposed in Environmental Code of Practices in Volume 8 EMP (ECP 12: Protection of Flora) An awareness program for the construction workers to discourage cutting of vegetation 	Contractor	EU-CSC/ AD – Ecology	Construction	Monthly
Birds	<ul style="list-style-type: none"> Impact on birds due to high noise generated from construction equipment, especially drilling and blasting activities 	<ul style="list-style-type: none"> Acoustic enclosures are recommended around the high noise generating equipment to reduce noise emissions Construction equipment should meet the emission standards given in Pakistan National Environmental Quality Standards If high concentrations of birds are 	Contractor	EU-CSC/ AD – Ecology	Construction	Monthly

Component	Issue/impact	Mitigation/Enhancement Measures	Responsibility for implementation	Responsibility for Supervision	Timing	Monitoring
		noticed near the construction sites, they should be deterred using bird deterrent distress and alarm calls, etc.				
	<ul style="list-style-type: none"> Gaps in the baseline data on migratory birds 	<ul style="list-style-type: none"> Further studies during winter season to establish baseline data for migratory birds (Details are given in Annex 5.1) 	Consultant	AD Ecology	Pre-construction/construction	Monthly
Mammals	<ul style="list-style-type: none"> Noise and vibrations from the construction activities at quarry and realigned of KKH at Kaigha may impact Markhor in Community Conservation Area (CCA) at Kaigha 	<ul style="list-style-type: none"> Contractor should carry out trail blasts with various charge amounts and record vibrations levels at the closest boundary of the CCA and finally chose the optimum amount of blasting per event. Excavation activities are to be carried out in a way that there be natural rock berms on the eastern side and northern side of the quarry Acoustic enclosures are recommended for crushing plant 	Contractor	EU-CSC/ AD – Ecology	Construction	Monthly
		<ul style="list-style-type: none"> Enhancement of Kaigha CCA by providing additional facilities for recreation of tourists and hunters Carry out detailed wildlife census in the Kaigha CCA focusing on Markhor 	AD – Ecology with the support of WWF or IUCN	Deputy Project Director – Safeguard, DHP	Construction	Monthly
	<ul style="list-style-type: none"> Risk of poaching from construction workers due to increased access through new access roads and realigned KKH 	<ul style="list-style-type: none"> Conducting awareness programs for the construction workers for protection of flora and fauna in the region. Temporary access roads will be decommissioned after completion of the Project. 	Contractor	EU-CSC/ AD – Ecology	Construction	Monthly
		<ul style="list-style-type: none"> Wildlife personnel of District Wildlife 	District	AD-Ecology	Construction	Quarterly

Component	Issue/impact	Mitigation/Enhancement Measures	Responsibility for implementation	Responsibility for Supervision	Timing	Monitoring
		Department are inadequate and not mobile enough to apprehend the hunters/Poachers. The Project can support the district wild life authorities in conducting awareness programs on wildlife conservation.	Wildlife Department			
	<ul style="list-style-type: none"> ▪ Some data gaps in the presence and wildlife and its habitat in the project surrounding areas 	<ul style="list-style-type: none"> ▪ Additional field studies to develop baseline data for wildlife (Details are given in Annex 5.1) ▪ Establish vantage stations to monitor the presence and movement wildlife for two seasons. ▪ Revise, if required, mitigation measures and management plans proposed in Chapters 4 and 5 	AD – Ecology with the support of consultants	EU-CSC/ AD – Ecology	Pre-Construction/ Construction	Monthly

5.2 CONSERVATION OF BIODIVERSITY

The biodiversity of the mountains of Northern Pakistan is under anthropological pressures and require lot of long time conservation measures for protection biodiversity. Though these issues are not related to Dasu Project, WAPDA as organisation responsible for developing cascade of hydropower development projects in the region can further look in to these conservation measures and support them as a corporate responsibility. Some of these activities can also be implemented through Environmental Enhancement Fund (Section 9 of Vol: 2 EIA) to be established under the Project. These measures include:

- Development of horticulture/silviculture complex for developing forest and agriculture nurseries. Details are given in Appendix 5.1
- Forest Management Plan for planning sustainable forest management and long-term and continued timber yield. Details are given in Appendix 5.1
- Medicinal Management Plan for conducting research, developing infrastructure and marketing of medicinal plants those are endemic to mountains of northern Pakistan. Details are given in Appendix 5.1
- Programs for conservation of wildlife species focusing Markhor, Musk Deer, Western-horned Tagopan and others. Details are given in Appendix 5.1
- Arranging training programs to various public sector institutions (forest, wildlife, agriculture, tourism, universities) in understanding the mountain biodiversity of Northern Pakistan. Details are given in Appendix 5.1

6. CONCLUSIONS

The terrestrial ecology/ biodiversity will face minimal risks from the construction and operation of DHP. Based on primary field surveys, secondary review and consultations it can be concluded that potential DHP impacts may only cause low level risks to certain components of terrestrial biodiversity. However, strict implementation of mitigation measures proposed in Project's EMP is required to address general construction related impacts. The Project impact area, comprising of Project foot prints and reservoir submergence area, is located from the base of the river to 1000 masl on both right and left bank. The biodiversity in this impact area is low and insignificant. However, some amphibians, reptiles, small mammals and insects are found here that may be impacted to a much lesser extent due to very low population occurrence. There is significant biodiversity in the broader study area especially in the higher altitudes (above 3,000 masl) away from the project impact area. These upland habitats cater wildlife resources including ungulates, carnivores and birds of prey. These habitats are already under heavy anthropogenic uses. There is no direct impact of the Project on this high elevation biodiversity. However realigned KKH on left bank on access road on right bank may provide improved access to the upland wildlife habitat so conservation, management and environmental education measures will need to be enhanced/ introduced for long-term and sustainable use of biodiversity. Tree plantations, augmented community-based conservation, forest nurseries, institutional capacity development and local skill enhancement will ensure sustainable development and successful operation of this project in future. Active participation of local communities will ensure lasting success of DHP in the heart of northern mountains.

7. REFERENCES

- Abbasi, A.M., M.A. Khan, M. Ahmad, R. Qureshi, M. Arshad, S. Jahan, M. Zafar and S. Sultana. 2010. Ethnobotanical study of wound healing herbs among the tribal communities in Northern Himalaya Ranges District Abbottabad, Pakistan. *Pakistan Journal of Botany* 42(6): 2777-2782.
- Abd el-ghani, M.M. 2000. Floristics and environmental relations in two extreme desert zones of western Egypt. *Global Ecol. Biogeogr.*, 9: 499–516.
- Ahlborn G. G., Jackson R. M. 1988. Marking in free-ranging snow leopards in west Nepal: a preliminary assessment. In: H. Freeman (ed.). *Proceedings of the Fifth International Snow Leopard Symposium*, Int. Snow Leopard Trust and Wildlife Institute of India. P. 269.
- Ahmed, M. 1998. *Pakistan Ki Jangli Heyat (Wild inhabitants of Pakistan)*: 1st Edition. Inter Graphics Printer, Pakistan.
- Ali, Fi, 1993. Himalayan Jungle Project Palas Valley, Indus Kohistan, *Small Mammals Survey Report*. M.Sc. Zoology, P.U. Lahore
- Ali, S.I. and M. Qaiser (Eds.). 1993-1995 & 2000-2009. *Flora of Pakistan (Fascicle series)*. Islamabad, Karachi.
- Ali, S.I. and Y.J. Nasir (Eds.). 1989-1991. *Flora of Pakistan (Fascicle series)*. Islamabad, Karachi.
- Ali, Sajjad M.S May 2008 *Wildlife Biology Conservation and Status of Markhor (Capra falconeri) in the Northern Parts of North West Frontier Province, Pakistan* Ankara, Turkeyr
- Anwar, M. 2012. Protected Area and Community Conservation Areas in KPK.
- Anwar, M. and Sheikh, K.M. 2005. A Review of the Implementation of the Biodiversity Action Plan (BAP) for Pakistan. IUCN-Pakistan program. 89 pp.
- Anwar, M.B; Jackson, R; Nadeem, M. S; Janečka, J. E; Hussain, S; Beg, M. A; Muhammad, G. and Qayyum, M. 2011. Food Habits of Snow Leopard *Panthera unica* (Schreber, 1775) in Baltistan, Northern Pakistan. *European Journal of Wildlife Research*. 57 (5): 1077-1083.
- Bailey, T.N. (1993). *The African leopard: ecology and behavior of a solitary felid*. New York: Columbia University Press.
- Bareen, F and Iqbal, S.H. 1997. Riparian vegetation and Freshwater Fungal Flora of some Lakes in the GB. In *Karakorum – Hindukush – Himalayas : dynamics of change / Irmtraud Stellrecht (ed.) – Koln : Koppe (Culture area Karakorum scientific studies)*.
- Bazin, F., Skinner, J. and Koundouno, J. (eds.) 2011. *Sharing the water, sharing the benefits: Lessons from six large dams in West Africa*. International Institute for Environment and Development, London, UK.
- Berkamp, G., McCartney, M., Dugan, P., McNeely, J., Acreman, M. (2000) *Dams, Ecosystem Functions and Environmental Restoration. Thematic Review II.1* prepared as an input to the World Commission on Dams, Cape Town, www.dams.org
- Bertram, B.C.B. (1999). Leopard. In *The encyclopedia of mammals*: 44–48. Macdonald, D.W. (Ed.). Oxford: Andromeda Oxford Limited
- Bhatti, G.R., R. Qureshi and M. Shah. 2001. Ethnobotany of Qadanwari of Nara Desert. *Pak J. Bot.*, 33(special issue): 801-812.
- Bibby, C.J. and Burgess, N.D. 1992. *Bird Census Techniques*. Academic Press Limited. London.

- CBD. 2006. Towards Effective Protected Area Systems. An Action Guide to Implement the Convention on Biological Diversity Programme of Work on Protected Areas. UNEP
- Champion, H.G., S.K. Seth and G.M. Khattak. 1965. Forest types of Pakistan. Pakistan Forest Institute, Peshawar.
- Chaudhry, A. A., and Qureshi, M. Y. 2011. Northern Mountainous Region of Pakistan. *In: editors: Akbar and Anwar, Wildlife of Western Himalayan Region of Pakistan (Northern Mountainous):* WWF-Pakistan
- Chaudhry, Z. 2012. Project Description – Dasu Hydropower Project. DHC, Lahore
- Conservation news 2001. Snow Leopard conservation: a NABU project in Kyrgyzstan. *Oryx*. 35 (4): 354.
- Emerton, L. 2002. A Toolkit for Financing NBSAPs in Asia (IUCN-Asia)
- F. M. Qamar, H. Ali, S. Ashraf*, A. Daud**, H. Gillani, H. Mirza and H. U. Rehman. Distribution and Habitat Mapping of Key Fauna Species in Selected Areas of Western Himalayas, Pakistan. *Journal of Animal and Plant Sciences*, 21(2 Suppl.): 2011, Page: 396-399 ISSN: 1018-7081
- Faisal, A., 2006. Environmental Impact Assessment in Pakistan – overview, implementation and effectiveness. M.Sc. Thesis KTH
Future Development . Department of Geography, Ankara University, Sihhiye,
- Ghimire, S. K., D. McKey and Y. Ameeruddy-Thomas. 2006. Himalayan medicinal plant diversity in an ecologically complex high altitude anthropogenic landscape, Dolpo, Nepal. *Environmental Conservation*, 33: 128-140.
- Gordon F. Revey (2006). Assessment of Rock Blasting Impacts And Recommended Practices For Proposed Roblar Road Quarry Sonoma County, California.
- Green, M. J. B. 1986. The distribution, status and conservation of Himalayan musk deer. *Biol. Conserv.* 35:347-375.
- Grimmett, R., Roberts, T. and Inskipp, T. 2008. *Helm Field Guide Birds of Pakistan*. Christopher Helm. London.
- Guihua Wang, Qinhuang Fang, Luoping Zhang, Weiqi Chen, Zhenming Chen and Huasheng Hong. 2010. Valuing the effects of hydropower development on watershed ecosystem services: Case studies in the Jiulong River Watershed, Fujian Province, China. *Estuarine, Coastal and Shelf Science* 86 (2010) 363–368
- Hall, S, Fraser, J., Mellen, J. and Shephardson, D.J. (1998). "Response of Zoo Animals to Airblast and Ground Vibration Resulting from Light Rail Train Construction," Metro Washington Park Zoo, Portland, Oregon, 1998
- Hauer, S., Ansorge, H., and Zinke, O. 2002. Mortality pattern of Otter (*Lutra lutra*) from Eastern Germany. *J. Zool.* 256:361-368.
- Hussain, S. 2003. The status of the snow leopard in Pakistan and its conflict with local farmers. *Oryx*. 37 (1): 26-33.
- IUCN- Asia. 2004. The Global Case Study: Integration of Economics into National Biodiversity Strategies and Action Plans (IUCN-Asia).
- IUCN, 2004. IUCN Red List of Threatened Mammal Species. <http://redlist.org/> Cymbiont. Ca/resultslist.asp
- Jackson, R. M., Wangchuk, R. 2001. Linking snow leopard conservation and people-wildlife conflict resolution: grassroots measures to protect the endangered snow leopard from herder retribution. *Endangered Species Update*. 18: 138-141.

- Khan, A.A., Khan, R., Ullah, A., Shah, M.A., Mahmood, J.A. & Sheikh, K.M. 1996. The Conservation Perspectives of Imperial Eagle *Aquila helica* and Steppe Eagle *Aquila nipalensis* in Pakistan. Eagle Studies B.-U.Meyburg & R.D. Chancellor (eds.) WWGBP Berlin. 459- 461pp.
- Khan, A.A., Sheikh, K.M. and Right, G. 1996. A Perspective of Community Based Management at Zangi Nawar Lake, Balochistan, Pakistan. Blackwell Science Australia. Lakes & Reservoirs: Research and Management 1996. 2 (3-4), 153-155.
- Khan, A.A., Wright, G. and Sheikh, K.M. 1999. Socio-economic Constraints, Women and Wetland Resources of Pakistan. Pakistan Journal of Ornithology 3 (1-2): 13-17
- Khan, B., A. Abdukadir, R. Qureshi and G. Mustafa. 2011. Medicinal uses of plants by the inhabitants of Khunjerab National Park, Gilgit, Pakistan. Pakistan Journal of Botany, 43(5): 2301-2310.
- Khan, M.S., 2006. *Amphibians and reptiles of Pakistan*. Krieger Publishing Company, Malabar, Florida. pp.311.
- Khan, S. W. and S. Khatoon. 2004. Ethnobotanical studies in Haramosh and Bugrote Valleys (Gilgit). Int. J. Biotech., 1(4): 584-589.
- Lanszki, J., Koermendi, S., Hancz, C., and Martin, T. G. 2001. Examination of some factors effecting selection of fish prey by Otter living by eutrophic fish pond. J. Zool. 25:97-103.
- Lee, D et al. 2004. The Global Action Plan for the Conservation and Management of White-headed Duck (Wetlands International, CITES and Wetlands and Waterfowl Trust (WWT) UK)
- Mahmood-ul-Hassan, M; Javid, A; Nadeem, M. S; and Ashraf, S. 2012. An extralimital record of the Egyptian tomb bat *Taphozous perforatus* from Pakistan. *Mammalia*, 76(2):227-229.
- Mason, C. F., and Macdonald, S. M. 1986. Otters ecology and conservation. Cambridge University Press, Cambridge.
- McNeely, J., Sheikh, K. and A.T. Smith. 2009. Conservation Biology in Asia: Major Policy Issues. *Conservation Biology* 23(4): 805-810
- Mehmet Somunc, Ashfaq Ahmad Khan, and Liaqat Ali Waseem 2010. Review of
- Mirza, Z. B. 2007. *A Field Guide to Birds of Pakistan*. WWF-Pakistan.
- Myers, N. (1986). Conservation of Africa's cats: problems and opportunities. In Cats of the world: 437–457. Miller, S.D. & Everett, D.D. (Eds). Washington, DC: National Wildlife federation.
- Nadeem, M. S; Imran, S. M. K; Mahmood, T; Kayani, A. R; and Shah, S. I. 2012. A Comparative Study of the Diets of Barn Owl (*Tyto alba*) and Spotted Owlet (*Athene brama*) Inhabiting Ahmadpur East, Southern Punjab, Pakistan. *Animal Biology*, 62(1): 13-28.
- Nadeem, M. S; Naz, R; Shah, S. I; Beg, M. A; Kayani, A. R; Mushtaq, M; and Mahmood, T. 2012. Season and locality related changes in the diet of Asiatic jackal (*Canis aureus*) in Potohar, Pakistan. *Turkish Journal of Zoology*, accepted.
- Nasir, E. and Ali, S.I. (Eds.), 1970-1989. *Flora of Pakistan (fascicles series 1-190)*. Islamabad, Karachi.
- Nawaz R., and Sutton, R. 2000. Annotated checklist of bird in Kuz and Bar Palas.Himalayabn Jungle Project (WWF), Hse# 403 - A, St 3, Jinnahabad, Abbottabad, NWFP Pakistan

- Nazar, R., S. Begum, A. Naz, R. Qureshi, R.A. Memon, A.K. Chaudhry and Z. Akram. 2009. Weed flora of Pir Mehr Ali Shah Arid Agriculture University Rawalpindi: Winter Aspect. *Pak. J. Weed Sci. Res.*, 14(1-2): 55-72.
- Nowell, K., Jackson, P. 1996. Wild cats: a status survey and conservation action plan. IUCN, Gland, Switzerland.
- Pandit, M. K. and Grumbine, R. E. (2012), Potential Effects of Ongoing and Proposed Hydropower Development on Terrestrial Biological Diversity in the Indian Himalaya. *Conservation Biology*. doi: 10.1111/j.1523-1739.2012.01918.x
- PEPA. 2000. Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 . Pakistan Environmental Protection Agency.
- Prenda, J., Lopex, N. P., and Bravo, R. 2001. Conservation of otter in Mediterranean area: the importance of habitat quality and temporal variations in water availability. *Aqua. Conserv. Mar. Freshw. Ecosyst.* 11: 343-355.
- Protected Areas System in Pakistan: Present Status and Problems Concerning
- Qureshi, R. 2002. Ethnobotany of Rohri Hills, Sindh, Pakistan. *Hamdard Medicus*, 45(3): 86-94.
- Qureshi, R. 2004. Floristic and Ethnobotanical Study of Desert Nara Region, Sindh. Department of Botany, Shah Abdul Latif University, Khairpur, Sindh, Pakistan. Ph.D. Dissertation, Vol. II.
- Qureshi, R. 2012. Medicinal flora of Hingol National Park, Baluchistan, Pakistan. *Pak.J.Bot.*, 44(2): 725-732
- Qureshi, R. 2012. Medicinal flora of Hingol National Park, Baluchistan, Pakistan. *Pakistan Journal of Botany*, 44 (2): 271-275.
- Qureshi, R. and G.R. Bhatti. 2007. Nara Desert, Sindh, Pakistan: Part III: Range Types and Their Plant Resources. *Rangelands*, 29 (1): 26-29.
- Qureshi, R. and G.R. Bhatti. 2008. Diversity of micro-habitat and its plant resources. *Pakistan Journal of Botany*, 40(3): 979-992.
- Qureshi, R. and G.R. Bhatti. 2008. Ethnobotany of plants used by the Thari people of Nara Desert, Pakistan. *Fitoterapia* 79: 468–473
- Qureshi, R. and G.R. Bhatti. 2009. Folklore uses Amaranthaceae family of Nara Desert, Sindh, Pakistan. *Pakistan Journal of Botany*. 41(4): 1565-1572.
- Qureshi, R. M. Maqsood, M. Arshad and A.K. Chaudhry. 2011. Ethnomedicinal uses of plants by the people of Kadhi areas of Khushab, Punjab, Pakistan. *Pakistan Journal of Botany* 43(1): 121-133
- Qureshi, R., A. Waheed, M. Arshad and Tallat Umbreen. 2009. Medico-Ethnobotany of Tehsil Chakwal. *Pakistan Journal of Botany* 41(2): 529-538
- Qureshi, R., G.R. Bhatti and R.A. Memon. 2010. Ethnomedicinal uses of herbs from Nara Desert, Pakistan. *Pakistan Journal of Botany* 42(2): 839-851.
- Rahim, G., R. Qureshi, M. Gulfraz, M. Arshad and S. Rahim. 2012. Preliminary phytochemical screening and ethnomedicinal uses of *Teucrium stocksianum* from Malakand Division. *Journal of Medicinal Plants Research*, 6(5): 704-707.
- Rankiaer, C. 1934. *Life form of Plants and Statistical Plant Geography*. Clarendon press, Oxford.
- Rauf, F., R. Qureshi and H. Shaeen. 2012. Folk medicinal uses of indigenous plant species of Barroha, Bhara Kahu and Maanga in Islamabad, Pakistan. *Journal of Medicinal Plants Research*, 6(11): 2061-2070.
- Roberts, T. J. 1997. *The mammals of Pakistan*. Oxford University Press, Karachi. 361 p.
- Roberts, T. J., 1991. *Birds of Pakistan* Vol. I Oxford University Press, Karachi.
- Roberts, T. J., 1992. *Birds of Pakistan* Vol. II Oxford University Press, Karachi.

