SUSTAINABLE FOREST MANAGEMENT PLAN

KOT DHINGANO-LAKHAT RIVERINE FOREST LANDSCAPE (SINDH)

2021-2030

INTERNATIONAL UNION FOR CONSERVATION OF NATURE, PAKISTAN FEBRUARY 2021

TABLE OF CONTENTS

List of Tables

List of Figures

FOREWORD

The Province of Sindh came face to face with the unprecedented challenges of the continuous reduction of high conservation value Indus Riverine Forests. This challenge needs the immediate priority for the Government to tackle the issue of provincial as well as national interest on war footing and address the underlying causes of degradation in such an important forest ecosystem. The degradation and loss of Riverine forests is one such contributing factor, disrupting nature's balance and posed a serious risk of climate change related issues for the people of province.

These forests are home to vast majority of terrestrial and freshwater biodiversity – from endemic Indus dolphin to largely threatened hog deer. Together, they contain approximately 50 percent of all plant and animal species diversity in scattered/ fragmented forests of riverine tract. These forest landscapes provide habitats for most of birds and mammal species found in the province and some of the important reptiles. However, presently very few pockets of riverine forests are relatively intact; majority of these exist in fragments with little or no connectivity. Deforestation is a major threat to these precious forests, which is one of the main reasons for the loss of biodiversity.

The effectiveness of 'Agroforestry Lease Policy 2005' in the context of riverine forests in Sindh and related actions and approaches for conservation and sustainable development of forests has raised a big question for naturalists. Therefore, the 2005 policy was abrogated by the provincial government on the direction of Supreme Court of Pakistan. However, despite introduction of 'The Sindh Sustainable Forest Management Policy, 2019', the ground situation confirms that deforestation and forest degradation continue to take place at alarming rates, which contribute significantly to the ongoing loss of biodiversity. Agricultural expansion continues to be one of the main drivers behind forest clearance in the province.

The one possible solution to stope ongoing degradation of riverine forests of Sindh is to protect and manage productive riverine forests resources and trees within an integrated landscape approach and reverse the damage done through forest restoration efforts.

Critical to these transformations are effective governance, policy alignment between sectors and administrative levels, land-tenure security, respect for the rights and knowledge of local communities, enhanced capacity for monitoring of forest biodiversity outcomes, and by no means less important, innovative financing modalities.

Sindh Forest Department has lost the tradition of managing forests under long term forest management plans, which should be reversed. The process initially has been begun with the preparation of 10-year forest management plans for the two forest landscapes selected for sustainable forest management under the SFM project.

IUCN during development of this management plan of Kot Dhingano-Lakhat Riverine Forest Landscape has benefited from the baseline data acquired and collected by the SFM Provincial Coordination Unit in support of SFM project, provincial forest field staff and IUCN management team.

(Sindh Forest Department)

VISION STATEMENT

Sindh sustainable forest management policy 2019 envisions a future in which '*forest ecosystems are healthy for the wellbeing and more prosperous future of its people and the global society'.* It entails *'Forests for People and Planet'* as a Tagline. This is premised on forestry in Sindh regaining its past glory by restituting and restoring the forest lands to full forest cover, which is sustainably managed and expanded. It espouses futuristic and inclusive approach for sustainable management of forestry resources for the benefit of society and transforming greener and environment friendly Sindh.

The long-term vision for the Kot Dhingano-Lakhat Riverine Forest Landscape is to demonstrate landscape-scale application of forest biodiversity conservation. It is hoped that the natural resources of this landscape can be used for low impact on fragile riverine forests and socio-economic benefits of surrounding local communities, along with enhanced awareness, capacity and support in the planning and sustainable management of forests for biodiversity conservation, climate change mitigation and carbon sequestration. It is further hoped that the management of this forest landscape can be used to highlight the positive steps taken by the Sindh Forest Department towards both conservation and sustainable economic development, through sustainable forest management (SFM).

ACKNOWLEDGEMENTS

The IUCN Pakistan would like to express sincere gratitude for