- Ruiz, O. J., Olmo, V. J., Manas, M., and Batet, A. 2002. The influences of resource seasonality on breeding patterns of Eurasian otter in Mediterranean habitat. *Can. J. Zool.* 80:2178-2189.
- Schaller, G. B. 1971. Imperilled phantom of Asian peaks. *National Geographic.* 140 (5): 702–707.
- Schaller, G. B. 1976. Mountain Mammals in Pakistan. *Oryx* 13 (4): 351–356.
- Shahbaz, B., Tanvir, Ali and A.Q. Suleri 2006. A critical analysis of Forest Policies of Pakistan: Implications for Sustainable Livelihoods. *Mitigation and Adaptation Strategies for Global Change* (2006).
- Shaheen, H., R. Qureshi, A. Akram and M. Gulfraz. 2012. Some important medicinal flora of Noorpur Thal, Khushab, Pakistan. *Archives Des Sciences*, 65(2): 57-73.
- Sheikh, K and Anwar, M. 2001. The BAP Process in Pakistan – action on behalf of Biodiversity. Country & Regional Round –Up. IUCN The world Conservation Union- Asia, Colombo, 12-13 pp.
- Sheikh, K et al. 2002. Use, Exploitation and Prospects for Conservation: People and Plant Biodiversity of Naltar Valley, NW-Karakorums, Pakistan. *Biodiversity & Conservation* 11(4): 715-742 Kluwer Academic Publishers, Netherlands.
- Sheikh, K. 1998. Lakes of the World-Rangla Wetland Complex-Pakistan. International Lake Environment Committee Foundation 1091 Oroshimo-Cho, Kusatsu-city, Shiga 525-0001, Japan *ILEC-Newsletter* No. 32 July. Page 7
- Sheikh, K. 1999. Habitat and Breeding Ecology of Himalayan Laughing Thrush *Garrulax lineatus* in the North-western Karakorums. *Pakistan Journal of Ornithology* 2: 34-42
- Sheikh, K. 1999. Sighting of Ferruginous Duck *Aythya nyroca* in Northern Pakistan. *WWT Bulletin*, UK.
- Sheikh, K. 2000. Ecological Studies of Avifauna in the Naltar valley Northern Pakistan with a Conservation Perspective. Ph.D. Thesis
- Sheikh, K. 2000. Some findings on the IUCN-Red data Book Avian Species from Naltar valley, Northern Pakistan. *Pakistan Journal of Ornithology.* 3: 21-26 pp
- Sheikh, K. 2003. Challenges of a Sustainable Tourism based Economy in the Naltar valley, Northwestern Karakorums, Pakistan. *Proceedings of the International Conference on 'Sustainable Mountain Communities' the Banff Centre, Banff National Park, Alberta, June 14-18th 2003, 218-224 pp.*
- Sheikh, K. 2003. Potential, Problems and Prospects of Sustainable Nature-based Tourism in the Eastern Murree Hills, Pakistan. *Proceedings of the International Conference on 'Sustainable Mountain Communities' the Banff Centre, Alberta, June 14-18th 2003, Canada.*
- Sheikh, K. 2003. Wildlife Conservation Perspectives in a Karakorum Landscape: Experiences from Naltar Valley, Northern Pakistan. International Symposium on the Biodiversity of GB of Pakistan. held September 8-9th 2003 in Islamabad. Higher Education Commission, QAU Islamabad and University of Bonn, Germany.
- Sheikh, K. 2005. 'IUCN & Freshwater Biodiversity Conservation (Assessments, Research and Management)'. *Proceedings of the Fisheries and Freshwater Biodiversity Symposium.* University of Veterinary & Animal Sciences, Lahore, Pakistan. 43-47 pp.
- Sheikh, K. 2006. Problems and prospects of community-based Conservation in the North-western Karakorums, Pakistan. Intl. symposium of Society and Natural resources, Vancouver, Canada.

- Sheikh, K. And Ahmad, T. 1998. Gene Pools under Rigorous Strain: Need for a Wetland conservation Strategy, Experiences from Punjab Pakistan. *Proceedings of the 8th Intl. Conf. on the Conservation and Management of Lakes*, May 1-3 Copenhagen, Denmark
- Sheikh, K. and Elzen, R.v.d. 2003. Raptors in North-western Karakorums: Sightings and Notes from Naltar Valley, Northern Pakistan. Proceedings of the 3rd Asian Raptor Symposium 'Asian Raptors Today', October 2003 in Taiwan.
- Sheikh, K. and Kashif, N. 2006. Strategic Role of Pakistan Wetlands Resources: Need for a Migratory Waterbird Conservation Network. Proc. of Global flyway Conf., 3-8 April 2004, Edinburgh, UK
- Sheikh, K. and Usman, I. 2002. Developing Guidelines for Provincial Biodiversity Action Plans (PBAPs) in NWFP, Pakistan. Global Lessons on Integrating Economics into Biodiversity & Conservation. A Case Study for Regional Biodiversity Program, and Regional Environ. Economics Program, IUCN-Asia 64 pp.
- Sheikh, K. M. 2004. Proceedings of the National Consultation: Protected Areas Management Effectiveness in Pakistan. IUCN-Pakistan Program. 61 pp.
- Sheikh, K. M. and Freeman, M.M.R. 2006. Conservation Hunting, Sustainable Development and Community Values in the Canadian Arctic. Proceedings of the IUCN-SUSG and Zool. Society of London Symposium on Recreational Hunting – 12-13th October 2006, London UK.
- Sheikh, K., Ahmad, T. and Khan, A. A. 1996. Some Notes on Avifauna of Mangla Reservoir, AJK, Pakistan. Pak. Jour. of Ornithology, 1(1) 31-37
- Sheikh, K., Ahmad, T. and Mirza, Z.B. and Elzen, R. v. d. 2000. Birdlife of Naltar Valley, North- Western Karakorums: New Trends in Mountain Research. Submitted for 17th Pakistan Congress of Zoology.
- Sheikh, K., Ahmad, T., Elzen, R.v.d., and Mirza, Z.B. 1998. Conservation Aspects from Northern Pakistan: Wetland Birds of Naltar valley. *Proceedings of the 8th Intl. Conference on the Conservation and Management of Lakes*, May 1-3 Copenhagen, Denmark
- Sheikh, K., Mahmood, J.A. and Nadeem, M.S. 1997. Conservation: A Must? To Safeguard the Biodiversity of Rangla Wetland Complex. In. Biodiversity of Pakistan. Mufti, S.A., Woods, C.A. and Hasan S.A.(eds.) Pakistan Museum of Natural History and Florida Natural History Museum. 127-132 pp.
- Sheikh, K.M. & Khan, A. A. 1996. Wise Use: A Traditional Approach to Utilize the Resources of Rangla Wetland Complex. Pak. Journal of Ornithology 2(1-2): 62-75
- Sheikh, K.M. 1994. Gamaghar Jheel Going, Going Gone Almost. Vol 1. 29 pp. June 1994 *The Way Ahead*. IUCN-Pakistan's Environment and Development Quarterly.
- Sheikh, K.M. 2004. IUCN-P, Protected Areas Systems in Pakistan and Steps for Future. IUCN- Pakistan Program 84 pp.
- Sheikh, K.M. 2006. Involving Religious Leaders in Conservation Education in the Western Karakorum, Pakistan. Mountain Research and Development 26 (4) 319-322
- Sheikh, K.M. 2006. The Status and Conservation of Bears in Pakistan. Chapter 1 In Understanding Asian Bears to Secure their Future. Japan Bear Network (compiler) Ibaraki, Japan. 1-6 pp. <http://www14.big.or.jp/~santilli/pdf/chapter1.pdf>
- Sheikh, K.M. and Kashif, N. 2008. Strategic Use of Pakistan's Wetland Resources: Need for a Migratory Bird Conservation Network. Proceedings of the Global Flyway conference. Edinburgh, UK

- Sheikh, K.M. and Molur, S. R.V. 2005. (Editors) Status and Red List of Pakistan Mammals. 312pp. IUCN Pakistan Program
- Sherazi, S.H. and Sheikh, K.M. 1994. Kharal Lake: A Need for Conservation Efforts, *Natura*, WWF Pakistan Vol. 20, Issue 2, 18-20 pp.
- Shinwari, S., R. Qureshi and E. Baydoun. 2011. Ethnobotanical study of Kohat Pass (Pakistan). *Pakistan Journal of Botany*, 43(Special Issue): 135-139.
- Skinner, J., Niassé, M. and Haas, L. (eds.) 2009. Sharing the benefits of large dams in West Africa. *Natural Resource Issues* No. 19. International Institute for Environment and Development, London, UK.
- Trippensee, R. E. 1953. *Wildlife management, fur bearers waterfowl and fish*. Vol. II. McGraw-Hill, Toronto, London.
- Virk, A.T., Sheikh, K. M. and Marwat, A.H. 2003. Biodiversity- Northern Areas Strategy for Sustainable Development (NASSD). GB Government. & IUCN-P Program. 34 pp.
- William, J. and Sutherland 1996. *Ecological Census techniques*, A Handbook. Cambridge University Press.
- Woodcock, M. W., 1980. *Collins hand guide to the birds of the Indian Sub-Continent*. William Collins Sons & Co. Limited. London.
- World Health Organization, WHO. (2005) *Ecosystems and human well-being: health synthesis*. A Report of the Millennium Ecosystem Assessment. Available at <http://www.who.int/globalchange/ecosystems/ecosys.pdf>.

Web Resources:

- <http://pakistanwetlands.org/webpages/migratory%20bird.html>
- https://www.geology.ucdavis.edu/~shlemonc/.../Smith_mammals.pdf
- unpan1.un.org/intradoc/groups/public/.../apcity/unpan004690.pdf National Forest Policy of Pakistan 2001.
- <http://www.khyberpakhtunkhwa.gov.pk/Departments/Forestry/index.php> KPK Forest Department
- http://en.wikipedia.org/wiki/File:Central_Asian_Flyway_Map.gif
- <http://www.wwfpak.org/gcic/Pages/HAW.html> High Altitude Wetlands
- <http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/286583.html> Forest Management Planning in Ontario
- <http://www.unep.org/dams/documents/Default.asp?DocumentID=664>

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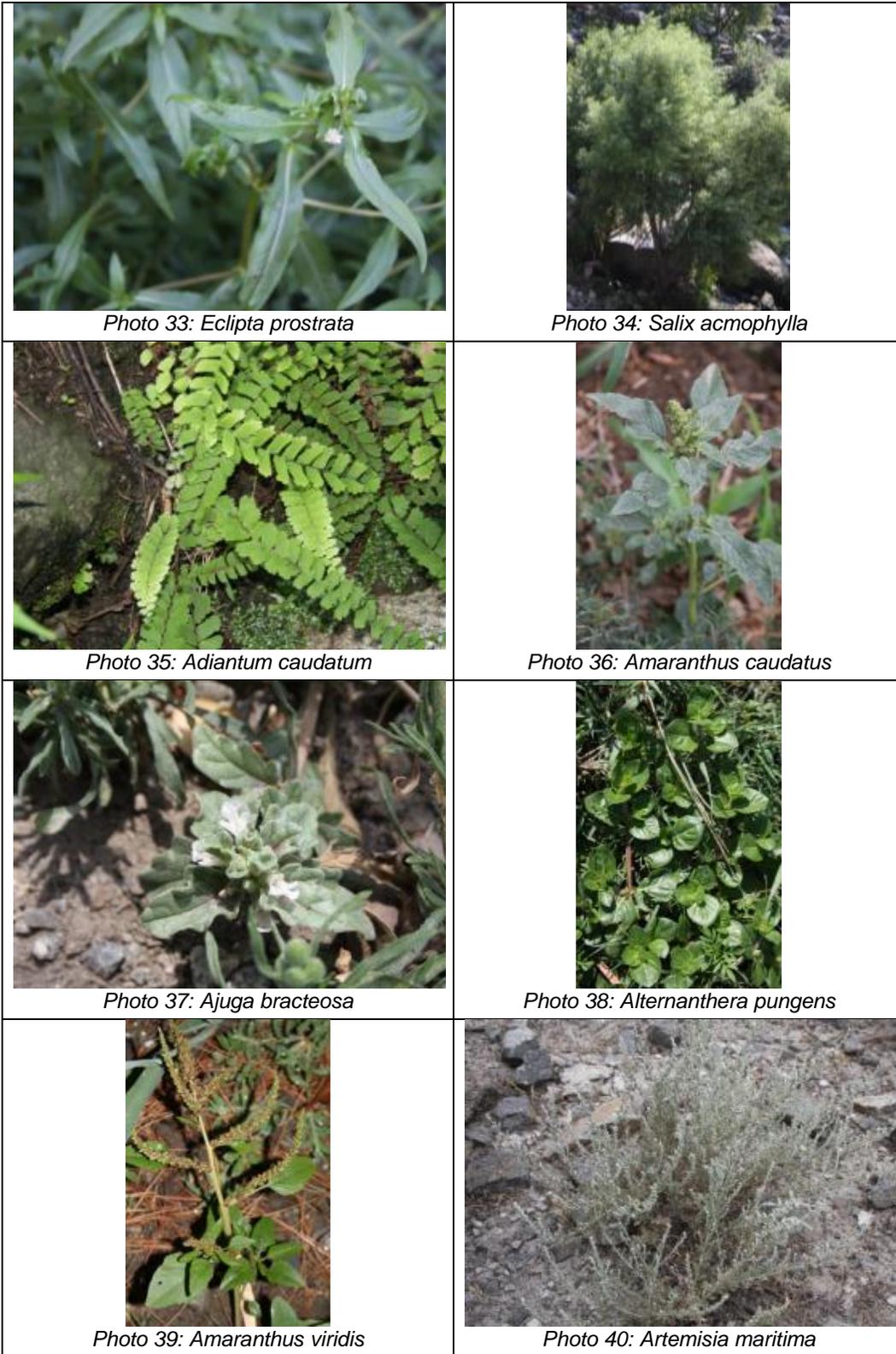




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Appendix – 1.1

LIST OF INSTITUTIONS / INDIVIDUALS CONTACTED FOR TERRESTRIAL ECOLOGY ASSESSMENTS¹

Institution/ Affiliation/ Agency	Name/ Professional/ Contact Person
Pakistan Museum of Natural History (PMNH), Islamabad	Mr. Muhammad Asif
Pakistan Museum of Natural History (PMNH), Islamabad	Mr. Muhammad Shabbir
Pakistan Museum of Natural History (PMNH), Islamabad	Dr. M.K. Laghari, Director Botanical Division
Pakistan Museum of Natural History (PMNH), Islamabad	Dr. Saleem Ahmad, Curator
Pakistan Forest Institute (PFI), Peshawar	Mr. Mian Shafiqe
KPK Wildlife Department, Peshawar	Mr. Niaz Ahmed
Divisional Forest Officer (DFO), Abbottabad	Mr. Arif Orakzai
NCCW, Ministry of Climate Change, Islamabad	Mr. Hafez Ahmad
Center for Environmental Research and Conservation (CERC), Islamabad	Prof. Z. B. Mirza
Divisional Forest Officer (DFO), Kohistan (Pattan)	Mr. Abdul Ghafoor
Forest Department Dasu	Mr. Fazal Aleem, Range Office,
Forestry and Range Management Department, AAU, Rawalpindi	Dr. Abdul Khaliq
WWF-Pakistan	Mr. Najimul Huda
EPA-Islamabad	Mr. Afzal Naseem
Pakistan Wildlife Foundation, Islamabad	Mr. Waseem Ahmad Khan
Wildlife Management Department, AAU, Rawalpindi	Dr. Maqsood Anwar
Punjab Fisheries Department, Islamabad	Mr. Iftikhar Ahmad
Fisheries Department, NARC	Dr. Abdul Rub
Zoology, Department, Punjab University, Lahore	Dr. Zulfiqar Ali
BRC, Islamabad	Prof. Dr. Afsar Mian
IUCN-Pakistan	Mr. Mahmood A. Cheema, Director IUCN Islamabad Office
WWF-Pakistan	Mr. Ali H. Habib, Director General, WWF Pakistan
Ministry of Climate Change, Islamabad	Mr. Mahmood Nasir, Inspector General of Forests, Pakistan
NCCW, Ministry of Climate Change, Islamabad	Mr. Umeed Khalid, Conservator of Wildlife

¹ The individuals and or institutions were contacted to acquire any secondary data available and or if they may have any major observations or suggestions applicable to DHP.

Appendix – 1.2

LOCAL COMMUNITIES CONSULTED DURING TERRESTRIAL ECOLOGY SURVEYS

Sr. No.	Name	Profession	Village	Remarks
1	Nabiullah	Student	Barseen Nullah	25.7.12
2	Gulzar Ahmed	Farmer	Chuchang	Group Discussion 26.7.12
3	Muhammad Wakeel	-Do-	Chuchang	
4	Hizbur Rehman	-Do-	Chuchang	
5	Muhammad Ilyas	-Do-	Chuchang	
6	Afreen Saral Khel	-Do-	Thooti	3.9.12
7	Shamzan Sarakhel	-Do-	Malyar	26.7.12
8	Sher Afzal	Game watcher	Kaiga	26.7.12
9	Javed Iqbal	nothing	Kotgal	5.8.12
10	Shehzad Amir,	Shepherd	Chuchang	5.8.12
11	Bashir Ahmad	Farmer	Harbin	1.9.12
12	Haroon Ahmad	Shopkeeper	Shori Nullah	1.9.12
13	Rahim Dil	Farmer	Shatial	1.9.12
14	Anjeel Khan	Hunter	Laachi	Group Discussion 4.9.12
15	Ejaz Ahmad, Laachi	Farmer/hunter	Laachi	
16	Hikmat Khan, Laachi	Farmer/hunter	Laachi	
17	Raffaqt Khan	Farmer	Laachi	
18	Yousaf Saral Khail	-do-	Thooti	3.9.12
19	Malik Noshier,	Shepherd	Tangir	1.9.12
20	Faqeer Muhammad	Nothing	Barseen	5.8.12
21	Muhammad Ashrif	Hunter	Aliel	3.9.12
22	Abdul Hameed	Farmer	Aliel	Group Discussion 3.9.12
23	Muhammad Zaman	-do-	Aliel	
24	Muhammad Amin	Hunter	Aliel	
25	Sabit ullah	Student	Sazinkot	1.9.12
26	Navid Iqbal	Teacher	Sazinkot	1.9.12
27	Naqeeb Khan	Hunter	Sazinkot	1.9.12
28	Sheer Afzal	Farmer	Dasu	5.8.12
29	Noor Ahmad	Farmer	Seo	6.8.12
30	Shah Jhan	Farmer	Seglo	6.8.12
31	Abdul Rehman	Shepherd	Waliabad	26.7.12
32	Sheer Jamil	Shopkeeper	Summer Nullah	1.9.12
33	Fareed Khan	Farmer	Summer Nullah	1.9.12
34	Mir Aslam	Farmer	Panibagh	7.9.12
35	Alam Gheer	Shepherd	Razika	6.8.12
36	Sardar Khan	Farmer	Goshali	8.9.12
37	Kafyat ullah	Medical store	Komila	9.9.12
38	Sher Dad	Farmer	Razika	Group Discussion 6.8.12
39	Pirzada Haleem	Hunter	Razika	
40	Muhammad Yahya	Student	Razika	
41	Alam Gheer	Shepherd	Razika	

Appendix – 1.3

PROFORMA FOR THE INTERVIEW OF LOCAL INHABITANTS REGARDING ECONOMIC USES OF PLANT SPECIES

- Date.....
- Name/ Address of Respondent: _____
- Enumerator: _____

- Botanical Name: _____ Vernacular Name: _____
- Language: _____
- Locality: _____

- A-Medicine: _____
- Part of plant used: _____
- Method of preparation: _____
- Type of Ailment: _____
- B-Veterinary: _____
- Disease: _____
- Part of plant used: _____
- Method of preparation: _____
- C-Fodder: _____
- All parts of Plants: []
- Leaves: []
- Fruits: []
- Seeds: []
- Availability of forage: []
- D-Fuel: []
- E-Fruit []
- F-Vegetable []
- G-Timber []
- E-Any other usage/Cultural Beliefs: []

Appendix – 1.4

TERRESTRIAL (ANIMAL) ECOLOGY AND BIODIVERSITY - QUESTIONNAIRE

Date: _____ Time of interview: _____ Village/ Location: _____
 Weather: _____ : Nullah/Stream: _____ Right or Left bank: _____
 Name: _____ Occupation: _____

Which part of the Dasu has most wild animals?

What type of wild animals you have observed in the Area?

Do they live in the forests and / or wild vegetation or nearby the water, When do you observe them and in which season mostly? What was the average group size?

Do you hunt the animals? If yes which species? Do you hunt frequently/occasionally?

What is a general movement patterns of these animals?

Is the population of this animal species declining in the area or increasing? What could be reason? Hunting/habitat loss/poaching/ other?

Why you hunt? For meet/skin/medicine/sales

What types of birds are present in the area?

Have you seen any birds of prey (Shikari birds) e.g. eagles, Vultures? And have you seen them

Do you hunt the birds? Or keep them as a pet?

Are the number of birds declining?

Do you know there is going to be construction of the dam in this area? Are you happy with the construction of Dam?

Did you observed ducks/cranes in the area? If yes when? Group size? Moving direction? Which month or season you mostly see them. Can you identify them in the books that I will show you.

Do you think that Dam construction would affect the area forests, wildlife or plants of the area positively or negatively? If yes, how? Pollution?/ Fish?/Wildlife?

Would you like to share any special observation or incident about wildlife or biodiversity in this area?

Do you have any photos or sketches of the wildlife from this area?

Any other comments:

Appendix – 2.1

FLORAL BIODIVERSITY RECORDED IN DASU PROJECT AREA

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
1	<i>Abelmoschus esculentus</i> (L.) Moench.	Malvaceae	Herb	Annual	Therophyte	Bhindi	1	1
2	<i>Abies pindrow</i> Royle.	Pinaceae	Tree	Perennial	Phanerophyte	Chur	1	0
3	<i>Achyranthes aspera</i> L.	Amaranthaceae	Herb	Annual	Chamaephyte	Malkuni	1	1
4	<i>Adiantum capillus-veneris</i> L.	Adiantaceae	Herb	Perennial	Chamaephyte		1	1
5	<i>Adiantum venustum</i> D. Don	Adiantaceae	Herb	Perennial	Chamaephyte	Jathoori	1	1
6	<i>Ailanthus altissima</i> (Mill.) Swingle	Simarubaceae	Tree	Perennial	Phanerophyte	Darawa	1	1
7	<i>Ajuga bracteosa</i> Wall. ex Bth.	Lamiaceae	Herb	Annual	Therophyte		1	1
8	<i>Ajuga parviflora</i> Bth.	Lamiaceae	Herb	Annual	Therophyte		1	1
9	<i>Alnus nitida</i> Endl.	Betulaceae	Shrub	Perennial	Phanerophyte		0	1
10	<i>Alternanthera pachyacantha</i>	Aizoaceae	Herb	Perennial	Hemicryptophyte		0	1
11	<i>Alternanthera pungens</i> Kunth.	Amaranthaceae	Herb	Annual	Chamaephyte		1	0
12	<i>Amaranthus caudatus</i> L.	Amaranthaceae	Herb	Annual	Therophyte	Ghanar	1	1
13	<i>Amaranthus graecizense</i> L.	Amaranthaceae	Herb	Annual	Therophyte		1	1
14	<i>Amaranthus oleraceus</i> L.	Amaranthaceae	Herb	Annual	Therophyte	Kas ghanar	1	1
15	<i>Amaranthus viridis</i> L.	Amaranthaceae	Herb	Annual	Therophyte	Ghanar	1	1
16	<i>Anagallis arvensis</i> L.	Primulaceae	Herb	Annual	Therophyte		1	1
17	<i>Arabidopsis himalaica</i> (Edgew.) O.E.S.	Brassicaceae	Herb	Annual	Therophyte		1	1
18	<i>Aristida cyanatha</i> Nees ex Steud.	Poaceae	Grass	Perennial	Hemicryptophyte		1	1
19	<i>Artemisia maritima</i> L.	Asteraceae	Herb	Annual	Therophyte	Daroon	1	1
20	<i>Asparagus filicinus</i> Buch.-Ham. ex D. Don	Asparagaceae	Shrub	Perennial	Hemicryptophyte	Zao	1	1
21	<i>Aster aitchisonii</i> Boiss.	Asteraceae	Herb	Annual	Therophyte		1	1
22	<i>Astragalus candolleanus</i> Royle ex Benth.	Fabaceae	Shrub	Perennial	Phanerophyte	Chioo	0	1
23	<i>Atriplex lasiantha</i> Boiss.	Chenopodiaceae	Herb	Annual	Therophyte	Kiklohukbursa	0	1

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
24	<i>Barleria acanthoides</i> Vahl.	Acanthaceae	Subshrub	Perennial	Chamaephyte		0	1
25	<i>Barleria cristata</i> L.	Acanthaceae	Herbs	Perennial	Chamaephyte		0	1
26	<i>Bauhinia variegata</i> L.	Caesalpiniaceae	Tree	Perennial	Phanerophyte		0	1
27	<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	Herb	Annual	Hemicryptophyte	Korat	1	0
28	<i>Bidens biternata</i> (Lour.) Merr. & Sherff.	Asteraceae	Herb	Annual	Therophyte	Surbul	1	0
29	<i>Boerhavia procumbens</i> Banks ex Roxb.	Nyctaginaceae	Herb	Perennial	Cryptophyte		1	0
30	<i>Bothriochloa bladhii</i> (Retz.) S.T Blake	Poaceae	Grass	Perennial	Hemicryptophyte	Lhash	1	1
31	<i>Bothriochloa ischaemum</i> (L.) Keng	Poaceae	Grass	Perennial	Hemicryptophyte	Lhash	1	1
32	<i>Brachiaria distachya</i> (L.) Stapf	Poaceae	Grass	Annual	Therophyte		1	1
33	<i>Brachiaria reptans</i> (L.) Gard. & C.E. Hubb.	Poaceae	Grass	Annual	Therophyte		1	1
34	<i>Brousonetia papyrifera</i> (L.) Vent.	Moraceae	Tree	Perennial	Phanerophyte	Jangal murt	0	1
35	<i>Calamintha umbrosa</i> (M. Bieb.) Fisch. & Mey.	Lamiaceae	Herb	Annual	Therophyte	Bheroo rang	1	0
36	<i>Calotropis procera</i> (Willd.) R. Br.	Asclepiadaceae	Shrub	Perennial	Phanerophyte		0	1
37	<i>Cannabis sativa</i> L.	Cannabinaceae	Herb	Annual	Therophyte		1	1
38	<i>Capparis spinosa</i> L.	Capparidaceae	Shrub	Perennial	Hemicryptophyte	Kurr	1	1
39	<i>Capsella bursa-pastoris</i> (L.) Medik	Brassicaceae	Herb	Annual	Therophyte		1	1
40	<i>Carex chitralensis</i> Nelmes Mag.	Cyperaceae	Sedge	Annual	Hemicryptophyte	Zatch	0	1
41	<i>Carum carvi</i> L.	Apiaceae	Herb	Annual	Therophyte	Zeera	0	1
42	<i>Cedrus deodara</i> (Roxb. Ex Lamb.) G. Don	Pinaceae	tree	Perennial	Phanerophyte	Beesh	1	0
43	<i>Celtis australis</i> L.	Ulmaceae	Shrub	Perennial	Phanerophyte	Makosh	1	
44	<i>Centella asiatica</i> (L.) Urban	Apiaceae	Herb	Annual	Cryptophyte	Tikroo	1	0
45	<i>Cheilanthes farinosa</i> (Forssk.) Kaulf.	Pteridaceae	Herb	Annual	Therophyte		1	1
46	<i>Chenopodium album</i> L.	Chenopodiaceae	Herb	Annual	Therophyte	Kanwan	1	1
47	<i>Chenopodium ambrosioides</i> L.	Chenopodiaceae	Subshrub	Biennial	Hemicryptophyte	Tahoo	1	1
48	<i>Chenopodium botrys</i> L.	Chenopodiaceae	Herb	Annual	Therophyte	Kunwan	1	1
49	<i>Chenopodium cf. opulifolium</i> Schrad. ex Koch & Ziz.	Chenopodiaceae	Herb	Annual	Therophyte		1	0

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
50	<i>Chrozophora tinctoria</i> (L.) Juss.	Euphorbiaceae	Herb	Annual	Therophyte		0	1
51	<i>Chrysopogon aucheri</i> (Boiss.) Stapf	Poaceae	Grass	Perennial	Hemicryptophyte		1	1
52	<i>Cirsium falconerii</i> (Hk.f.) Petrak	Asteraceae	Herb	Annual	Therophyte	Jocho	1	0
53	<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae	Subshrub	Perennial	Hemicryptophyte		0	1
54	<i>Clematis montana</i> Buch.	Ranunculaceae	Climber	Perennial	Phanerophyte		1	1
55	<i>Clematis nepalensis</i> Royle	Ranunculaceae	Climber	Perennial	Phanerophyte		1	0
56	<i>Cleome viscosa</i> L.	Capparidaceae	Herb	Annual	Therophyte		1	1
57	<i>Commelina paludosa</i> Bl. Enum.	Commelineaceae	Herb	Annual	therophyte		0	1
58	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Climber	Perennial	Hemicryptophyte	Halor	1	1
59	<i>Conyza aegyptica</i> Ait.	Asteraceae	Herb	Annual	Therophyte		1	1
60	<i>Conyza bonariensis</i> L.	Asteraceae	Herb	Annual	Therophyte	Phuljoo	1	1
61	<i>Conyza canadensis</i> L.	Asteraceae	Herb	Annual	Therophyte	Panar tahoor	1	1
62	<i>Coronopus didymus</i> (L.) Sm.	Brassicaceae	Herb	Annual	Cryptophyte	Marchaki	1	1
63	<i>Cotinus coggygia</i> Scop.	Anacardiaceae	Tree	Perennial	Phanerophyte	Khakoh/Shini	0	1
64	<i>Cotoneaster affinis</i> var. <i>bacillaris</i> (Lindl.) Schneider	Rosaceae	Shrub	Perennial	Phanerophyte	Luni	0	1
65	<i>Cotoneaster microphylla</i> Wall. ex Lindl.	Rosaceae	Shrub	Perennial	Phanerophyte	Kiur	1	1
66	<i>Cotoneaster nummularia</i> Fisher & Meyer	Rosaceae	Shrub	Perennial	Phanerophyte	Dudul/Magosh	1	1
67	<i>Cousinia thomsonii</i> Clarke	Asteraceae	Herb	Annual	Therophyte		0	1
68	<i>Cucumis melo</i> var. <i>agrestis</i> Naud.	Cucurbitaceae	Herb	Annual	Cryptophyte		1	1
69	<i>Cucurbita maxima</i> Duch. ex Lam.	Cucurbitaceae	Climber	Annual	Cryptophyte		1	1
70	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Parasite	Annual	Therophyte	Zhoo	1	1
71	<i>Cymbopogon distans</i> (Nees) W. Wats.	Poaceae	Grass	Perennial	Hemicryptophyte	Kattal	0	1
72	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Grass	Perennial	Hemicryptophyte	Kabal	1	1
73	<i>Cynoglossum lanceolatum</i> Forssk.	Boraginaceae	Herb	Annual	Therophyte	Chiroo	1	1
74	<i>Cyperus niveus</i> Retz.	Cyperaceae	Sedge	Perennial	Hemicryptophyte		0	1
75	<i>Cyperus rotundus</i> L.	Cyperaceae	Sedge	Perennial	Hemicryptophyte		1	1

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
76	<i>Dactyloctenium aegyptium</i> L.	Poaceae	Grass	Annual	Hemicryptophyte	Sarkhoo gha	1	1
77	<i>Dalbergia sissoo</i> Roxb.	Fabaceae	Tree	Perennial	Phanerophyte		0	1
78	<i>Datura innoxia</i> Mill.	Solanaceae	Shrub	Perennial	Chamaephyte		0	1
79	<i>Datura stramonium</i> L.	Solanaceae	Shrub	Perennial	Phanerophyte		1	0
80	<i>Debregeasia salicifolia</i> (D. Don) Rendle	Urticaceae	Shrub	Perennial	Phanerophyte	Chiroo	1	1
81	<i>Dianthus crinitus</i> Sm.	Caryophyllaceae	Herb	Annual	Therophyte		1	0
82	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Poaceae	Grass	Perennial	Hemicryptophyte		1	1
83	<i>Dicliptera roxburghiana</i> Nees	Acanthaceae	Herb	Annual	Cryptophyte		1	1
84	<i>Digera muricata</i> (L.) Mart.	Amaranthaceae	Herb	Annual	Therophyte		1	1
85	<i>Digitaria sanguinalis</i> (L.) Scop.	Poaceae	Grass	Annual	Hemicryptophyte		1	1
86	<i>Diospyros lotus</i> L.	Ebenaceae	Tree	Perennial	Phanerophyte	Amlok	0	1
87	<i>Dodonaea viscosa</i> (L.) Jacq.	Sapindaceae	Shrub	Perennial	Phanerophyte	Shounth/Bajj	1	1
88	<i>Duchesnea indica</i> (Andr.) Focke	Rosaceae	Herb	Annual	Cryptophyte		1	1
89	<i>Echinochloa colona</i> (L.) Link	Poaceae	Grass	Annual	Therophyte		1	1
90	<i>Echinops cornigerus</i> DC.	Asteraceae	Herb	Annual	Therophyte	Kuro/Ziach	1	1
91	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	Herb	Annual	Therophyte		1	1
92	<i>Ephedra ciliata</i> Fisch. & Mey. ex C.A. Mey.	Ephederaceae	Shrub		Hemicryptophyte	Ragaal	0	1
93	<i>Ephedra intermedia</i> Schrenk	Ephederaceae	Shrub	Perennial	Phanerophyte	Suo	0	1
94	<i>Eragrostis aterovirens</i> (Desf.) Trin. ex Nees	Poaceae	Herb	Annual	Therophyte		1	1
95	<i>Eragrostis cilianensis</i> (All.) Vig.	Poaceae	Herb	Annual	Therophyte		1	1
96	<i>Eragrostis minor</i> Host.	Poaceae	Herb	Annual	Therophyte		1	1
97	<i>Eucalyptus lanceolatus</i>	Myrtaceae	Tree	Perennial	Phanerophyte		1	1
98	<i>Euonymus pendulus</i> Wall.	Celastraceae	Shrub	Perennial	Phanerophyte		0	1
99	<i>Euphorbia granulata</i> Forssk.	Euphorbiaceae	Herb	Annual	Therophyte		1	1
100	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Herb	Annual	Therophyte		1	1
101	<i>Euphorbia indica</i> Lam.	Euphorbiaceae	Herb	Annual	Therophyte	Ispatre	1	1
102	<i>Euphorbia kanorica</i> Boiss.	Euphorbiaceae	herb	Perennial	Hemicryptophyte		0	1

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
103	<i>Euphorbia prostrata</i> (L.) Ait	Euphorbiaceae	Herb	Perennial	Cryptophyte		1	1
104	<i>Euphrasia himalayica</i> Wettst.	Scrophulariaceae	Herb	Annual	Therophyte		1	0
105	<i>Ficus carica</i> L.	Moraceae	Tree	Perennial	Phanerophyte	Pha	1	1
106	<i>Fumaria indica</i> (Hauskn.) H.N. Pugsley	Fumariaceae	Herb	Annual	Therophyte		1	1
107	<i>Gallium aparine</i> L.	Rubiaceae	Herb	Annual	Therophyte		1	1
108	<i>Gentiana capitata</i> Ham. ex D. Don	Gentianaceae	Herb	Annual	Therophyte	Salaloo	0	1
109	<i>Geranium rotundifolium</i> L.	Geraniaceae	Herb	Annual	Therophyte		1	1
110	<i>Geranium willichianum</i> D. Don	Geraniaceae	Herb	Annual	Therophyte	Ratajot	1	1
111	<i>Grewia optiva</i> Drum. ex Burret.	Tiliaceae	Tree	Perennial	Phanerophyte		1	1
112	<i>Heliotropium europaeum</i> L.	Boraginaceae	Herb	Annual	Therophyte		1	1
113	<i>Heliotropium</i> spp.	Boraginaceae	Herb	Annual	Therophyte	Dodosulo	1	1
114	<i>Heteropogon contortus</i> (L.) P. Beauv.	Poaceae	Grass	Perennial	Hemicryptophyte		0	1
115	<i>Impatiens edgeworthii</i> Hook.f.	Scrophulariaceae	Herb	Annual	Cryptophyte		1	1
116	<i>Indigofera heterantha</i> Wall. Ex Brand	Fabaceae	Shrub	Perennial	Phanerophyte	Kachhi	1	0
117	<i>Juglans regia</i> L.	Juglandaceae	Tree	Perennial	Phanerophyte	chhoe	1	1
118	<i>Juncus</i> spp.	Juncaceae	Herb	Perennial	Hemicryptophyte		1	1
119	<i>Kickxia ramosissima</i> (Wall.) Janchen	Scrophulariaceae	Herb	Annual	Therophyte		1	1
120	<i>Lactuca auriculata</i> (Wall. ex Dc.)	Asteraceae	Herb	Annual	Therophyte		1	1
121	<i>Lactuca dissecta</i> D. Don.	Asteraceae	Herb	Annual	Therophyte		1	1
122	<i>Lactuca serriola</i> L.	Asteraceae	Herb	Annual	Therophyte	Harool	1	1
123	<i>Lagenaria siceraria</i> (Molina) Standley	Cucurbitaceae	Climber	Annual	Cryptophyte		1	1
124	<i>Launaea procumbens</i> (Roxb.) Ram. & Rajgo.	Asteraceae	Herb	Annual	Chamaephyte		1	1
125	<i>Lepidium pinnatifidum</i> Ledeb.	Brassicaceae	Herb	Annual	Therophyte	Makoch	1	1
126	<i>Lespedeza elegans</i> Cambess.	Fabaceae	Herb	Annual	Cryptophyte		1	1
127	<i>Leucaena leucocephala</i> (Lam.) de-Wit	Mimosaceae	Tree	Perennial	Phanerophyte		0	1
128	<i>Luffa cylindrica</i> (L.) Roem.	Cucurbitaceae	Climber	Annual	Cryptophyte		1	1
129	<i>Malva neglecta</i> Waller.	Malvaceae	Herb	Annual	Therophyte	Shani	1	1

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
130	<i>Malva parviflora</i> L.	Malvaceae	Herb	Annual	Therophyte	Zarooshal/Masha	1	0
131	<i>Malvastrum coromendelianum</i> L.	Malvaceae	Herb	Perennial	Cryptophyte		1	1
132	<i>Maytenus royleanus</i> (Wall. ex Lawson) Cufodontis	Celastraceae	Shrub	Perennial	Phanerophyte	Phaikar	1	1
133	<i>Medicago lupulina</i> L.	Fabaceae	Herb	Annual	Therophyte		1	1
134	<i>Melia azedarach</i> L.	Meliaceae	Tree	Perennial	Phanerophyte		1	1
135	<i>Mentha longifolia</i> (L.) Huds.	Lamiaceae	Herb	Perennial	Hemicryptophyte	Feeru	1	1
136	<i>Micromeria biflora</i> (Ham.) Bth.	Lamiaceae	Herb	Perennial	Hemicryptophyte	Kaldajar	1	1
137	<i>Morus alba</i> L.	Moraceae	Tree	Perennial	Phanerophyte	Marath	1	1
138	<i>Morus nigra</i> L.	Moraceae	Tree	Perennial	Phanerophyte		1	1
139	<i>Myrtus communis</i> L.	Myrtaceae	Shrub	Perennial	Phanerophyte	Amboo/Lachi	1	1
140	<i>Nasturtium officinale</i> R. Br.	Brassicaceae	Herb	Biennial	Hemicryptophyte	Zalzaal	1	1
141	<i>Nerium oleander</i> L.	Apocynaceae	Shrub	Perennial	Phanerophyte		1	1
142	<i>Olea ferruginea</i> Royle	Oleaceae	Tree	Perennial	Phanerophyte		1	1
143	<i>Onopordum acanthium</i> L.	Asteraceae	Herb	Annual	Therophyte	Zehech	1	0
144	<i>Otostegia limbata</i> (Benth.) Boiss.	Lamiaceae	Shrub	Perennial	Phanerophyte		0	1
145	<i>Oxalis corniculata</i> L.	Oxalidaceae	Herb	Perennial	Hemicryptophyte	Chukoo	1	1
146	<i>Parthenium hytserophorus</i> L.	Asteraceae	Herb	annual	Therophyte		1	1
147	<i>Paspalidium flavidum</i> (Retz.) A. Camus	Poaceae	Grass	Perennial	Hemicryptophyte		1	1
148	<i>Paspalum paspalodes</i> (Michx.) Scribner	Poaceae	Grass	Annual	Therophyte		1	1
149	<i>Pennesitum orientale</i> L.	Poaceae	Grass	Perennial	Hemicryptophyte		1	1
150	<i>Periploca aphylla</i> Decne.	Asclepiadaceae	Shrub	Perennial	Phanerophyte	Sui	0	1
151	<i>Persicaria barbata</i> (L.) Hara	Polygonaceae	Herb	Perennial	Cryptophyte	Danduni	1	1
152	<i>Phalaris minor</i> Retz.	Poaceae	Grass	Annual	Therophyte		1	1
153	<i>Phragmites australis</i> (Cav.) Trin.ex Steud.	Poaceae	Shrub	Perennial	Hemicryptophyte	Nai	1	1
154	<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae	Herb	Biennial	Phanerophyte		0	1
155	<i>Physalis peruviana</i> L.	Solanaceae	Herb	Annual	Therophyte	Manakach	1	1

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
156	<i>Pinus gerardiana</i> Wall. non Lamb.	Pinaceae	Tree	Perennial	Phanerophyte	Thulesh	1	1
157	<i>Pinus roxburghii</i> Sargent	Pinaceae	Tree	Perennial	Phanerophyte	Chugi	1	0
158	<i>Pinus wallichiana</i> A.B. Jackson	Pinaceae	Tree	Perennial	Phanerophyte	Chhar	1	0
159	<i>Pistacia chinensis</i> Bunge	Anacardiaceae	Tree	Perennial	Phanerophyte	Kangar	1	1
160	<i>Plantago aitchisonii</i> Pilger	Plantaginaceae	Herb	Annual	Therophyte	Shileet	1	1
161	<i>Plantago lanceolata</i> L.	Plantaginaceae	Herb	Annual	Therophyte	Shileet	1	1
162	<i>Plantago ovata</i> Frossk.	Plantaginaceae	Herb	Annual	Therophyte	Shileet	1	1
163	<i>Plectranthus rugosus</i> Wall. ex Bth.	Lamiaceae	Herb	Annual	Therophyte	Salal	1	1
164	<i>Poa annua</i> L.	Poaceae	Herb	Annual	Therophyte		1	1
165	<i>Polygonum affine</i> D. Don	Polygonaceae	Herb	Annual	Hemicryptophyte	Banke	1	1
166	<i>Polygonum effusum</i> Meirsn.	Polygonaceae	Herb	Annual	Hemicryptophyte	Banke	1	1
167	<i>Bistorta capitata</i>	Polygonaceae	Herb	Annual	Hemicryptophyte	Mana kash	1	0
168	<i>Polypogon fugax</i> Nees ex Steud.	Poaceae	Herb	Annual	Therophyte		1	1
169	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae	Herb	Annual	Therophyte		1	1
170	<i>Populus deltoides</i> Bartram ex Marsh.	Salicaceae	Tree	Perennial	Phanerophyte	Sufaida	1	1
171	<i>Portulaca oleracea</i> L.	Portulacaceae	Herb	Annual	Therophyte	Pishil	1	1
172	<i>Prunus amygdalus</i> Batsch	Rosaceae	Tree	Perennial	Phanerophyte		1	0
173	<i>Prunus armeniaca</i> L.	Rosaceae	Tree	Perennial	Phanerophyte	Ashae	1	1
174	<i>Prunus domestica</i> L.	Rosaceae	Tree	Perennial	Phanerophyte	Aroo	1	0
175	<i>Pteridium aquilinum</i> (L.) Kuhn.	Pteridaceae	Herb	Perennial	Hemicryptophyte		1	1
176	<i>Pteris crerica</i> L.	Pteridaceae	Herb	Perennial	Hemicryptophyte	Kuenz	0	1
177	<i>Pteris vittata</i> L.	Pteridaceae	Herb	Perennial	Hemicryptophyte	Kuenz	0	1
178	<i>Punica granatum</i> L.	Punicaceae	Shrub	Perennial	Phanerophyte	Dangoo	1	1
179	<i>Pyrus communis</i> L.	Rosaceae	Tree	Perennial	Phanerophyte	Taango	1	0
180	<i>Pyrus mallus</i> L.	Rosaceae	Tree	Perennial	Phanerophyte	Bhaap	1	0
181	<i>Quercus baloot</i> Griffith	Fagaceae	Tree	Perennial	Phanerophyte	Bani/Jaand	1	1
182	<i>Quercus dilatata</i> Lindl. ex Royle	Fagaceae	Tree	Perennial	Phanerophyte	Kagani/Zharyun	1	0

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
183	<i>Ranunculus scleratus</i> L.	Ranunculaceae	Herb	Annual	Therophyte		1	1
184	<i>Rhus mysurensis</i> Heyne ex Wight & Arn.	Anacardiaceae	Tree	Perennial	Phanerophyte	Kasudur	1	1
185	<i>Ribes alpestre</i> Dcne. ex Jacq.	Rosaceae	Shrub	Perennial	Phanerophyte	Shigay	1	1
186	<i>Ricinis communis</i> L.	Euphorbiaceae	Shrub	Perennial	Phanerophyte		1	1
187	<i>Robinia pseudoacacia</i> L.	Fabaceae	Tree	Perennial	Phanerophyte		0	1
188	<i>Rubus ellipticus</i> Smith	Rubiaceae	shrub	Perennial	Phanerophyte	Gorash	1	1
189	<i>Rumex dentatus</i> L.	Polygonaceae	Herb	Perennial	Chamaephyte		0	1
190	<i>Rumex hastatus</i> D. Don	Polygonaceae	Subshrub	Perennial	Phanerophyte		1	1
191	<i>Rumex nepalensis</i> Spreng	Polygonaceae	Herb	Perennial	Chamaephyte	Hababil	1	0
192	<i>Saccharum ravennae</i> (L.) Murray	Poaceae	Grass	Perennial	Hemicryptophyte	Swar phuroo	1	1
193	<i>Salix acmophylla</i> Boiss.	Salicaceae	Tree	Perennial	Phanerophyte	Chhubi	1	1
194	<i>Salvia moorcroftiana</i> Wall. ex Bth.	Lamiaceae	Herb	Annual	Cryptophyte		1	1
195	<i>Saussurea albescens</i> (DC.) Schr. Bip.	Asteraceae	Herb	Annual	Therophyte		1	1
196	<i>Saussurea atkinsonii</i> Clarke	Asteraceae	Herb	Annual	Therophyte		1	1
197	<i>Saussurea heteromalla</i> DC.	Asteraceae	Herb	Annual	Therophyte		1	1
198	<i>Scorzonera virgata</i> DC.	Asteraceae	Herb	Annual	Therophyte		1	1
199	<i>Setaria glauca</i> (L.) P. Beauv	Poaceae	Grass	Annual	Therophyte		1	1
200	<i>Setaria viridis</i> (L.) P. Beauv.	Poaceae	Grass	Annual	Therophyte	Pashtili	1	1
201	<i>Silene conoidea</i> L.	Caryophyllaceae	Herb	Annual	Therophyte		1	1
202	<i>Solanum nigrum</i> L.	Solanaceae	Herb	annual	Therophyte		0	1
203	<i>Solanum surattense</i> Burm.f.	Solanaceae	Herb	Perennial	Phanerophyte	Shuroo gae/mano gae	1	1
204	<i>Solanum villosum</i> (L.) Moench	Solanaceae	Herb	Annual	Therophyte		1	1
205	<i>Sonchus arvensis</i> f. brachyotus (DC.) Kirp.	Asteraceae	Herb	Annual	Therophyte		1	1
206	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	Herb	Annual	Therophyte		1	1
207	<i>Sonchus oleraceus</i> L.	Asteraceae	Herb	Annual	Therophyte	Chuloor	1	0
208	<i>Sorghum halepense</i> (L.) Bern.	Poaceae	Herb	Perennial	Therophyte		1	0

No.	Plant Species	Family	Habit	Life span	Life form	Local name	RT bank	LT bank
209	<i>Stellaria media</i> (L.) Cyr.	Caryophyllaceae	Herb	Annual	Therophyte		1	1
210	<i>Tagetes minuta</i> L.	Asteraceae	Herb	Annual	Therophyte		1	0
211	<i>Tamarix aphylla</i> (L.) Karst.	Tamaricaceae	Tree	Perennial	Phanerophyte		0	1
212	<i>Taraxacum officinale</i> Weber.	Asteraceae	Herb	Perennial	Chamaephyte	Palor	1	1
213	<i>Taraxacum wallichii</i> DC.	Asteraceae	Herb	Perennial	Chamaephyte		1	1
214	<i>Themeda anathera</i> (Nees) Hack.	Poaceae	Herb	Perennial	Hemicryptophyte	Furun	1	1
215	<i>Thymus serpyllum</i>	Lamiaceae	Herb	Annual	Chamaephyte	Isperki	1	0
216	<i>Tragus biflorus</i> Schult.	Poaceae	Grass	Annual	Therophyte		1	1
217	<i>Tribulus longipetalus</i> Viv.	Zygophyllaceae	Herb	Annual	Therophyte	Shiwo kuroo	0	1
218	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Herb	Annual	Therophyte	Shiwo kuroo	1	1
219	<i>Trifolium repens</i> L.	Fabaceae	Herb	Perennial	Hemicryptophyte		1	0
220	<i>Urtica dioica</i> L.	Urticaceae	Subshrub	Annual	Therophyte	Jomi	1	1
221	<i>Valeriana stracheyi</i>	Valerianaceae	Herb	Annual	Therophyte	Koindaru	1	0
222	<i>Valeriana wallichii</i> DC.	Valerianaceae	Herb	Annual	Therophyte		1	0
223	<i>Verbascum thapsus</i> L.	Scrophulariaceae	Herb	Biennial	Therophyte	Khardak/Kheros	1	1
224	<i>Verbena officinalis</i> L.	Verbenaceae	Herb	Annual	Cryptophyte	Chiroo	1	1
225	<i>Veronica beccabunga</i> L.	Scrophulariaceae	Herb	Annual	Therophyte		1	1
226	<i>Vitex negundo</i> L.	Verbenaceae	Shrub	Perennial	Phanerophyte		1	1
227	<i>Vitis himalyana</i>	Vitaceae	Climber	Perennial	Phanerophyte	Kuchar jachh	1	1
228	<i>Vitis jaquemontii</i> Parker	Vitaceae	Climber	Perennial	Phanerophyte	Magrath	1	1
229	<i>Vitis vinifera</i> L.	Vitaceae	Climber	Perennial	Phanerophyte	Jach	1	1
230	<i>Withania coagulens</i> Dunal	Solanaceae	Subshrub	Perennial	Phanerophyte		0	1
231	<i>Xanthium strumarium</i> L.	Asteraceae	Herb	Annual	Phanerophyte	Kundi	1	1
232	<i>Zizyphus sativa</i> Gaertn	Rhamnaceae	Shrub	Perennial	Phanerophyte	Sizin/Sigiun	1	1
						1	192	198

Appendix – 2.2
PLANTS ECONOMIC VALUE INVENTORY

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
1	<i>Abelmoschus esculentus</i> (L.) Moench.	Malvaceae	Bhindi	√	–	√	√	–	–	–	√	–	–
2	<i>Abies pindraw</i> Royle.	Pinaceae	Chur	–	–	–	√	√	√	–	–	–	√
3	<i>Achyranthes aspera</i> L.	Amaranthaceae	Malkuni	√	√	√	√	–	–	–	–	–	–
4	<i>Adiantum capillus-veneris</i> L.	Adiantaceae		√	–	–	–	–	–	–	–	–	√
5	<i>Adiantum venustum</i> D. Don	Adiantaceae	Jathoori	√	–	–	–	–	–	–	–	–	√
6	<i>Ailanthus altissima</i> (Mill.) Swingle	Simarubaceae	Darawa	–	–	√	√	–	√	–	–	–	√
7	<i>Ajuga bracteosa</i> Wall. ex Bth.	Lamiaceae		√	–	√	–	–	–	–	–	–	–
8	<i>Ajuga parviflora</i> Bth.	Lamiaceae		√	–	√	–	–	–	–	–	–	–
9	<i>Alnus nitida</i> Endl.	Betulaceae		–	–	√	√	–	–	–	–	–	√
10	<i>Alternanthera pachyacantha</i>	Aizoaceae		–	–	√	–	–	–	–	–	–	–
11	<i>Alternanthera pungens</i> Kunth.	Amaranthaceae		–	–	√	–	–	–	–	–	√	–
12	<i>Amaranthus caudatus</i> L.	Amaranthaceae	Ghanar	√	–	√	–	–	–	–	√	√	–
13	<i>Amaranthus graecizense</i> L.	Amaranthaceae		–	–	√	–	–	–	–	–	√	–
14	<i>Amaranthus oleraceus</i> L.	Amaranthaceae	Kas ghanar	–	–	√	–	–	–	–	–	√	–
15	<i>Amaranthus viridis</i> L.	Amaranthaceae	Ghanar	–	–	√	–	–	–	–	√	√	–
16	<i>Anagallis arvensis</i> L.	Primulaceae		–	–	√	–	–	–	–	–	√	–
17	<i>Arabidopsis himalaica</i> (Edgew.) O.E.S.	Brassicaceae		–	–	√	–	–	–	–	–	√	–
18	<i>Aristida cyanatha</i> Nees ex Steud.	Poaceae		–	–	√	–	–	–	–	–	–	–
19	<i>Artemisia maritima</i> L.	Asteraceae	Daroon	√	–	√	√	–	–	–	–	–	√
20	<i>Asparagus filicinus</i> Buch.-Ham. ex D. Don	Asparagaceae	Zao	√	–	–	√	–	–	–	–	–	√
21	<i>Astragalus candolleanus</i> Royle ex Benth.	Fabaceae	Chioo	–	–	√	√	–	–	–	–	–	–
22	<i>Atriplex lasiantha</i> Boiss.	Chenopodiaceae	Kiklohukbursa	–	–	√	–	–	–	–	–	–	–

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
23	<i>Barleria acanthoides</i> Vahl.	Acanthaceae		–	–	√	–	–	–	–	–	–	–
24	<i>Barleria cristata</i> L.	Acanthaceae		–	–	√	–	–	–	–	–	–	–
25	<i>Bauhinia variegata</i> L.	Caesalpinaceae		√	–	√	√	–	√	–	√	–	√
26	<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	Korat	√	–	√	–	–	–	–	–	–	√
27	<i>Bidens biternata</i> (Lour.) Merr. & Sherff.	Asteraceae	Surbul	–	–	√	–	–	–	–	–	√	–
28	<i>Boerhavia procumbens</i> Banks ex Roxb.	Nyctaginaceae		–	–	√	–	–	–	–	–	–	–
29	<i>Bothriochloa bladhii</i> (Retz.) S.T Blake	Poaceae	Lhash	–	–	√	–	–	–	–	–	–	–
30	<i>Bothriochloa ischaemum</i> (L.) Keng	Poaceae	Lhash	–	–	√	–	–	–	–	–	–	–
31	<i>Brachiaria distachya</i> (L.) Stapf	Poaceae		–	–	√	–	–	–	–	–	√	–
32	<i>Brachiaria reptans</i> (L.) Gard. & C.E. Hubb.	Poaceae		–	–	√	–	–	–	–	–	√	–
33	<i>Brousonetia papyrifera</i> (L.) Vent.	Moraceae	Jangal murt	–	–	√	√	–	√	–	–	–	√
34	<i>Calamintha umbrosa</i> (M. Bieb.) Fisch. & Mey.	Lamiaceae	Bheroo rang	–	–	√	–	–	–	–	–	√	–
35	<i>Calotropis procera</i> (Willd.) R. Br.	Asclepiadaceae		√	–	√	√	–	–	–	–	–	√
36	<i>Cannabis sativa</i> L.	Cannabinaceae		√	–	√	–	–	–	–	–	√	–
37	<i>Capparis spinosa</i> L.	Capparidaceae	Kurr	–	–	√	√	–	–	–	–	–	√
38	<i>Capsella bursa-pastoris</i> (L.) Medik	Brassicaceae		–	–	√	–	–	–	–	–	√	–
39	<i>Carex chitralensis</i> Nelmes Mag.	Cyperaceae	Zatch	–	–	√	√	–	–	–	–	–	√
40	<i>Carum carvi</i> L.	Apiaceae	Zeera	√	–	√	–	–	–	–	–	–	√
41	<i>Cedrus deodara</i> (Roxb. Ex Lamb.) G. Don	Pinaceae	Beesh	–	–	–	√	√	√	–	–	–	√
42	<i>Celtis australis</i> L.	Ulmaceae	Makosh	–	–	√	√	–	–	–	–	–	–
43	<i>Centella asiatica</i> (L.) Urban	Apiaceae	Tikroo	√	–	√	–	–	–	–	–	–	–
44	<i>Cheilanthes farinosa</i> (Forssk.) Kaulf.	Pteridaceae		–	–	√	–	–	–	–	–	–	√
45	<i>Chenopodium album</i> L.	Chenopodiaceae	Kanwan	√	–	√	–	–	–	–	√	√	–
46	<i>Chenopodium ambrosioides</i> L.	Chenopodiaceae	Tahoo	√	–	√	√	–	–	–	–	√	–
47	<i>Chenopodium botrys</i> L.	Chenopodiaceae	Kunwan	–	–	√	–	–	–	–	–	–	–

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
48	<i>Chenopodium cf. opulifolium</i> Schrad. ex Koch & Ziz.	Chenopodiaceae		–	–	√	–	–	–	–	–	–	–
49	<i>Chrozophora tinctoria</i> (L.) Juss.	Euphorbiaceae		–	–	√	–	–	–	–	–	–	–
50	<i>Chrysopogon aucherii</i> (Boiss.) Stapf	Poaceae		–	–	√	–	–	–	–	–	–	–
51	<i>Cirsium falconerii</i> (Hk.f.) Petrak	Asteraceae	Jocho	–	–	√	–	–	–	–	–	–	–
52	<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae		√	√	√	√	–	–	–	–	–	√
53	<i>Clematis montana</i> Buch.	Ranunculaceae		–	–	√	–	–	–	–	–	–	–
54	<i>Clematis nepalensis</i> Royle	Ranunculaceae		–	–	√	–	–	–	–	–	–	–
55	<i>Cleome viscosa</i> L.	Capparidaceae		–	–	√	–	–	–	–	–	√	–
56	<i>Commelina paludosa</i> Bl. Enum.	Commelineace		–	–	√	–	–	–	–	–	√	–
57	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Halor	–	–	√	–	–	–	–	–	√	–
58	<i>Conyza aegyptica</i> Ait.	Asteraceae		–	–	√	–	–	–	–	–	√	–
59	<i>Conyza bonariensis</i> L.	Asteraceae	Phuljoo	–	–	√	–	–	–	–	–	√	–
60	<i>Conyza canadensis</i> L.	Asteraceae	Panar tahoor	–	–	√	–	–	–	–	–	√	–
61	<i>Coronopus didymus</i> (L.) Sm.	Brassicaceae	Marchaki	–	–	√	–	–	–	–	–	√	–
62	<i>Cotinus coggygria</i> Scop.	Anacardiaceae	Khakoh/Shini	–	–	√	√	–	√	√	–	–	–
63	<i>Cotoneaster affinis</i> var. <i>bacillaris</i> (Lindl.) Schneider	Rosaceae	Luni	–	–	√	√	–	–	√	–	–	–
64	<i>Cotoneaster microphylla</i> Wall. ex Lindl.	Rosaceae	Kiur	–	–	√	√	–	–	√	–	–	–
65	<i>Cotoneaster nummularia</i> Fisher & Meyer	Rosaceae	Dudul	–	–	√	√	–	–	–	–	–	–
66	<i>Cousinia thomsonii</i> Clarke	Asteraceae		–	–	√	–	–	–	–	–	–	–
67	<i>Cucumis melo</i> var. <i>agrestis</i> Naud.	Cucurbitaceae		–	–	√	–	–	–	√	–	√	√
68	<i>Cucurbita maxima</i> Duch. ex Lam.	Cucurbitaceae		–	–	√	√	–	–	–	√	–	–
69	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Zhoo	–	–	√	–	–	–	–	–	–	–
70	<i>Cymbopogon distans</i> (Nees) W. Wats.	Poaceae	Kattal	–	–	√	–	–	–	–	–	–	–
71	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Kabal	–	–	√	–	–	–	–	–	√	–

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
72	<i>Cynoglossum lanceolatum</i> Forssk.	Boraginaceae	Chiroo	–	–	√	–	–	–	–	–	–	–
73	<i>Cyperus niveus</i> Retz.	Cyperaceae		–	–	√	–	–	–	–	–	–	–
74	<i>Cyperus rotundus</i> L.	Cyperaceae		–	–	√	–	–	–	–	–	√	–
75	<i>Dactyloctenium aegyptium</i> L.	Poaceae	Sarkhoo gha	–	–	√	–	–	–	–	–	√	–
76	<i>Dalbergia sissoo</i> Roxb.	Fabaceae		–	–	√	√	√	√	–	–	–	√
77	<i>Datura innoxia</i> Mill.	Solanaceae		√	–	–	√	–	–	–	–	–	–
78	<i>Datura stramonium</i> L.	Solanaceae		√	–	–	√	–	–	–	–	–	–
79	<i>Debregeasia salicifolia</i> (D. Don) Rendle	Urticaceae	Chiroo	–	–	√	–	–	√	–	–	–	√
80	<i>Dianthus crinitus</i> Sm.	Caryophyllaceae		–	–	√	–	–	–	–	–	–	–
81	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Poaceae		–	–	√	–	–	–	–	–	√	–
82	<i>Dicliptera roxburghiana</i> Nees	Acanthaceae		–	–	√	–	–	–	–	–	–	–
83	<i>Digera muricata</i> (L.) Mart.	Amaranthaceae		–	–	√	–	–	–	–	√	√	–
84	<i>Digitaria sanguinalis</i> (L.) Scop.	Poaceae		–	–	√	–	–	–	–	–	√	–
85	<i>Diospyros lotus</i> L.	Ebenaceae	Amlok	–	–	√	√	√	√	√	–	–	√
86	<i>Dodonaea viscosa</i> (L.) Jacq.	Sapindaceae	Shounth/Bajj	–	–	√	√	–	–	–	–	–	√
87	<i>Duchesnea indica</i> (Andr.) Focke	Rosaceae		–	–	√	–	–	–	√	–	–	–
88	<i>Echinochloa colona</i> (L.) Link	Poaceae		–	–	√	–	–	–	–	–	√	–
89	<i>Echinops cornigerus</i> DC.	Asteraceae	Kuro	–	–	√	–	–	–	–	–	–	√
90	<i>Eclipta prostrata</i> (L.) L.	Asteraceae		√	–	√	–	–	–	–	–	–	–
91	<i>Ephedra ciliata</i> Fisch. & Mey. ex C.A. Mey.	Ephederaceae	Ragaal	–	–	√	√	–	–	–	–	–	–
92	<i>Ephedra intermedia</i> Schrenk	Ephederaceae	Suo	–	–	√	√	–	–	–	–	–	√
93	<i>Eragrostis aterovirens</i> (Desf.) Trin. ex Nees	Poaceae		–	–	√	–	–	–	–	–	√	–
94	<i>Eragrostis cilianensis</i> (All.) Vig.	Poaceae		–	–	√	–	–	–	–	–	√	–
95	<i>Eragrostis minor</i> Host.	Poaceae		–	–	√	–	–	–	–	–	√	–
96	<i>Eucalyptus lanceolatus</i>	Myrtaceae		–	–	√	√	–	√	–	–	–	√

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
97	<i>Euonymus pendulus</i> Wall.	Celastraceae		–	–	√	√	–	–	–	–	–	–
98	<i>Euphorbia granulata</i> Forssk.	Euphorbiaceae		–	–	√	–	–	–	–	–	√	–
99	<i>Euphorbia hirta</i> L.	Euphorbiaceae		–	–	√	–	–	–	–	–	√	–
100	<i>Euphorbia indica</i> Lam.	Euphorbiaceae	Ispatre	–	–	√	–	–	–	–	–	√	–
101	<i>Euphorbia kanorica</i> Boiss.	Euphorbiaceae		–	–	√	–	–	–	–	–	–	–
102	<i>Euphorbia prostrata</i> (L.) Ait	Euphorbiaceae		–	–	√	–	–	–	–	–	√	–
103	<i>Euphrasia himalayica</i> Wettst.	Scrophulariaceae		–	–	√	–	–	–	–	–	–	–
104	<i>Ficus carica</i> L.	Moraceae	Pha	√	–	√	√	–	√	√	–	–	√
105	<i>Fumaria indica</i> (Hauskn.) H.N. Pugsley	Fumariaceae		√	–	√	–	–	–	–	–	√	–
106	<i>Gallium aparine</i> L.	Rubiaceae		–	–	√	–	–	–	–	–	√	–
107	<i>Gentiana capitata</i> Ham. ex D. Don	Gentianaceae	Salaloo	–	–	√	–	–	–	–	–	–	–
108	<i>Geranium rotundifolium</i> L.	Geraniaceae		–	–	√	–	–	–	–	–	–	–
109	<i>Geranium willichianum</i> D. Don	Geraniaceae	Ratajot	–	–	√	–	–	–	–	–	–	–
110	<i>Heliotropium europaeum</i> L.	Boraginaceae		√	–	√	√	–	–	–	–	√	–
111	<i>Heliotropium</i> spp.	Boraginaceae	Dodosulo	–	–	√	–	–	–	–	–	–	–
112	<i>Heteropogon contortus</i> (L.) P. Beauv.	Poaceae		–	–	√	–	–	–	–	–	–	–
113	<i>Impatiens edgeworthii</i> Hook.f.	Scrophulariaceae		–	–	√	–	–	–	–	√	–	–
114	<i>Indigofera heterantha</i> Wall. Ex Brand	Fabaceae	Kachhi	–	√	√	√	–	–	–	–	–	–
115	<i>Juglans regia</i> L.	Juglandaceae	Achhoe	√	–	√	√	√	√	√	–	–	√
116	<i>Juncus</i> spp.	Juncaceae		–	–	√	√	–	–	–	–	–	–
117	<i>Kickxia ramosissima</i> (Wall.) Janchen	Scrophulariaceae		√	–	√	–	–	–	–	–	–	–
118	<i>Lactuca auriculata</i> (Wall. ex Dc.)	Asteraceae		–	–	√	–	–	–	–	–	√	–
119	<i>Lactuca dissecta</i> D. Don.	Asteraceae		–	–	√	–	–	–	–	–	√	–
120	<i>Lactuca serriola</i> L.	Asteraceae	Harool	–	–	√	–	–	–	–	–	√	–
121	<i>Lagenaria siceraria</i> (Molina) Standley	Cucurbitaceae		–	–	√	–	–	–	–	√	–	–

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
122	<i>Lepidium pinnatifidum</i> Ledeb.	Brassicaceae	Makoch	–	–	√	–	–	–	–	–	√	–
123	<i>Lespedeza elegans</i> Cambess.	Fabaceae		–	–	√	–	–	–	–	–	–	–
124	<i>Leucaena leucocephala</i> (Lam.) de-Wit	Mimosaceae		–	–	√	√	√	√	–	–	–	–
125	<i>Luffa cylindrica</i> (L.) Roem.	Cucurbitaceae		–	–	√	–	–	–	–	√	–	–
126	<i>Malva neglecta</i> Waller.	Malvaceae	Shani	–	–	√	–	–	–	–	√	√	–
127	<i>Malva parviflora</i> L.	Malvaceae	Zarooshal/Masha	–	–	√	–	–	–	–	√	√	–
128	<i>Malvastrum coromendelianum</i> L.	Malvaceae		–	–	√	–	–	–	–	–	√	–
129	<i>Maytenus royleanus</i> (Wall. ex Lawson) Cufodontis	Celastraceae	Phaikar	–	–	√	–	–	–	–	–	–	–
130	<i>Medicago lupulina</i> L.	Fabaceae		–	–	√	–	–	–	–	–	√	–
131	<i>Melia azedarach</i> L.	Meliaceae		√	–	√	√	–	√	–	–	–	–
132	<i>Mentha longifolia</i> (L.) Huds.	Lamiaceae	Feeru	√	–	√	–	–	–	–	–	–	√
133	<i>Micromeria biflora</i> (Ham.) Bth.	Lamiaceae	Kaldajar	–	–	√	–	–	–	–	–	–	–
134	<i>Morus alba</i> L.	Moraceae	Marath	√	–	√	√	√	√	√	–	–	√
135	<i>Morus nigra</i> L.	Moraceae		√	–	√	√	√	√	√	–	–	√
136	<i>Myrtus communis</i> L.	Myrtaceae	Amboo/Lachi	√	–	√	√	–	–	√	–	–	√
137	<i>Nasturtium officinale</i> R. Br.	Brassicaceae	Zalzaal	√	–	√	–	–	–	–	√	–	√
138	<i>Nerium oleander</i> L.	Apocynaceae		–	–	–	√	–	–	–	–	–	√
139	<i>Olea ferruginea</i> Royle	Oleaceae		√	–	√	√	–	√	–	–	–	√
140	<i>Onopordum acanthium</i> L.	Asteraceae	Zehech	–	–	√	–	–	–	–	–	–	√
141	<i>Oxalis corniculata</i> L.	Oxalidaceae	Chukoo	–	–	√	–	–	–	–	–	√	–
142	<i>Parthenium hytserophorus</i> L.	Asteraceae		–	–	√	–	–	–	–	–	√	–
143	<i>Paspalidium flavidum</i> (Retz.) A. Camus	Poaceae		–	–	√	–	–	–	–	–	√	–
144	<i>Paspalum paspalodes</i> (Michx.) Scribner	Poaceae		–	–	√	–	–	–	–	–	√	–
145	<i>Pennesitum orientale</i> L.	Poaceae		–	–	√	–	–	–	–	–	–	–
146	<i>Periploca aphylla</i> Decne.	Asclepiadaceae	Sui	–	–	√	√	–	–	–	–	–	√

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
147	<i>Persicaria barbata</i> (L.) Hara	Polygonaceae	Danduni	–	√	√	–	–	–	–	–	–	√
148	<i>Phalaris minor</i> Retz.	Poaceae		–	–	√	–	–	–	–	–	√	–
149	<i>Phragmites australis</i> (Cav.) Trin.ex Steud.	Poaceae	Nai	–	–	√	√	–	–	–	–	–	√
150	<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae		√	–	√	–	–	–	–	–	√	–
151	<i>Physalis peruviana</i> L.	Solanaceae	Manakach	–	–	√	–	–	–	√	–	√	–
152	<i>Pinus gerardiana</i> Wall. non Lamb.	Pinaceae	Thulesh	√	–	–	√	√	√	√	–	–	√
153	<i>Pinus roxburghii</i> Sargent	Pinaceae	Chugi	–	–	–	√	–	–	–	–	–	√
154	<i>Pinus wallichiana</i> A.B. Jackson	Pinaceae	Chhar	–	–	√	√	√	√	–	–	–	√
155	<i>Pistacia chinensis</i> Bunge	Anacardiaceae	Kangar	√	–	√	√	–	√	–	–	–	√
156	<i>Plantago aitchisonii</i> Pilger	Plantaginaceae	Shileet	–	–	√	–	–	–	–	–	–	–
157	<i>Plantago lanceolata</i> L.	Plantaginaceae	Shileet	√	–	√	–	–	–	–	–	–	–
158	<i>Plantago ovata</i> Frossk.	Plantaginaceae	Shileet	√	–	√	–	–	–	–	–	–	–
159	<i>Plectranthus rugosus</i> Wall. ex Bth.	Lamiaceae	Salal	–	–	√	–	–	–	–	–	–	√
160	<i>Poa annua</i> L.	Poaceae		–	–	√	–	–	–	–	–	√	–
161	<i>Polygonum affine</i> D. Don	Polygonaceae	Banke	–	–	√	–	–	–	–	–	√	–
162	<i>Polygonum effusum</i> Meirsn.	Polygonaceae	Banke	–	–	√	–	–	–	–	√	√	–
163	<i>Polygonum hydropiper</i> L.	Polygonaceae		–	–	√	–	–	–	–	–	–	–
164	<i>Polypogon fugax</i> Nees ex Steud.	Poaceae		–	–	√	–	–	–	–	–	√	–
165	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae		–	–	√	–	–	–	–	–	√	–
166	<i>Populus deltoides</i> Bartram ex Marsh.	Salicaceae	Sufaida	–	–	√	√	√	√	–	–	–	√
167	<i>Portulaca oleracea</i> L.	Portulacaceae	Pishil	–	–	√	–	–	–	–	√	√	–
168	<i>Prunus amygdalus</i> Batsch	Rosaceae		√	–	√	√	–	√	√	–	–	√
169	<i>Prunus armeniaca</i> L.	Rosaceae	Ashae	√	–	√	√	–	√	√	–	–	√
170	<i>Prunus domestica</i> L.	Rosaceae	Aroo	√	–	√	√	–	√	√	–	–	√
171	<i>Pteridium aquilinum</i> (L.) Kuhn.	Pteridaceae		–	–	√	–	–	–	–	–	–	√

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
172	<i>Pteris cretica</i> L.	Pteridaceae	Kuenz	–	–	√	–	–	–	–	–	–	√
173	<i>Pteris vittata</i> L.	Pteridaceae	Kuenz	–	–	√	–	–	–	–	–	–	√
174	<i>Punica granatum</i> L.	Punicaceae	Dangoo	√	–	√	√	–	√	√	–	–	√
175	<i>Pyrus communis</i> L.	Rosaceae	Taango	–	–	√	√	–	√	√	–	–	√
176	<i>Pyrus mallus</i> L.	Rosaceae	Bhaap	√	–	√	√	–	√	√	–	–	√
177	<i>Quercus baloot</i> Griffith	Fagaceae	Bani/Jaand	√	–	√	√	√	√	–	–	–	√
178	<i>Quercus dilatata</i> Lindl. ex Royle	Fagaceae	Kagani/Zharyun	–	–	√	√	√	√	–	–	–	√
179	<i>Ranunculus scleratus</i> L.	Ranunculaceae		√	–	√	–	–	–	–	–	–	–
180	<i>Rhus mysurensis</i> Heyne ex Wight & Arn.	Anacardiaceae	Kasudur	–	–	√	√	–	–	–	–	–	√
181	<i>Ribes alpestre</i> Dcne. ex Jacq.	Rosaceae	Shigay	√	–	√	√	–	–	–	–	–	√
182	<i>Ricinis communis</i> L.	Euphorbiaceae		√	–	–	√	–	–	–	–	–	√
183	<i>Robinia pseudoacacia</i> L.	Fabaceae		–	–	√	√	–	√	–	–	–	√
184	<i>Rubus ellipticus</i> Smith	Rubiaceae	Gorash	–	–	√	√	–	–	√	–	–	√
185	<i>Rumex dentatus</i> L.	Polygonaceae		–	–	√	–	–	–	–	–	√	–
186	<i>Rumex hastatus</i> D. Don	Polygonaceae		–	–	√	√	–	–	–	–	–	√
187	<i>Rumex nepalensis</i> Spreng	Polygonaceae	Hababil	√	√	√	√	–	–	–	–	–	–
188	<i>Saccharum ravennae</i> (L.) Murray	Poaceae	Swar phuroo	–	–	√	√	–	–	–	–	–	√
189	<i>Salix acmophylla</i> Boiss.	Salicaceae	Chhubi	–	–	√	√	–	–	–	–	–	√
190	<i>Salvia moorcroftiana</i> Wall. ex Bth.	Lamiaceae		√	–	√	–	–	–	–	–	–	–
191	<i>Saussurea albescens</i> (DC.) Schr. Bip.	Asteraceae		–	–	√	–	–	–	–	–	–	–
192	<i>Saussurea atkinsonii</i> Clarke	Asteraceae		–	–	√	–	–	–	–	–	–	–
193	<i>Saussurea heteromalla</i> DC.	Asteraceae		–	–	√	–	–	–	–	–	–	–
194	<i>Scorzonera virgata</i> DC.	Asteraceae		–	–	√	–	–	–	–	–	–	–
195	<i>Setaria glauca</i> (L.) P. Beauv	Poaceae		–	–	√	–	–	–	–	–	√	–
196	<i>Setaria viridis</i> (L.) P. Beauv.	Poaceae	Pashtili	–	–	√	–	–	–	–	–	√	–

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
197	<i>Silene conoidea</i> L.	Caryophyllaceae		–	–	√	–	–	–	–	–	√	–
198	<i>Solanum nigrum</i> L.	Solanaceae		√	–	√	–	–	–	–	–	√	–
199	<i>Solanum surattense</i> Burm.f.	Solanaceae	Shuroo gae/mano gae	√	–	√	–	–	–	–	–	–	–
200	<i>Solanum villosum</i> (L.) Moench	Solanaceae		–	–	√	–	–	–	–	–	√	–
201	<i>Sonchus arvensis</i> f. <i>brachyotus</i> (DC.) Kirp.	Asteraceae		–	–	√	–	–	–	–	–	–	–
202	<i>Sonchus asper</i> (L.) Hill.	Asteraceae		–	–	√	–	–	–	–	–	√	–
203	<i>Sonchus oleraceus</i> L.	Asteraceae	Chuloor	–	–	√	–	–	–	–	–	√	–
204	<i>Sorghum halepense</i> (L.) Bern.	Poaceae		–	–	–	√	–	–	–	–	√	–
205	<i>Stellaria media</i> (L.) Cyr.	Caryophyllaceae		–	–	√	–	–	–	–	–	√	–
206	<i>Tagetes minuta</i> L.	Asteraceae		–	–	√	√	–	–	–	–	–	–
207	<i>Tamarix aphylla</i> (L.) Karst.	Tamaricaceae		–	–	–	√	–	–	–	–	–	√
208	<i>Taraxacum officinale</i> Weber.	Asteraceae	Palor	–	–	√	–	–	–	–	–	–	–
209	<i>Taraxacum wallichii</i> DC.	Asteraceae		–	–	√	–	–	–	–	–	–	–
210	<i>Themeda anathera</i> (Nees) Hack.	Poaceae	Furun	–	–	√	–	–	–	–	–	–	–
211	<i>Thymus serpyllum</i>	Lamiaceae	Isperki	–	–	√	–	–	–	–	–	–	√
212	<i>Tragus biflorus</i> Schult.	Poaceae		–	–	√	–	–	–	–	–	–	–
213	<i>Tribulus longipetalus</i> Viv.	Zygophyllaceae	Shiwo kuroo	–	–	√	–	–	–	–	–	–	–
214	<i>Tribulus</i> spp.	Zygophyllaceae	Shiwo kuroo	–	–	√	–	–	–	–	–	–	–
215	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Shiwo kuroo	√	–	√	–	–	–	–	–	√	–
216	<i>Trifolium repens</i> L.	Fabaceae		–	–	√	–	–	–	–	–	–	–
217	<i>Urtica dioica</i> L.	Urticaceae	Jomi	–	–	–	–	–	–	–	√	–	–
218	<i>Valeriana stracheyi</i>	Valerianaceae	Koindaru	–	–	√	–	–	–	–	–	–	–
219	<i>Valeriana wallichii</i> DC.	Valerianaceae		–	–	√	–	–	–	–	–	–	–
220	<i>Verbascum thapsus</i> L.	Scrophulariaceae	Khardak/Kheros	√	–	√	√	–	–	–	–	–	–
221	<i>Verbena officinalis</i> L.	Verbenaceae	Chiroo	–	–	√	–	–	–	–	–	√	–

No.	Plant Species	Family	Local name	Medicinal	Ethno-Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vegetable	Weeds	Others
222	<i>Veronica beccabunga</i> L.	Scrophulariaceae		–	–	√	–	–	–	–	–	–	–
223	<i>Vitex negundo</i> L.	Verbenaceae		√	–	√	√	–	–	–	–	–	√
224	<i>Vitis himalyana</i>	Vitaceae	Kuchar jachh	–	–	√	√	–	–	–	–	–	–
225	<i>Vitis jaquemontii</i> Parker	Vitaceae	Magrath	–	–	√	√	–	–	–	–	–	–
226	<i>Vitis vinifera</i> L.	Vitaceae	Jach	√	–	√	√	–	–	√	–	–	√
227	<i>Withania coagulens</i> Dunal	Solanaceae		√	–	–	√	–	–	–	–	–	–
228	<i>Xanthium strumarium</i> L.	Asteraceae	Kundi	–	–	–	√	–	–	–	–	√	–
229	<i>Zizyphus sativa</i> Gaertn	Rhamnaceae	Sizin/Sigiun	√	–	√	√	–	–	–	–	–	–
				57	5	213	78	13	30	21	16	74	67

Note: Out of 232, 229 species are subjected to some sort of use in the local area.

Appendix – 2.3

DISEASES TREATED BY NATIVE FLORAL SPECIES

Sr. No.	Diseases treated	Number of Species	Percentage
1	Constipation	12	12.12
2	Boils	11	11.11
3	Tonic	9	9.09
4	Cough	8	8.08
5	Inflammation	6	6.06
6	Dysentery	6	6.06
7	Diarrhea	5	5.05
8	Wounds healing	4	4.04
9	Pain	4	4.04
10	Asthma	3	3.03
11	Cold	3	3.03
12	Flue	3	3.03
13	Pimples	3	3.03
14	Nausea	2	2.02
15	Vomiting	2	2.02
16	Diarrhea	2	2.02
17	Hiccough	1	1.01
18	Sharpen memory	1	1.01
19	Diabetes	1	1.01
20	Fever	1	1.01
21	Toothache	1	1.01
22	Kidney stone	1	1.01
23	Menstruation	1	1.01
24	Leucorrhoea	1	1.01
25	Jaundice	1	1.01
26	Skin eruption	1	1.01
27	Sedative	1	1.01
28	Headache	1	1.01
29	Chicken pox	1	1.01
30	Influenza	1	1.01
31	Blood purifier	1	1.01
32	Pyorrhea	1	1.01
		99	100.00

Appendix – 2.4

FRUITING PLANTS RECORDED FROM PROJECT AREA

Sr. No.	Plant Species	Family	Local name
CULTIVATED			
1	<i>Diospyros lotus</i> L.	Ebenaceae	Amlok
2	<i>Ficus carica</i> L.	Moraceae	Pha
3	<i>Juglans regia</i> L.	Juglandaceae	Achhoe
4	<i>Morus alba</i> L.	Moraceae	Marath
5	<i>Morus nigra</i> L.	Moraceae	Marath
6	<i>Pinus gerardiana</i> Wall. non Lamb.	Pinaceae	Thulesh
7	<i>Prunus amygdalus</i> Batsch	Rosaceae	Badam
8	<i>Prunus armeniaca</i> L.	Rosaceae	Ashae
9	<i>Prunus domestica</i> L.	Rosaceae	Aroo
10	<i>Pyrus communis</i> L.	Rosaceae	Taango
11	<i>Pyrus mallus</i> L.	Rosaceae	Bhaap
WILD			
1	<i>Cotinus coggygria</i> Scop.	Anacardiaceae	Khakoh/Shini
2	<i>Cotoneaster affinis</i> var. <i>bacillaris</i> (Lindl.) Schneider	Rosaceae	Luni
3	<i>Cotoneaster microphylla</i> Wall. ex Lindl.	Rosaceae	Kiur
4	<i>Cucumis melo</i> var. <i>agrestis</i> Naud.	Cucurbitaceae	
5	<i>Duchesnea indica</i> (Andr.) Focke	Rosaceae	
6	<i>Myrtus communis</i> L.	Myrtaceae	Amboo/Lachi
7	<i>Physalis peruviana</i> L.	Solanaceae	Manakach
8	<i>Punica granatum</i> L.	Punicaceae	Dangoo
9	<i>Rubus ellipticus</i> Smith	Rubiaceae	Gorash
10	<i>Vitis vinifera</i> L.	Vitaceae	Jach
11	<i>Ribes alpestre</i> Dcne. ex Jacq.	Rosaceae	Shigay
12	<i>Solanum villosum</i> (L.) Moench	Solanaceae	Kachmacho
13	<i>Zizyphus sativa</i> Gaertn	Rhamnaceae	Sizin/Sigiun

Appendix – 2.5

LIST OF PLANT SPECIES USED AS VEGETABLE/ POTHERBS

S. No.	Plant species	Local name	Family
CULTIVATED			
1	<i>Abelmoschus esculentus</i> (L.) Moench.	Bhindi	Malvaceae
2	<i>Allium cepa</i> L.	Kashoo	Liliaceae
3	<i>Allium sativum</i> L.	Thoom	Liliaceae
4	<i>Bauhinia variegata</i> L.		Caesalpinaceae
5	<i>Brassica botrytis</i> L.	Phul Gobhi	Brassicaceae
6	<i>Brassica capitata</i> L.	Ban Gobhi	Brassicaceae
7	<i>Brassica compastris</i> L.	Asger	Brassicaceae
8	<i>Brassica oleracea</i> L.	Gobhi	Brassicaceae
9	<i>Citrullus vulgaris</i> L.	Wond	Cucurbitaceae
10	<i>Cucubita pepo</i> L.	Sesi wond	Cucurbitaceae
11	<i>Cucumis sativus</i> L.	Laa	Cucurbitaceae
12	<i>Cucurbita maxima</i> Duch. ex Lam.		Cucurbitaceae
13	<i>Luffa cylindrica</i> (L.) Roem.		Cucurbitaceae
14	<i>Luffa ectangularis</i> (L.) Roxb.		Cucurbitaceae
15	<i>Lycopersicon esculentum</i> Mill.	Balugan	Solanaceae
16	<i>Momordica charantia</i> L.	Toki	Cucurbitaceae
WILD			
1	<i>Amaranthus caudatus</i> L.	Ghanar	Amaranthaceae
2	<i>Amaranthus viridis</i> L.	Ghanar	Amaranthaceae
3	<i>Chenopodium album</i> L.	Kanwan	Chenopodiaceae
4	<i>Digera muricata</i> (L.) Mart.		Amaranthaceae
5	<i>Impatiens edgeworthii</i> Hook.f.		Scrophulariaceae
6	<i>Malva neglecta</i> Waller.	Shani	Malvaceae
7	<i>Malva parviflora</i> L.	Zarooshal/Masha	Malvaceae
8	<i>Nasturtium officinale</i> R. Br.	Zalzaal	Brassicaceae
9	<i>Polygonum effusum</i> Meirsn.	Banke	Polygonaceae
10	<i>Portulaca oleracea</i> L.	Pishil	Portulacaceae
11	<i>Urtica dioica</i> L.	Jomi	Urticaceae

Appendix – 2.6

FUELWOOD SPECIES RECORDED IN THE STUDY AREA

S. No.	Plant Species	Family	Local name
1	<i>Abelmoschus esculentus</i> (L.) Moench.	Malvaceae	Bhindi
2	<i>Abies pindraw</i> Royle.	Pinaceae	Chur
3	<i>Achyranthes aspera</i> L.	Amaranthaceae	Malkuni
4	<i>Ailanthus altissima</i> (Mill.) Swingle	Simarubaceae	Darawa
5	<i>Alnus nitida</i> Endl.	Betulaceae	
6	<i>Artemesia maritima</i> L.	Asteraceae	Daroon
7	<i>Asparagus filicinus</i> Buch.-Ham. ex D. Don	Asparagaceae	Zao
8	<i>Astragalus candolleanus</i> Royle ex Benth.	Fabaceae	Chioo
9	<i>Bauhinia variegata</i> L.	Caesalpiniaceae	
10	<i>Brousonetia papyrifera</i> (L.) Vent.	Moraceae	Jangal murt
11	<i>Calotropis procera</i> (Willd.) R. Br.	Asclepiadaceae	
12	<i>Capparis spinosa</i> L.	Capparidaceae	Kurr
13	<i>Carex chitralensis</i> Nelmes Mag.	Cyperaceae	Zatch
14	<i>Cedrus deodara</i> (Roxb. Ex Lamb.) G. Don	Pinaceae	Beesh
15	<i>Celtis australis</i> L.	Ulmaceae	Makosh
16	<i>Chenopodium ambrosioides</i> L.	Chenopodiaceae	Tahoo
17	<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae	
18	<i>Cotinus coggryia</i> Scop.	Anacardiaceae	Khakoh/Shini
19	<i>Cotoneaster affinins</i> var. <i>bacillaris</i> (Lindl.) Schneider	Rosaceae	Luni
20	<i>Cotoneaster microphylla</i> Wall. ex Lindl.	Rosaceae	Kiur
21	<i>Cotoneaster nummularia</i> Fisher & Meyer	Rosaceae	Dudul
22	<i>Cucurbita maxima</i> Duch. ex Lam.	Cucurbitaceae	
23	<i>Dalbergia sissoo</i> Roxb.	Fabaceae	
24	<i>Datura innoxia</i> Mill.	Solanaceae	
25	<i>Datura stramonium</i> L.	Solanaceae	
26	<i>Diospyros lotus</i> L.	Ebenaceae	Amlok
27	<i>Dodonaea viscosa</i> (L.) Jacq.	Sapindaceae	Shounth/Bajj
28	<i>Ephedra ciliata</i> Fisch. & Mey. ex C.A. Mey.	Ephederaceae	Ragaal
29	<i>Ephedra intermedia</i> Schrenk	Ephederaceae	Suo
30	<i>Eucalyptus lanceolatus</i>	Myrtaceae	
31	<i>Euonymus pendulus</i> Wall.	Celastraceae	
32	<i>Ficus carica</i> L.	Moraceae	Pha
33	<i>Heliotropium europaeum</i> L.	Boraginaceae	
34	<i>Indigofera heterantha</i> Wall. Ex Brand	Fabaceae	Kachhi
35	<i>Juglans regia</i> L.	Juglandaceae	Achhoe
36	<i>Juncus</i> spp.	Juncaceae	
37	<i>Leucaena leucocephala</i> (Lam.) de-Wit	Mimosaceae	
38	<i>Melia azedarach</i> L.	Meliaceae	

S. No.	Plant Species	Family	Local name
39	<i>Morus alba</i> L.	Moraceae	Marath
40	<i>Morus nigra</i> L.	Moraceae	
41	<i>Myrtus communis</i> L.	Myrtaceae	Amboo/Lachi
42	<i>Nerium oleander</i> L.	Apocynaceae	
43	<i>Olea ferruginea</i> Royle	Oleaceae	
44	<i>Periploca aphylla</i> Decne.	Asclepiadaceae	Sui
45	<i>Phragmites australis</i> (Cav.) Trin.ex Steud.	Poaceae	Nai
46	<i>Pinus gerardiana</i> Wall. non Lamb.	Pinaceae	Thulesh
47	<i>Pinus roxburghii</i> Sargent	Pinaceae	Chugi
48	<i>Pinus wallichiana</i> A.B. Jackson	Pinaceae	Chhar
49	<i>Pistacia chinensis</i> Bunge	Anacardiaceae	Kangar
50	<i>Populus deltoides</i> Bartram ex Marsh.	Salicaceae	Sufaida
51	<i>Prunus amygdalus</i> Batsch	Rosaceae	
52	<i>Prunus armeniaca</i> L.	Rosaceae	Ashae
53	<i>Prunus domestica</i> L.	Rosaceae	Aroo
54	<i>Punica granatum</i> L.	Punicaceae	Dangoo
55	<i>Pyrus communis</i> L.	Rosaceae	Taango
56	<i>Pyrus mallus</i> L.	Rosaceae	Bhaap
57	<i>Quercus baloot</i> Griffith	Fagaceae	Bani/Jaand
58	<i>Quercus dilatata</i> Lindl. ex Royle	Fagaceae	Kagani/Zharyun
59	<i>Rhus mysurensis</i> Heyne ex Wight & Arn.	Anacardiaceae	Kasudur
60	<i>Ribes alpestre</i> Dcne. ex Jacq.	Rosaceae	Shigay
61	<i>Ricinis communis</i> L.	Euphorbiaceae	
62	<i>Robinia pseudoacacia</i> L.	Fabaceae	
63	<i>Rubus ellipticus</i> Smith	Rubiaceae	Gorash
64	<i>Rumex hastatus</i> D. Don	Polygonaceae	
65	<i>Rumex nepalensis</i> Spreng	Polygonaceae	Hababil
66	<i>Saccharum ravennae</i> (L.) Murray	Poaceae	Swar phuroo
67	<i>Salix acmophylla</i> Boiss.	Salicaceae	Chhubi
68	<i>Sorghum halepense</i> (L.) Bern.	Poaceae	
69	<i>Tagetes minuta</i> L.	Asteraceae	
70	<i>Tamarix aphylla</i> (L.) Karst.	Tamaricaceae	
71	<i>Verbascum thapsus</i> L.	Scrophulariaceae	Khardak/Kheros
72	<i>Vitex negundo</i> L.	Verbenaceae	
73	<i>Vitis himalyana</i>	Vitaceae	Kuchar jachh
74	<i>Vitis jaquemontii</i> Parker	Vitaceae	Magrath
75	<i>Vitis vinifera</i> L.	Vitaceae	Jach
76	<i>Withania coagulens</i> Dunal	Solanaceae	
77	<i>Xanthium strumarium</i> L.	Asteraceae	Kundi
78	<i>Zizyphus sativa</i> Gaertn	Rhamnaceae	Sizin/Sigiun

Appendix – 3.1

BIRDS REPORTED FROM THE STUDY AREA/ PROJECT AREA

Common Name	Scientific name	Family
Great or Eurasian Cormorant	<i>Phalacrocorax carbo sinensis</i>	Phalacrocoracidae
Grey Heron or Common Heron	<i>Ardea cinerea</i>	Ardeidae
Black stork	<i>Ciconia nigra</i>	Ciconiidae
White-necked stork or Woolly-necked stork	<i>Ciconia episcopus</i>	Ciconiidae
Black necked stork	<i>Ephippiorhynchus asiaticus</i>	Ciconiidae
Spoonbill	<i>Platalea leucorodia</i>	Threskiornithidae
Greylag goose	<i>Anser anser</i>	Anatidae
Bar-headed goose	<i>Anser indicus</i>	Anatidae
Ruddy shelduck	<i>Tadorna ferruginea</i>	Anatidae
Gadwall	<i>Anas strepera</i>	Anatidae
Eurasian wigeon	<i>Anas penelope</i>	Anatidae
Mallard	<i>Anas platyrhynchos</i>	Anatidae
Common teal	<i>Anas creca</i>	Anatidae
Northern pintail	<i>Anas acuta</i>	Anatidae
Northern shoveler	<i>Anas clypeata</i>	Anatidae
Common pochard	<i>Aythya ferina</i>	Anatidae
Ferruginous Duck or White-eyed pochard	<i>Anthya nyroca</i>	Anatidae
Tufted duck	<i>Aythya fuligula</i>	Anatidae
Goosander/Common Merganser	<i>Mergus merganser</i>	Anatidae
Black kite	<i>Milvus migrans</i>	Accipitridae
Lammergeyer or bearded vulture	<i>Gypaetus barbatus</i>	Accipitridae
Egyptian vulture	<i>Neophron percnopterus</i>	Accipitridae
Himalayan griffon vulture	<i>Gyps himalayensis</i>	Accipitridae
Chukar	<i>Alectoris chukar</i>	Phasianidae
Common quail	<i>Coturnix coturnix</i>	Phasianidae
Western Tragopan	<i>Tragopan melanocephalus</i>	Phasianidae
Koklass pheasant	<i>Pucrasia macrolopha</i>	Phasianidae
Himalayan Monal	<i>Lophophorus impejanus</i>	Phasianidae
Himalayan snowcock	<i>Tetraogallus himalayensis</i>	Phasianidae
Short-toed eagle	<i>Circaetus gallicus</i>	Accipitridae
Marsh harrier	<i>Circus aeruginosus</i>	Accipitridae
Hen harrier	<i>Circus cyaneus</i>	Accipitridae
Pallid harrier	<i>Circus macrourus</i>	Accipitridae
Goshawk	<i>Accipiter gentilis</i>	Accipitridae
Eurasian sparrow hawk	<i>Accipiter nisus</i>	Accipitridae
Shikra	<i>Accipiter badius</i>	Accipitridae
White-eyed buzzard	<i>Butastur teesa</i>	Accipitridae
Long-legged buzzard	<i>Buteo rafinus</i>	Accipitridae
Golden eagle	<i>Aquila chrysaetos</i>	Accipitridae
Booted eagle	<i>Hieraetus pennatus</i>	Accipitridae
Common kestrel	<i>Falco tinnunculus</i>	Falconidae
Northern hobby	<i>Falco subbuteo</i>	Falconidae
Water rail	<i>Rallus aquaticus</i>	Rallidae
Spotted crane	<i>Porzana porzana</i>	Rallidae
Baillon's crane	<i>Porzana pusilla</i>	Rallidae
Moorhen	<i>Gallinule chloropus</i>	Rallidae
Demoiselle crane	<i>Anthropoids virgo</i>	Gruidae
Pheasant-tailed jacana	<i>Hydrophasianus chirurgus</i>	Jacanidae

Common Name	Scientific name	Family
Red-wattled lapwing	<i>Vanellus indicus</i>	Charadriidae
Sociable lapwing	<i>Vanellus gregarious</i>	Charadriidae
Little stint	<i>Calidris minuta</i>	Scolopacidae
Tomminck's stint	<i>Calidris temminckii</i>	Scolopacidae
Curlew sandpiper	<i>Calidris ferruginea</i>	Scolopacidae
Eurasian woodcock	<i>Scolopax rusticola</i>	Scolopacidae
Spotted or dusky redshank	<i>Tringa erythropus</i>	Tringinae
Redshank	<i>Tringa totanus</i>	Tringinae
Green sandpiper	<i>Tringa ochropus</i>	Tringinae
Common sandpiper	<i>Actitis hypoleucos</i>	Tringinae
Brown-headed gull	<i>Larus brunnicephalus</i>	Laridae
Caspian tern	<i>Sterna caspia</i>	Sternidae
Blue rock pigeon	<i>Columba livia</i>	Columbidae
Snow pigeon	<i>Columba leuconota</i>	Columbidae
Indian ring dove	<i>Streptopelia decaocto</i>	Columbidae
Eastern rufous turtle dove	<i>Streptopelia orientalis</i>	Columbidae
Little brown dove	<i>Streptopelia senegalensis</i>	Columbidae
Spotted dove	<i>Streptopelia chinensis</i>	Columbidae
Eurasian cuckoo	<i>Cuculus canorus</i>	Cuculidae
Little cuckoo	<i>Cuculus poliocephalus</i>	Cuclidae
Northern eagle owl	<i>Bubo bubo</i>	Strigidae
Collared pygmy owlet	<i>Glaucidium brodiei</i>	Strigidae
Tawny owl	<i>Strixaluco</i>	Strigidae
European nightjar	<i>Caprimulgus europaeus</i>	Caprimulgidae
White-throated needle tail swift	<i>Hirundapus caudacutus</i>	Apodidae
Common swift	<i>Apus apus</i>	Apodidae
Alpine swift	<i>Apus melba</i>	Apodidae
Little swift	<i>Apus affinis</i>	Apodidae
Common kingfisher	<i>Alcedo atthis</i>	Apodidae
Blue-cheeked bee-eater	<i>Merops superciliosus</i>	Meropidae
European bee-eater	<i>Merops apiaster</i>	Meropidae
Eurasian roller	<i>Coracias garrulous</i>	Meropidae
Indian roller	<i>Coracias benghalensis</i>	Meropidae
Hoopoe	<i>Upupa epops</i>	Upupidae
Eurasian wryneck	<i>Jynx torquilla</i>	Picidae
Scaly-bellied green woodpecker	<i>Picus squamatus</i>	Picidae
Himalayan pied woodpecker	<i>Dendrocopos himalayensis</i>	Picidae
Brown-fronted woodpecker	<i>Denrocopos auriceps</i>	Picidae
Crested lark	<i>Galerida cristate</i>	Alaudidae
Small skylark	<i>Alauda gulgula</i>	Alaudidae
Common skylark	<i>Alauda arvensis</i>	Alaudidae
Collared sand martin	<i>Riparia riparia</i>	Hirundinidae
Crag martin	<i>Ptyonoprogne rufestris</i>	Hirundinidae
Common swallow	<i>Hirundo rustica</i>	Hirundinidae
Common house martin	<i>Delichon urbica</i>	Hirundinidae
Tawny pipit	<i>Anthus campestris</i>	Motacillidae
Tree pipit	<i>Anthus trivilis</i>	Motacillidae
Hodgson's pipit	<i>Anthus roseatus</i>	Motacillidae
Yellow-headed wagtail	<i>Motacilla citreola</i>	Motacillidae
Grey wagtail	<i>Motacilla cinera</i>	Motacillidae
Long-tailed minivet	<i>Pericrocotus ethologus</i>	Campephagidae
Rasy minivet	<i>Pericrocotus roseus</i>	Campephagidae
White-cheeked bulbul	<i>Pycnonotus leucogenys</i>	Pycnonotidae
Common dipper	<i>Cinclus cinclus</i>	Cinclidae
Drown dipper	<i>Cinclus pallasii</i>	Cinclidae
Winter wren	<i>Troglodytes troglodytes</i>	Troglodytidae

Common Name	Scientific name	Family
Rufous-breasted accentor	<i>Prunella strophciata</i>	Troglodytidae
Black-throated accentor	<i>Prunella atrogularis</i>	Prunellidae
Himalayan accentor	<i>Prunella himalayana</i>	Prunellidae
Alpine accentor	<i>Prunella collaris</i>	Prunellidae
Blue throat	<i>Luscinia svecia</i>	Turdidae
Black-breasted rubythroat	<i>Luscinia pectoralis</i>	Turdidae
Indian blue robin	<i>Luscinia brunnea</i>	Turdidae
Orange-flanked bush robin	<i>Tarsiger cyanurus</i>	Turdidae
Blue-headed redstart	<i>Phoenicurus caeruleocephalus</i>	Turdidae
Black redstart	<i>Phoenicurus ochruros</i>	Turdidae
Blue-fronted redstart	<i>Phoenicurus frontalis</i>	Turdidae
Plumbeous redstart	<i>Rhyacornis fuliginosus</i>	Turdidae
Stonechat redstart	<i>Saxicola torquata</i>	Turdidae
Pied stonechat	<i>Saxicola caprata</i>	Turdidae
Dark-grey bush	<i>Saxicola ferrea</i>	Turdidae
Isabelline wheatear	<i>Oenanthe isabellina</i>	Turdidae
Pleschanka's wheatear	<i>Oenanthe pleschanka</i>	Turdidae
Eastern pied wheatear	<i>Oenanthe picata</i>	Turdidae
White-capped redstart	<i>Chaimarrornis leucocephalus</i>	Turdidae
Rufous-tailed rock-thrush	<i>Monticola saxatilis</i>	Turdidae
Blue-capped	<i>Monticola cinelorchyncha</i>	Turdidae
Chestnut-bellied rock thrush	<i>Monticola rufiventris</i>	Turdidae
Blue rock thrush	<i>Monticola solitarius</i>	Turdidae
Blue whistling thrush	<i>Myiophoneus caeruleus</i>	Turdidae
Plain-backed mountain thrush	<i>Zoothera mollissima</i>	Turdidae
Scaly thrush	<i>Zoothera dauma</i>	Turdidae
Eurasian blackbird	<i>Turdus merula</i>	Turdidae
Chestnut thrush	<i>Turdus rubrocanus</i>	Turdidae
Dark-throated thrush	<i>Turdus ruficollis atregularis</i>	Turdidae
Mistle thrush	<i>Turdus viscivorus</i>	Turdidae
Little forktail	<i>Enicurus scouleri</i>	Enicurinae
Spotted forktail	<i>Enicurus maculates</i>	Enicurinae
Pale strong-footed bush warbler	<i>Cettia fortipes</i>	Sylviidae
Blyth's reed warbler	<i>Acrocephalus dumetorum</i>	Sylviidae
Booted warbler	<i>Hippolais caligata</i>	Sylviidae
Orphean warbler	<i>Sylvia hortensis</i>	Sylviidae
Lesser whitethroat	<i>Sylvia curruca</i>	Sylviidae
Grey-headed flycatcher warbler	<i>Seicercus xanthoschistos</i>	Sylviidae
Western crowned leaf warbler	<i>Phylloscopus occipitalis</i>	Sylviidae
Slender-billed leaf warbler	<i>Phylloscopus tytleri</i>	Sylviidae
Greenish warbler	<i>Phylloscopus trochiloides</i>	Sylviidae
Pallas's or yellow-rumped leaf warbler	<i>Phylloscopus proregulus</i>	Sylviidae
Brooks's leaf warbler	<i>Phylloscopus subviridis</i>	Sylviidae
Yellow-browed leaf warbler	<i>Phylloscopus inornatus</i>	Sylviidae
Olivaceous leaf warbler	<i>Phylloscopus griseolus</i>	Sylviidae
Tickell's leaf warbler	<i>Phylloscopus affinis</i>	Sylviidae
Chiffchaff	<i>Phylloscopus collybita</i>	Sylviidae
Goldcrest	<i>Regulus regulus</i>	Sylviidae
Sooty or dark-sided flycatcher	<i>Muscicapa sibirica</i>	Muscicapidae
Rufous-tailed flycatcher	<i>Muscicapa ruficanda</i>	Muscicapidae
Slaty-blue flycatcher	<i>Ficedula tricolor</i>	Muscicapidae
Ultramarine flycatcher	<i>Ficedula superciliaris</i>	Muscicapidae
Asian paradise flycatcher	<i>Terpsiphone paradise</i>	Monarchidae
Variiegated laughing thrush	<i>Garrulax variegates</i>	Timaliidae
Streaked laughing thrush	<i>Carrulax lineatus</i>	Timaliidae

Common Name	Scientific name	Family
White-throated longtail tit	<i>Aegithalos niveogularis</i>	Aegithalidae
White-cheeked longtailed tit	<i>Aegithalos leucognys</i>	Aegithalidae
Black crested tit	<i>Parus rufonuchalis</i>	Paridae
Crested black tit	<i>Parus melanolophus</i>	Paridae
Great tit	<i>Parus major</i>	Paridae
Green-backed tit	<i>Parus monticolus</i>	Paridae
White-cheeked nuthatch	<i>Sitta leucopsis</i>	Sittidae
Eurasian nuthatch	<i>Sitta europaea</i>	Sittidae
Wall creeper	<i>Tichodroma muraria</i>	Tichodromadidae
Himalayan or bar-tailed tree creeper	<i>Certhia himalayana</i>	Certhiidae
Golden oriole	<i>Oriolus oriolus</i>	Oriolidae
Brown shrike	<i>Lanius cristatus</i>	Laniidae
Rufous-backed shrike	<i>Lanius schach</i>	Laniidae
Great grey shrike	<i>Lanius excubitor</i>	Laniidae
Ashy or grey drongo	<i>Dicrurus leucophaeus</i>	Dicruridae
Black-throated jay	<i>Garrulous lanceolatus</i>	Corvidae
Alpine or yellow billed chough	<i>Pyrrhocorax graculus</i>	Corvidae
Red-billed chough	<i>Pyrrhocorax pyrrhocorax</i>	Corvidae
Jackdaw	<i>Corvus monedula</i>	Corvidae
Jungle crow	<i>Corvus macrorhynchos</i>	Corvidae
Brahminy startling	<i>Sturnus pagodarum</i>	Sturnidae
Common myna	<i>Acridotheres tristis</i>	Sturnidae
Jungle myna	<i>Acridotheres fuscus</i>	Sturnidae
House sparrow	<i>Passer domesticus</i>	Passeridae
Spanish sparrow	<i>Passer hispaniolensis</i>	Passeridae
Cinnamon tree sparrow	<i>Passer rutilaw</i>	Passeridae
Himalayan greenfinch	<i>Carduelis spinoides</i>	Carduelinae
Spectacled or red browned finch	<i>Carduelis Callacanthis burtoni</i>	Carduelinae
Grey-headed goldfinch	<i>Carduelis carduelis caniceps</i>	Carduelinae
Hodgson's mountain finch	<i>Leucosticte nemoricola</i>	Carduelinae
Himalayan mountain finch	<i>Leucosticte brandti</i>	Carduelinae
Red-fronted serin	<i>Serinus pusillus</i>	Carduelinae
Common rose finch	<i>Carpodacus erythrinus</i>	Carduelinae
Himalayan or thin billed red-mantled rose finch	<i>Carpodacus grandis</i>	Carduelinae
Orange bullfinch	<i>Pyrrhula aurantuca</i>	Carduelinae
Pine bunting	<i>Emberiza leucocephalos</i>	Emberizinae
White-capped bunting	<i>Emberiza stewarti</i>	Emberizinae
Rock bunting	<i>Emberiza cia</i>	Emberizinae
Grey necked bunting	<i>Emberiza buchanani</i>	Emberizinae
Reed bunting	<i>Emberizaschoeniclus</i>	Emberizinae

Source: Sheikh (2000, 2001, 2002, 2003). Roberts (1991, 1992), Mirza (2007)

Appendix – 3.2

HABITAT PREFERENCE OF NON-PASSERINE BIRDS

Common Name	Scientific Name	Mountain peaks, cliffs	Rocky slopes	Stony Foothills, Eroded Deposit	Riparian Area	Rocky Outcrops and Boulders	Springs, Streams/ Nullah	Valleys , Croplands, with settlements
Great or Eurasian Cormorant	<i>Phalacrocorax carbo sinensis</i>						+	
Chukar	<i>Alectoris chukar</i>		+	+				
Grey Partridge/Francolin	<i>Francolinus pondicerianus</i>		+					+
Himalayan Monal	<i>Lophophorus impejanus</i>	+						
Western Tragopan	<i>Tragopan melanocephalus</i>	+						
Marsh harrier	<i>Circus aeruginosus</i>						+	
Black kite	<i>Milvus migrans</i>							+
Shikra	<i>Accipiter badius</i>		+					+
Common Kestrel	<i>Falco tinnunculus</i>			+				+
Water rail	<i>Rallus aquaticus</i>						+	
Red-wattled lapwing	<i>Vanellus indicus</i>							+
Common sandpiper	<i>Actitis hypoleucos</i>					+		
Blue rock pigeon	<i>Columba livia</i>		+	+				
Indian ring dove	<i>Streptopelia decaocto</i>							+
Oriental turtle dove	<i>Streptopelia orientalis</i>							+
Little brown dove	<i>Streptopelia senegalensis</i>					+		+
Spotted dove	<i>Streptopelia chinensis</i>							+
Northern eagle owl	<i>Bubo bubo</i>							+
Common kingfisher	<i>Alcedo atthis</i>						+	
Indian roller	<i>Coracias benghalensis</i>							+
Hoopoe	<i>Upupa epops</i>					+		+
Asian Koel	<i>Eudynamys scolopacea</i>			+				+
Total		02	04	04	0	03	04	13

Appendix – 3.3

HABITAT PREFERENE OF PASSERINE BIRDS

Common Name	Scientific Name	Mountain peaks, cliffs	Rocky slopes	Stony foothills, eroded deposit	Riparian area	Rocky outcrops and boulders	Springs, streams/ Nullah	Valleys , Croplands, with settlements
Crested lark	<i>Galerida cristate</i>			+		+		
Yellow wagtail	<i>Motacilla flava</i>						+	
Grey wagtail	<i>Motacilla cinera</i>						+	+
White/pied wagtail	<i>Motacilla alba</i>					+	+	
Large wagtail	<i>Motacilla maderaspatensis</i>						+	
White-cheeked bulbul	<i>Pycnonotus leucogenys</i>		+		+		+	+
Brown dipper	<i>Cinclus pallasii</i>						+	
Blue throat	<i>Luscinia svecia</i>							+
Indian blue robin	<i>Luscinia brunnea</i>							+
Blue-headed redstart	<i>Phoenicurus caeruleocephalus</i>					+	+	+
Black redstart	<i>Phoenicurus ochruros</i>					+		+
White-bellied Redstart	<i>Hodgsonius phoenicuroides</i>						+	
Plumbeous water Redstart	<i>Rhyacornis fuliginosus</i>						+	
Common Stonechat	<i>Saxicola torquate</i>					+		+
Pied Bushchat	<i>Saxicola caprata</i>					+		+
Rufous-tailed Rock Thrush	<i>Monticola saxatilis</i>							+
Blue whistling thrush	<i>Myiophoneus cacruleus</i>			+				+
Eurasian blackbird	<i>Turdus merula</i>						+	
Grey-hooded flycatcher	<i>Seicercus xanthoschistos</i>							+
White-cheeked nuthatch	<i>Sitta leucopsis</i>							+
Eurasian nuthatch	<i>Sitta europaea</i>							+
Isabelline shrike	<i>Lanius isbellinus</i>							+
Bay-backed shrike	<i>Lanius vittatus</i>							+
Jungle crow	<i>Corvus macrorhynchos</i>		+		+		+	+
House crow	<i>Corvus splendens</i>				+	+	+	+
Common Raven	<i>Corvus corax</i>							+
Lanceolated/Black-headed Jay	<i>Garrulus lanceolatus</i>							+

Common Name	Scientific Name	Mountain peaks, cliffs	Rocky slopes	Stony foothills, eroded deposit	Riparian area	Rocky outcrops and boulders	Springs, streams/ Nullah	Valleys , Croplands, with settlements
Yellow-billed Chough	<i>Phyrhacorax phyrhacorax</i>							+
Common myna	<i>Acridotheres tristis</i>				+		+	+
Jungle myna	<i>Acridotheres fuscus</i>							+
House sparrow	<i>Passer domesticus</i>						+	+
Red-fronted serin	<i>Serinus pusillus</i>							+
Rock bunting	<i>Emberiza cia</i>							+
Grey necked bunting	<i>Emberiza buchanani</i>							+
Black Drongo	<i>Dicurus macrocercus</i>		+		+			+
Great Tit	<i>Parus major</i>							+
Total		0	03	02	5	07	14	28

Appendix – 3.4

MAMMALIAN SPECIES REPORTED FROM PROJECT AREA

Common Name	Scientific name	Family
Leaf-nosed bat	<i>Rhinolophus ferrumequinum</i>	Rhinolophidae
Whiskered bat	<i>Myotis muricola</i>	Vespertilionidae
Hairy-armed bat	<i>Nyctalus leisleri</i>	Vespertilionidae
Grey long-eared bat	<i>Plectus austriacus</i>	Vespertilionidae
Tube-nosed bat	<i>Murina tubinaris</i>	Vespertilionidae
Rhesus macaque	<i>Macaca mulatta</i>	Cercopitheidae
Himalayan grey langur	<i>Semnopithecus entellus</i>	Cercopitheidae
Indian wolf	<i>Canis lupus</i>	Canidae
Asiatic jackal	<i>Canis aureus</i>	Canidae
Hill or Kashmir fox	<i>Vulpes velpes griffithi</i>	Canidae
Black bear	<i>Ursus thibetanus</i>	Ursidae
Stone marten	<i>Martes foina</i>	Mustelidae
Yellow-throated marten	<i>Martes flavigula</i>	Mustelidae
Alpine weasel	<i>Mustela altaica</i>	Mustelidae
Common otter	<i>Lutra lutra</i>	Mustelidae
Himalayan lynx	<i>Felis lynx</i>	Felidae
Leopard cat	<i>Prionilurus bengalensis</i>	Felidae
Snow leopard	<i>Panthera uncial</i>	Felidae
Himalayan musk deer	<i>Moschus chrysogaster</i>	Moschidae
Grey goral	<i>Naemorhedus goral</i>	Bovidae
Markhor	<i>Capra falconeri cashmiriensis</i>	Bovidae
Cape hare	<i>Lepus capensis</i>	Leporidae
Royle's pika	<i>Ochotona roylei</i>	Ochotonidae
Small Kashmir flying squirrel	<i>Hylopetes fimbriatus</i>	Pteromyidae
Indian crested porcupine	<i>Hystrix indica</i>	Hystricidae
Himalayan wood mouse	<i>Apodemus rusiges</i>	Muridae
Roof rat	<i>Rattus rattus</i>	Muridae
Turkestan rat	<i>Mus turkestanicus</i>	Muridae
House mouse	<i>Mus musculus</i>	Muridae
Royle's high mountain vole	<i>Alticola roylei</i>	Muridae
True's vole	<i>Hyperacrius fertilis</i>	Muridae

Source: Roberts (1997)

Appendix – 3.5
PREFERRED HABITATS OF MAMMALS

Common Name	Scientific Name	Mountain peaks, cliffs	Rocky slopes	Stony foothills, eroded deposit	Riparian area	Rocky outcrops and boulders	Springs, streams/ Nullah	Valleys , Cultivated lands, with settlements
Asiatic jackal	<i>Canis aureus</i>							+
Indian wolf	<i>Canis lupus</i>	+						
Hill or Kashmir fox	<i>Vulpes velpes griffithi</i>		+					+
Common Leopard	<i>Panthera pardus</i>	+						
Leopard cat	<i>Prionilurus bengalensis</i>	+						+
Caracal	<i>Felis caracal</i>	+						+
Asiatic Black bear	<i>Ursus thibetanus</i>	+						
Himalayan musk deer	<i>Moschus chrysogaster</i>	+						
Markhor	<i>Capra falconeri cashmiriensis</i>	+						
Rhesus macaque	<i>Macaca mulatta</i>	+						
Total		08	01	0	0	0	0	04

Appendix – 3.6

AMPHIBIAN AND REPTILES REPORTED FROM THE STUDY AREA

Sr. No.	Scientific Name	Common Name	Family	Status	Remarks
1	<i>Bufo stomaticus</i>	Indus Toad	BUFONIDAE	LC	1000m, after rains
2	<i>Bufo viridis</i>	Green Toad	-do--	C	2200m, bare sandy soil
3	<i>Paa hazarensis/ Sternosignata</i>	Mountain Frog	RANIDAE	LC	2000m; small pool under overhanging rock; identification not confirmed
4	<i>Agama tuberculata</i>	Kashmir Rock Agama	AGAMIDAE	NE	1000m, open rocky areas
5	<i>Agama agrorensis</i>	Agrore Valley Agama	-do-	NE	Chances of occurrence
6	<i>Hemidactylus flaviviridis</i>	Yellow-bellied House Gecko	Gekkonidae	NE	Pattan
7	<i>Gymnodactylus stoliczkai</i>	Karakoram Rock Gecko	Gekkonidae	NE	Chances of occurrence
8	<i>Ophisops jerdonii</i>	Punjab/Jerdon Snake- eyed Lizard	Lacertidae	NE	Chances of occurrence
9	<i>Eumeces taeniolatus</i>	Yellow-bellied Mole Skink	SCINCIDAE	NE	1750m, under boulder
10	<i>Liolopsima himalayanum</i>	Himalayan Ground Skink	-do-	NE	2400, 2550, 2750m; boulder slopes
11	<i>Riopa punctata</i>	Dotted Garden Skink	-do-	NE	Chances of occurrence
12	<i>Coluber rhodorachis</i>	Cliff Racer	COLUBRIDAE	NE	1900m, basking at large boulder; Required confirmation of occurrence
13	<i>Coluber ravergieri</i>	Mountain Racer	-do--	NE	2600m, rough boulder slop
14	<i>Naja oxiana</i>	Oxus Cobra	ELAPIDAE	NE	Reported by local, in nallah Required confirmation of occurrence
15	<i>Agkistrodon himalayanus</i>	Himalayan Pit Viper	VIPERIDAE	NE	-do-; 2550, 2650m, basking at slop
16	<i>Sphalerosophis diademea</i>	Diadem Snake	Colubridae	NE	Chances of occurrence
17	<i>Ptyas mucosus</i>	Dhaman	-do-	NE	-do-
18	<i>Eirenis persicus</i>	Dark-headed Dwarf Racer	-do-	NE	-do-

LC=Least concern; C=Common; NE=Not evaluated (www.wfpak.org/images/reptiles_list.pdf, visited on 4-10-2012); Source: Palas Conservation Project.

Appendix – 3.7
SUMMARY OF PROTECTED AREAS IN PAKISTAN

Region / Province	National Parks	Wildlife Sanctuaries	Game Reserves	Un Classified	Total Protected Areas	Total Area Conser-ved (ha)	Percentage of Total Land Area Protected
Azad Jammu Kashmir	1	0	8	0	9	51,998	3.91
Balochistan	2	15	7	7	31	1,837,704	5.29
Punjab	2	37	19	0	58	3,315,803	16.14
KPK	3	6	38	5	52	470,675	6.30
Sindh	1	35	14	4	54	1,307,575	9.27
Federal Territory	1	1	1	0	3	94,186	100
Gilgit Baltistan	4	5	9	0	18	2,092,180	2.97
Total	14	99	96	16	225	9,170,121	10.40

Source: Mehmet et al.2010

Appendix – 3.8

PROTECTED AND COMMUNITY CONSERVATION AREAS IN KP

(A) Protected Areas in KP

Protected Area	Provincial Jurisdiction	Category	Area in ha
Ayubia	KP	National Park	3,312
Chitra1 Go1	KP	National Park	7,750
Sheikh Buddin	KP	National Park	15,440
Saiful Maluk	KP	National Park	12,026
Lulusar Dodipat	KP	National Park	75,058
Agram Basti	KP	Wildlife Sanctuary	29,66
Borraka	KP	Wildlife Sanctuary	2,025
Indus Waterfowl refuge	KP	Wildlife Sanctuary	3,774
Kotal	KP	Wildlife Sanctuary	100
Lukki Crane refuge	KP	Wildlife Sanctuary	5,180
Manshi	KP	Wildlife Sanctuary	2,321
Manglot	KP	Wildlife Sanctuary	715
Tanda Dam	KP	Wildlife Sanctuary	405
Bagra	KP	Game Reserve	2,560
Bilyamin	KP	Game Reserve	7,090
Chirat	KP	Game Reserve	3,480
Darmalak	KP	Game Reserve	9,788
Doda Paya	KP	Game Reserve	3,900
Drosh Gol	KP	Game Reserve	2,061
Gehrait Gol	KP	Game Reserve	4,800
Ghoranzadi	KP	Game Reserve	6,649
Goleen Gol	KP	Game Reserve	49,750
Indus River	KP	Game Reserve	81,000
Jabbar	KP	Game Reserve	13,288
Kacha Marai	KP	Game Reserve	6,143
Kilinjar	KP	Game Reserve	2,000
Kamrani	KP	Game Reserve	2,119
Kingargali	KP	Game Reserve	20,300
Mahidand	KP	Game Reserve	22,000
Makhnial	KP	Game Reserve	4,148
Mang	KP	Game Reserve	4,350
Maraiwan	KP	Game Reserve	5,300
Marchungi	KP	Game Reserve	4,480
Maroba	KP	Game Reserve	3,520
Nizampur	KP	Game Reserve	780
Pind Hashim Khan	KP	Game Reserve	3,520
Purit Go1/ Chitral Chinar Gol	KP	Game Reserve	6,446
Qalandar Abad	KP	Game Reserve	8,490
Rakh Sardaran	KP	Game Reserve	4,200
Rakh Topi	KP	Game Reserve	17,600
Resi/Toibanda	KP	Game Reserve	5,050
Sewagali	KP	Game Reserve	1,820
Shewaki-Chukhtoo	KP	Game Reserve	11,379
Shinawari Chapti	KP	Game Reserve	1,000
Sudham	KP	Game Reserve	11,500
Teri/Isak Khumari	KP	Game Reserve	19,966
Thanedarwa1a	KP	Game Reserve	4,047
Tog Mangora	KP	Game Reserve	3,200
Tooshi	KP	Game Reserve	1,545
Totaai	KP	Game Reserve	17,000
Zarkani	KP	Game Reserve	12,800

(B) Community Conservation Areas in KPK

Sr. No.	Provincial Jursidictin	Community Conservation Areas	Area in
1	KP	Arkari	100,000
2	KP	Naser Kuhay	4,000
3	KP	Begusht	8,000
4	KP	Tooshi Shasha	20,000
5	KP	Goleen Gol	40,800
6	KP	Madaklasht	14,500
7	KP	Manur	6,200
8	KP	Gehrait	95,000
9	KP	Kaigah Nullah	5,000
10	KP	Battal	32
11	KP	Dab Manpithai	730
12	KP	Kohi Barmool	1822
13	KP	Sori Malandri	749
14	KP	Garyalla Karmar	760
15	KP	Mahal Kalu	506
16	KP	Garu Amankot	1214
17	KP	Kohi Dara	202
18	KP	Baga Hills	61
19	KP	Shewa Karmar	627
20	KP	Naranji	2189
21	KP	Besak	530
22	KP	Punjpir	55
23	KP	Darwazai Banda	1000
24	KP	Shehzadi Banda	3814
25	KP	Sumari Bala	3416
26	KP	Kanra Cheenah	359
27	KP	Ustarzai Payan	1477
28	KP	Dowrro/ Algada	583
29	KP	Shamshukai	2696
30	KP	Jatta Ismail Khel	2826
31	KP	Kamar	5096
32	KP	Dhandidal Khel	3564
33	KP	Drish Khel	2705
34	KP	Banda Lakanai	2195
35	KP	Pungi Banda	1314
36	KP	Takwara (Hathala)	360
37	KP	Dewan Shah	821
38	KP	Thath Solhan	22.66
39	KP	Sheikh Sultan	187.5 Acre
40	KP	Mohib Banda	27
41	KP	Palsala Dhanaka	530
42	KP	Sigram	2654.7
43	KP	Mankial	13063
44	KP	Bhan	25000
45	KP	Tang Banr	395.4
46	KP	Amluk Banr	46.35
47	KP	Dheran Pattay	735.3
48	KP	Totai	3000
49	KP	Khanori	1300
50	KP	Brah	1420
51	KP	Tangi Darra	648
52	KP	Adenzai	24282

Source: Anwar M (2012)

Appendix – 5.1

**MANAGEMENT PLANS FOR ECOLOGICAL
CONSERVATION NEAR PROJECT AREA
(NOT RELATED TO IMPACTS OF DHP)****1. FOLLOW ON STUDIES - DATA GAPS REGARDING SIGNIFICANT WILDLIFE
HABITAT AND BIODIVERSITY, UNCERTAINTIES, RISKS AND PROPOSED
MEASURES**

Important species of wildlife such as Markhor, Musk deer, Western Tragopan, Black bear, Himalayan Monal exist in the study area at higher altitudes; however, data gaps exist regarding exact numbers and their distribution. Based on primary surveys, secondary review and community consultations; it is concluded that these species does not maintain their habitat in the project footprints and only occur in the higher altitudes away from the river. However, the access routes exist in various tributaries (nullahs) that are linked with the Indus river system and can provide increased access to the core wildlife habitat. This may result in increased poaching, hunting, trapping and wildlife killings. When more data is available, it can help to generate viable wildlife management plan. Table 5.1.1 presents key characteristics where data and information gaps are detected and research/ investigative projects can be initiated.

Mitigation Measures: The overall terrestrial ecology assessment for the DHP has covered all aspects of flora, fauna, forestry and general human practices that have a direct or indirect potential impact on the natural ecological settings of the area. Generally, further information on following topics may need to be collected to establish the overall biodiversity and terrestrial aspects of the EIA. Further research and data collection is recommended to understand the population dynamics and a successful community-based natural resource management (CBNRM) in the area within the immediate vicinity of DHP. Furthermore;

- Vantage stations will be established to monitor the presence and movement of Tragopan and migratory birds, breeding birds, small mammals, ungulates and otters.
- Key locations where notable wildlife including birds exists will be focused for further data collection especially focusing on breeding and migratory species.
- Wildlife awareness signage to be developed and located throughout the area to augment research and conservation programs.
- Population of small mammals is low in the project foot prints. However, small mammal trapping is recommended (mark and recapture at selected spots both upstream and downstream) to develop accurate understanding of the wildlife distribution and augment management and conservation in the area. Pitfall method to understand accurate distribution of amphibians/ reptiles is also recommended in the potential projects initiated with the support of DHP.
- Wildlife education and community/hunters consultation will also help in initiating successful wildlife research/ conservation programs.
- Engage with Conservation Agencies to initiate Species Conservation Projects focusing Markhor, Musk Deer, Western-horned Tragopan and others.
- Launching and Sustaining CBNRM, Conservation Hunting (CH) and Sustainable Use Initiatives.
- Developing Capacity of Forest, Conservation and Wildlife Departments to take hands-on action and involve in Community-based Conservation/ Management of Wild resources.

Table 5.1.1: Data Gaps, Mitigating Uncertainties, Risks and Plans

Data Gaps and Uncertainties	Proposed Plans/ Measures/ Mitigating Uncertainties	Details	Remarks/ Usefulness
Data is not sufficient on aquatic mammals; for example Otters <i>Lutra lutra</i> . Constant efforts were made to record any sightings but no records were made.	More research and field studies are recommended to confirm the exact status of the species. A total 8 weeks of fieldwork is recommended during winter months at least for 2 years to confirm the presence and distribution. Same should be repeated in next year.	It is generally believed that Otters are not existing in this stretch of the Indus.	Otters are recently reported from Tarbela and Ghazi Brotha catchments. However, data is required from Basha to Thakot region. This assessment will not affect the result of the EIA but may improve the overall conservation and management of species. The new research should focus on the impacts of construction and operation of dam and consequently quantify any impacts on Otters (if found in this area).
To complete the data on threatened species of birds existing at higher altitudes such as Western-horned Tragopan by extension of the observation season	To establish the presence of threatened species and to develop specific mitigation measures if required.	Augment the current assessments through secondary resource review and consultations with selected individuals/agencies. It might be useful to engage in research and fieldwork in Feb/March/April/ May so that birds could be identified in the pre-breeding/ breeding seasons.	This assessment will not affect the result of the EIA but may improve the overall conservation/ management of this endangered species in the upper reaches of DHP.
To complete the data on birds on Migratory Birds, Wetland Birds by extension of the field observation season	To confirm the exact species of migratory birds and to develop specific mitigation measures if required. Further surveys and observations are required during winter period.	This will confirm the significance of wetlands and their overall conservation network in northern Pakistan; as well as confirm the overall potentials for migratory birds.	This assessment will not affect the result of the EIA but may improve the overall conservation and management of species.
Mark and re-capture may be used to confirm the presence and population status of small mammals.	A total 4 weeks of fieldwork would be required during winter period to confirm the above noted aspects/ parameters.	Complete research through secondary resource review and consultations with selected individuals/agencies.	This assessment will not affect the result of the EIA but may improve the overall conservation and management of species.

Data Gaps and Uncertainties	Proposed Plans/ Measures/ Mitigating Uncertainties	Details	Remarks/ Usefulness
Study exotic and Invasive Alien Species to prevent their spreading or to limit their growth are essential.	To establish the presence of exotic species and to develop specific mitigation measures if required;	Study the potential of fostering exotic species upstream and downstream. Exotic species tend to displace indigenous biodiversity.	This assessment will not affect the result of the EIA but may improve the overall conservation and management of species.
To complete the data on breeding birds by extension of field observation season	To confirm the exact species of migratory birds and to develop specific mitigation measures if required	Carry out primary field work and secondary research to confirm research in late winter and pre-breeding season to confirm the breeding range of birds in the downstream.	Mist-nets may be employed to confirm the birds in various reaches of the valleys. This assessment will not affect the result of the EIA but may improve the overall conservation and management of species.
Ungulate Research Monitoring Program (URMP) for Markhor and Musk deer.	This can become a major revenue generation activity, once their population is maintained and promoted through sustainable use hunting	Research should be carried out for next five years covering gestation period for both species.	This will help identify areas of conserving large mammals especially ungulates. This is only possible if the ungulate populations are monitored consistently. This will help in establishing scientific priorities and long-term conservation needs.

SCOPE OF WORK TO MITIGATE DATA/ INFORMATION GAPS AND UNCERTAINTIES

Following scope of work is proposed to carryout various activities and research programs in the DHP study area.

1. Study the problems and issues of current forestry practices and develop a forestry management plan to safeguard the forest resources of DHP area (2013-2015). Consultant teams will engage with a diversity of local, provincial, federal and conservation/ NRM groups to consolidate their findings and
2. Carryout a detailed field survey from Basha dam axis site to Tarbela and establish Vantage Points at every 10 kilometres to collect sufficient data on the occurrence and distribution of Otters in Indus River and its tributaries system.
3. Carryout extensive field surveys for two years to confirm the key habitats of various Galliformes in the Dasu district (2013-2015).
4. Carry out an extensive survey of all the area from the confluence of Gilgit River with Indus to Tarbela reservoir and identify any exotic and alien species taxing the natural ecosystem for three years (2013-16).
5. Demonstrate mist-netting and bird banding of various migratory species to ascertain their presence and distribution in the area (Five years from 2012-2017). The surveys and investigations sites should be located all over the area.
6. Develop and execute an Ungulate research and monitoring program to conserve and manage the ungulate populations in the Diamer-Basha and DHP (5 Years 2012-2017). This will solidify the existing information and help streamline the conservation and management practices.

7. Mark and re-capture method for small mammals and pit-fall method for amphibian should be used to confirm the presence and distribution of a variety of species in the project areas. The field investigations should be carried out from Thakot all the way to Diامر-Basha dam axis site.
8. Develop a complete repository of information on the insect fauna and biodiversity of the Indus river ecosystems (2012-2015).

PROSPECTIVE INDIVIDUALS/ PROFESSIONALS/ AGENCIES TO DELIVER/ ENGAGE IN ABOVE NOTED PROJECTS

- Dr. Tariq Mahmood, University of Arid Agriculture, Rawalpindi
- Dr. Aleem Ahmed Khan, BZ University, Multan
- Prof. Z. B. Mirza, CERC, Islamabad
- Mr. Umeed Khalid, NCCW, Ministry of Climate Change
- Mr. Naeem Ashraf, Ministry of Climate Change
- Dr. Masood Arshad, WWF-Pakistan
- Dr. Najam Khursheed, Karachi
- Dr. M. Sajid Nadeem, UAAR, Rawalpindi
- Dr. Rehamatullah Qureshi, UAAR, Rawalpindi
- Dr. Zulfiqar Ali, University of the Punjab, Lahore
- Dr. Kashif M. Sheikh, NatSoc, Alberta, Canada
- Dr. Rizwan Irshad, King Saud University, Riyadh, Saudi Arabia
- Dr. Abdul Aleem Chaudhry, ACC, Lahore
- WAPDA Pakistan
- NARC, Islamabad
- PARC, Islamabad
- University of Azad Jammu & Kashmir, Muzaffarabad
- University of Agriculture, Faisalabad
- University of Arid Agriculture, Rawalpindi
- University of Agriculture, Peshawar
- University of Arid Agriculture, Rawalpindi
- International Islamic University
- UNDP Pakistan
- WWF Pakistan
- IUCN Pakistan
- Pakistan Forest Institute (PFI)
- Quaid-i-Azam University, Islamabad
- Pakistan Museum of Natural History
- Aga Khan University, Karachi
- Lahore University of Management Sciences, Lahore
- Pakistan Forest Institute, Peshawar
- University of Peshawar, Peshawar
- University of the Punjab
- Government College University, Lahore
- Lahore University of Management Sciences
- Bio Resource Centre – Pakistan
- University of Karachi – Karachi
- Fatima Jinnah University – Rawalpindi
- Banff Centre, Alberta – Canada
- ICIMOD Nepal
- PTDC Pakistan
- Ministry of Climate Change, Islamabad
- Ministry of Tourism, Islamabad
- Lok Virsa Museum
- Aga Khan Cultural Service
- AKDN/ Aga Khan Rural Support Programme
- Pakistan Museum of Natural History
- KPK Forest Department

- KPK Wildlife Department
- National Council for the Conservation of Wildlife
- KPK Agriculture Department
- Ministry of Climate Change, Islamabad
- Himalayan Wildlife Foundation
- Kinnaird College University, Lahore
- Cholistan Institute of Desert Studies, Bahawalpur

2. DEVELOPMENT OF HORTICULTURE/ SILVICULTURE COMPLEX

A horticulture/ silviculture complex is recommended with plant species to be grown and serve as seed banks for conservation and forestry purposes.

Feasibility: Considerable scoping and target setting will be needed to put this into a practical reality. However, only a broader scope is discussed here to pave the way in developing a complex. The project's detailed design will require apt economic, market and environmental analysis along with the participation of local stakeholders and experts from key forest and agricultural institutions in Pakistan. The DHP complex would strongly support generation of suitable local employment opportunities for the present livestock farmers (and illegal wood loggers). Ideally, this complex should be established in the downstream of the dam axis site for maximum economic activity and community participation and for being close in proximity to Dasu, Komila, Pattan, Besham and other urban/ suburban settlements. About 25 acres can be devoted for maintaining and preserving habitat and plant diversity depicting natural vegetation. It is proposed that this horticultural/ silviculture complex is situated downstream near Malyar village since the vegetation is homogenous in the whole area.

Apart from a main building of the horticulture, several small pieces of land will also be allocated for local small farmers to grow and market seeds for the local communities and commercial contractors. Horticultural complex under the auspices of WAPDA will engage with industry, government or educational institutions or private collections. It will have essential institutional linkages with cropping systems engineers, wholesale or retail business managers, propagators and tissue culture specialists (fruits, vegetables, ornamentals, and turf), crop inspectors, crop production advisers, extension specialists, plant breeders, research scientists, and teachers in the down country.

As an essential component of horticulture; tree nurseries¹ will be developed that are a key success factor in many forestry and agriculture development interventions. Nurseries will serve as a constant source of tree seedlings to cope with the demands of the tree plantations especially in the areas where forest clearing and constant movement of construction traffic will be carried out. Users would include the nursery operator themselves, individuals, community organizations, farmer groups, government agencies, non-government organizations, corporate or private customers. In DHP; the horticulture complex and its silviculture nurseries will be owned by the KP Forest and agriculture departments and it is anticipated that at least 6-8 member staff will be required to manage the affairs of a Forest Nursery. The nursery will provide native tree plantations and also manage the needs of green belts and horticultural needs in model villages and residential areas of DHP.

Project tree nurseries are recommended in the case of DHP. Project nurseries are those established and managed by projects, nongovernment organizations (NGOs) or development organizations. They promote a tree planting culture within target communities. The intended lifespan of project nurseries is usually 3-5 years, but may

¹ A tree nursery will be a managed site, designed to produce tree seedlings grown under favorable conditions until they are ready for planting. It can be an informal, small-scale arrangement or a large commercial enterprise. However, all nurseries primarily aim to produce sufficient quantities of high quality seedlings to satisfy the needs of seedling users.

continue for longer periods. Production capacity varies from 10,000 to 100,000 seedlings per year. Project nurseries are usually established at the community level. DHP affected community members can participate in nursery planning and work in the nurseries to varying degrees; however the DHP designated organization will handle nursery management. Project nurseries will have access to technical information and resources produced by institutional nurseries. They will promote technical training for the target community and catalyse group nursery development.

The approximate budget for this plan would be US\$ 4 million and the resources requirements are given below:

Resource Requirements:

Staff Requests:

Manager/ Supervisor	(1)
Horticulturalist	(2)
Research Scientist and Specialists	(2)
Ethnobotanist/ Medicinal Plants Expert	(1)
Administrative Accountant/ Clerk	(2)
IT/ Communication Assistant	(1)
Business Development and Market Analyst	(1)
Visiting Scientists for Exchange and Training	(Varying Number)
Security Guards	(2)
Nursery Trainers	(4)
Extension/ Community Workers	(4)
Drivers	(2)

Other Resource Requirements:

Building/ Infrastructure/ Land/ Design
 Green House
 Transportation/ Cars
 Supplies and Equipment
 Research Budget

3. FOREST MANAGEMENT PLAN (FMP)

The forests on KP and GB are under evergrowing human pressure. A Forest Management Project with the objective of regeneration of forest at higher altitudes can be implemented within the framework of livelihood restoration program. The FMP will ensure the sustainability of the protected and private forest. It will be essentially linked with the horticultural developments in the DHP. At the outset a need assessment² and consultation will be required with the key forestry stakeholders in the first year of the Phase I. Principally, an FMP should;

- Plan long-term beyond the continued timber yield.
- Embrace the concept of sustainable forest management in participation with local stakeholders.
- Recognize other resource values and uses (biodiversity, water conservation)
- Clarify how the harvesting plan will be delivered
- Strategize how performance will be measured and monitored in DHP area.
- Involve local people in discussion from all villages and nullahs.
- Take local administration into confidence and design appropriate access routes for the management of forests.
- Taking political management in confidence so there is political will and buy-in
- Outlines the harvesting, renewal and other activities to be carried out.
- Addresses how the operator/ contractor will manage for forest values other than timber.

² Need assessment is realized as an activity which will delineate the exact socio-economic and environmental requirements of an FMP; as well as set measureable targets with the active participation of local communities, forest department, interest groups and other key stakeholders.

It is assumed that if following policies are being put into exercise; the forest management practices can be improved in the project area.

- Ensure people's participation at all stages of forestry sector project's formulation for improved ownership.
- The study of socioeconomic and demographic conditions should be carried out before launching a social forestry project in an area.
- A credit facility over the gestation period of the plantations may be made available to the participating farmers.
- All the wastelands available along the villages, and roadsides in addition to other degraded lands for wood production should be utilized.
- Educational and extension activities/ services should be backed with research.
- Efforts are required to motivate and encourage the local communities to raise woodlots in order to reduce pressure on the prevailing woody stands.
- Information regarding marketing should be gathered and very clearly communicated to the local communities.
- The existing trends of wood production and utilization, including the alternatives being used should be considered and communicated.
- Corporate sector should be encouraged/involved for long-term successful initiatives.

FMP can be implemented through the collaboration of the forest industry, local communities, government agencies, other resource users and the public. It will be essentially linked with Horticultural complex for maximum results and productivity. Public involvement is a key part of the planning and implementation process for FMPs. Along with preparing the plan itself, plan developers must develop consultation programs to inform and invite public involvement in developing the Forest Management Plan. Plans must also provide for ongoing dialogue with the public concerning day-to-day harvesting and renewal operations, resource impacts and potential conflicts. Further work is required; however, the FMP will typically go through four stages.

Stage 1: Assess present conditions. WAPDA supports Forest department to document the current state of the forests, age class distribution, species composition, bodies of water, existing roads and wildlife habitat.

Stage 2: Set objectives to achieve desired future conditions. WAPDA support Forest department and other natural resource groups to identify composition and age of forest stands and fiber production. Various groups should identify requisite habitat desired for the forest unit in the future and outline how it will sustain those traits and values over time. Forest Department should seek further advice in forest planning through soil science, wildlife biology and hydrology.

Stage 3: Identify options and strategies for achieving the objectives. WAPDA supports the KP Forest department to consult the public about the best balance of values to promote in forestry practices and develop three or four different harvesting and management strategies.

Stage 4: Implement and assess the selected plan. Once WAPDA has received the management plan from the concerned stakeholders. It should help Forest department to get the management plan approved. It can then schedule harvesting, silviculture and other management activities. Any deviations from the plan must be recorded and justified.

FMP Monitoring: To carry out their plans, forest managers often turn to national forest policy, provincial forest policy and forest practice codes or guidebooks of best management practices. Monitoring and auditing during this stage should confirm that a forest operation goes as planned. WAPDA itself may do the audit or, alternatively, the forest department or an independent third party may do it.

The adoption of tree planting for wood production is not very easy therefore, all the stakeholders must make concerted efforts to create social awareness and devise effective forestry strategies. Social forestry program will meet success when people's participation is ensured in planning, execution, selection of area, choice of species, management, harvesting and distribution of produce and benefits.

4. MEDICINAL MANAGEMENT PLAN

Feasibility: Kohistan district including Dasu project study area possesses reasonable diversity of medicinal plants due to merger of three greatest mountainous ranges of HKH. There are 61 plant species are recorded which are being used by the local communities for treating various diseases. Other species also have some supplemental medicinal uses as well. Some of the notable species include *Myrtus communis*, *Zizyphus sativa*, *Carum carvi*, *Citrullus colocynthis*, *Artemisia maritima*, *Ephedra intermedia* and *Valeriana willichii*. All these species are fairly used by the people in the study area. In addition, *Ephedra intermedia* is used as narcotic agent for making *Naswar*, a traditional narcotic agent. Most of the species are fairly distributed in the whole area, however some species such as *Bergenia ciliata*, *Calotropis procera*, *Centella asiatica*, *Citrullus colocynthis*, *Datura stramonium*, *Ephedra intermedia*, *Indigofera heterantha*, *Myrtus communis*, *Thymus serpyllum*, *Valeriana wallichii*, *Withania coagulens* and *Zizyphus sativa* are found in small pockets/ patches. The ripened fruits of *Myrtus communis* and *Zizyphus sativa* are edible and even sold in Pansar Bazar/Jari buti stores (herbs and spice stores). The leaves of *Thymus serpyllum* and *Myrtus communis* are also used as green tea. All these important species are found beyond the boundary of submergence. Most of the above-mentioned plants are located at higher elevation i.e. > 1000 amsl. Followings are some recommendations to mitigate the overall impacts on medicinal plants;

1. Census of population dynamics of key medicinal plants and their distribution.
2. The whole area should be thoroughly surveyed for collection of data as well as medicinal plants for in situ and ex situ conservation (e.g. in protected area and in gene banks).
3. Ex situ field gene banks need to be developed, particularly for habitat-specific as well as slow-growing species.
4. Regularly monitoring the conservation status of medicinal plants.

The institutional plan within the horticultural complex will host a medicinal plant expert who will assist with research, training and marketing of important plant species. This expert will liaise with local communities to develop a shared understanding of these resources and their and develop a node traditional knowledge exchange. He will also bridge with market analyst at the complex to explore avenues of economic generating activities for the local communities. Many of the species can then be propagated in the facility of horticulture complex and or the specific lands designated by the local farmers and villagers to grow native plants. As a next step, the products can be marketed to the local, regional and other urban markets where such plants and materials can be exported for various medicinal and commercial uses. In the end, the local capacity and vision will enhanced and the key beneficiaries will be the people of Dasu and Kohistan.

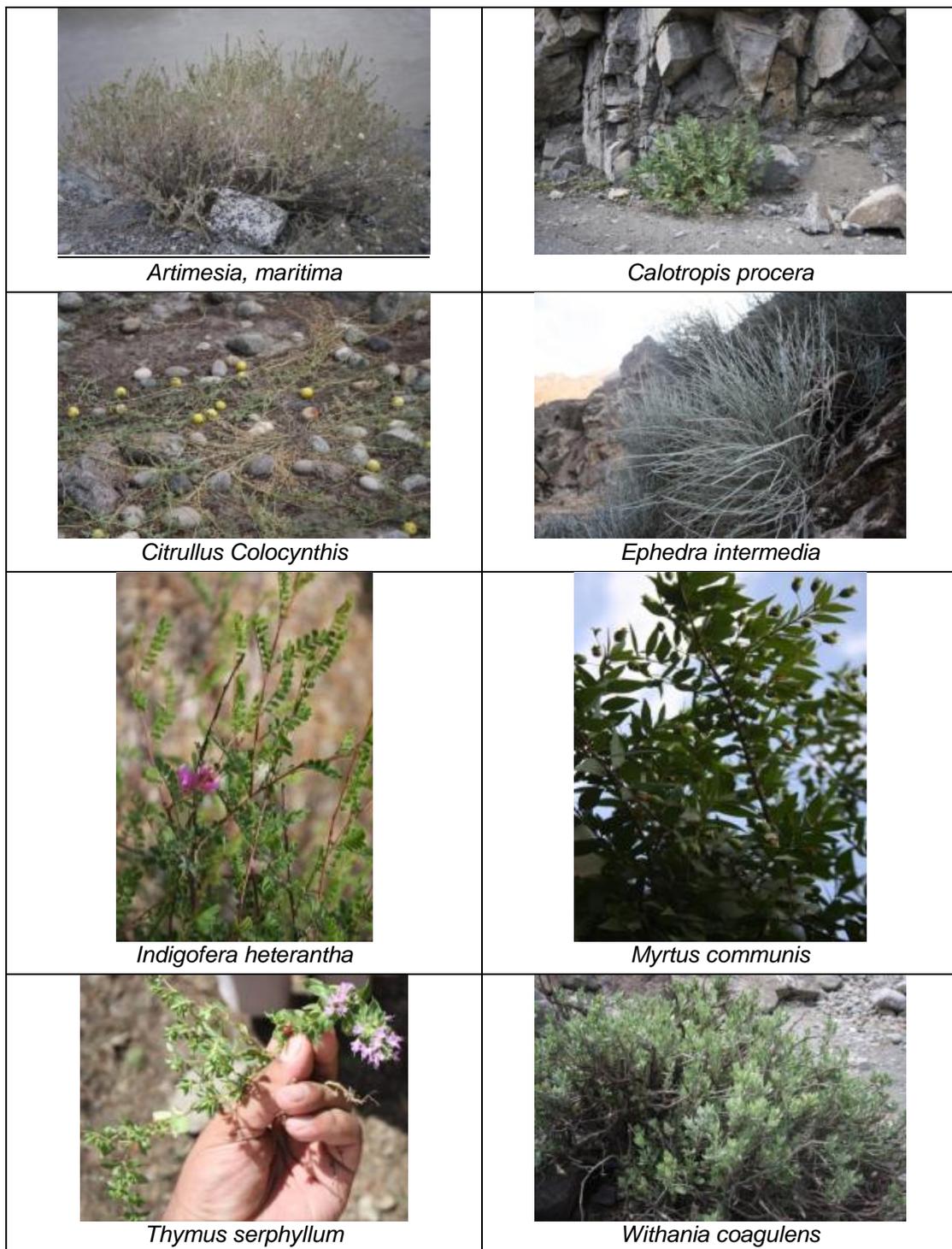


Figure 5.1.1: Important Medicinal Plant Species recorded from study area

5. TRAINING/CAPACITY BUILDING

Objective of the Plan is developing institutional capacity/training of Forest, Agriculture, Conservation and Wildlife Departments to take hands on actions and involve in sustainable agro-biodiversity, NRM and Conservation. The key training should focus on;

- Understanding of the importance of the mountain habitats and its associated biodiversity.
- Understanding of the marketable products from the DHP, such as locally made products from timber (NTFPs) and fruits.

- Development of nature-based tourism (eco-tourism) opportunities. Training should focus on adventure tourism, wildlife safaris and wildlife watching, conservation hunting.
- Basic courses in effective communication to improve coordination amongst institutions and their personnel.
- Protected areas management planning and their use for nature-based tourism.
- Effective agriculture through water conservation
- Better Access to the market for agricultural and forestry products.
- An awareness and counselling course focused on local environmental issues/ opportunities for the education of local communities/ visitors to protect the wildlife, habitats and environment of the area.

Once this type of training is imparted to personnel then the same can be extended to specific segments of mountain communities and they can sue for their socio-economic improvements. Community based education and conservation programs should be initiated for the long term benefits and success of DHP. Public consultation and workshops are required for brainstorming of the local communities and to involve them in conservation/ management activities.

This program can also support research programs for national/international reserachers and explorers to promote sustainable development in the mountain areas. Students from universities can be engaged for their M. Phil and Ph. D. research and for long term monitoring and assessment needs of the mountain wilderness environment. These personnel may be engaged for the scope of work designed to reduce the data gaps in the environmental management and conservation of the area. A collorboracion can be made with the following agencies:

- PFI, Peshawar
- Quaid-i-Azam University, Islamabad
- Pakistan Museum of Natural History
- Aga Khan University, Karachi
- Pakistan Forest Institute, Peshawar
- University of Peshawar, Peshawar
- University of the Punjab
- University of Agriculture, Faisalabad
- Univ. of Arid Agriculture, Rawalpindi
- Government College Univ., Lahore
- Lahore University of Management Sciences
- Bio Resource Centre – Pakistan
- University of Karachi – Karachi
- Fatima Jinnah Univ. – Rawalpindi

The program can also support experimentation stations/laboratory for NARC Islamabad and such other agriculture and enhancement pograms to boost Rural Economies (leading to sustainable agro-biodiversity). Similar programs can also be established at University of Agriculture, Faislabad, University of Arid Agriculture, Rawalpindi and University of Agriculture, Peshwar.

6. WILDLIFE CONSERVATION

Over the past decades, the recognized importance of protecting mountain ecosystems resulted in numerous protected areas in the mountain biomes around the world. This success has created an opportunity. The world's relatively well-developed systems of mountain protected areas can serve as examples of how to address connectivity issues, building ecological networks and applying the ecosystem approach. Mountain protected areas can demonstrate conservation strategies through ecosystem corridors to maintain biodiversity pattern and process in the landscape. Further, as mountain ecosystems are vulnerable to global changes, including the effects of climate change,

they can also serve explore adaptation options while generally raising the profile of the issues. As well, there is a need for a clearer understanding of how cultural and spiritual values can be fully recognized and appropriately protected alongside natural ones. There is also a need to recognize and promote the involvement of a diverse range of communities in protected area establishment and management.

One approach for conservation of mountain wildlife is - engage with Conservation Agencies and programs to initiate Species Conservation Projects focusing Markhor, Musk Deer, Western-horned Tragopan and others.

These programs will provide catalyst resources and conceptual framework for future community-based conservation and environmental programs. There are certain programs which have already shown signs of success in various remote parts of Pakistan.

Certain conservation programs such as IUCN, WWF, and WCS are engaged in the conservation and management of mountain biodiversity. Similarly, national universities and research institutions have an ongoing interests and obligation to collect information and use this for effective decision making. NCCW, Pakistan Museum of Natural History would be effective public-sector institutions to partner with.

The catalytic resources and funding that can come from DHP can help sustain long-term healthy ecosystem-based management of this mountain landscape.

Further projects and programs and action may involve;

- Launching and sustaining Community-based Natural Resource Management (CBNRM), Conservation Hunting (CH and Sustainable Use Initiatives.
- Introducing Wildlife safaris, Trophy hunting and Waterfowl Hunting programs

These types of conservation and sustainable use programs will require organization of the communities, buy-in of the institutions responsible and availability of the catalyst funding to promote these drivers.

7. WATERFOWL MIGRATION STUDY

Migratory birds using Indus flyway may use the reservoir as staging ground. There are several areas throughout the upstream where various nullahs form a zone of slow water movement and spreads like a pond. Pakistan lies in the northwestern part of southern Asia bordering with Afghanistan, Iran, China, India and in the south, the Arabian Sea. Wetland habitats, both natural and man-made, cover approximately 7800 km² (9.7% of the total area of Pakistan). The Indus river system and its flood plains form the main inland wetland areas. From the northern mountains to the southern coast, wetland areas provide refuge for large numbers of wintering migratory birds. Ducks, geese and swans pass through the high mountains to reach lowlands rich with lakes and man-made wetlands. Bar-headed Geese *Anser indicus* fly over high altitude passes as high as 6 000 m and above in a single flight.

An internationally coordinated field research on migratory birds and their habitats must be carried out on a regular basis. This should also include integrated migration studies to know the migration routes and exact breeding grounds of populations wintering in various areas of the mountainous regions. Integrated Waterfowl management planning must be undertaken on international basis.

Develop a team of dedicated amateur and professional researchers, university students, hunters and managers from all parts of Pakistan; to establish a network for recording up to date information on the distribution and movements of migratory birds at Dasu reservoir and develop a consistent and reliable data over 5-10 years. A bird ringing and recording stations established to do banding and recording of birds. This will require regular mist-netting and habitat ecology study of species for long-term successful management. In the bigger picture, it would be strategic to initiate a regional research project developed including Pakistan, China, Afghanistan, India, Russia and Central Asian states to establish a clear record of the population and

migratory nature/ routes of species. The researchers in this endeavour should share information and develop useful conservation strategies.

Kaigah is the only community conservation area (CCA) found in the study areas but there is valuable potential for similar conservation areas in other areas of DHP and its surroundings. It is noticed that Kaigah CCA has shown substantially positive results for the local communities. Markhor and other wildlife are protected from local hunting and poaching under a community-based conservation program of the Government of Pakistan and international conservation programs. The wildlife is marketed in the national and international markets and foreign wealthy hunters are invited to hunt species such as Markhor under special license and quota system. Most of the revenue and proceeds from these community-based hunting programs are distributed to the local communities and also in developing health and educational facilities for the benefit of local rural people. In addition;

Kandia, Thooti and Laachi nullahs/ villages should be studied for involvement and feasibility studies should be prepared to declare them as CCA. These studies should be led by KP wildlife department in collaboration with WWF, IUCN, and other local organizations of Dasu. The terms of references for the Feasibility study would be following;

- i. Interview and consultation with local communities in these villages.
- ii. Need assessment and listing of the key issues and opportunities.
- iii. Preliminary field survey and census of wildlife especially Markhor, Musk deer, Black bear and other species.
- iv. A detailed listing and assessment of the potential of the plants of economic value.
- v. Discussion with stakeholders and potential funding agencies.

Once new CCAs are established; then community-based organization (CBOs) will be required to study the desire, willingness and will power of the targeted communities. After need assessment and feasibility studies; detailed research and census of the wild resources will provide handsome data to execute a well-run CCA. These protected areas establishments will help in conserving the ecological character of representative samples of various eco-systems. These protected landscapes will also serve as an ongoing repository of ecosystem, species and genetic diversity. Funds generated from the foreign hunters through trophy hunting licenses, when used for the local development projects will transform the thinking of local poor and they would consider importance of wilderness and wild species. A part of this income can be devoted to support the wildlife staff, thus ensuring that protected zones are properly managed and respected and also for the improvement of habitat. This strategic direction in conservation shall reassure the policies and practices of provincial and federal governments to create, effectively manage and strengthen protected areas networks in northern Pakistan.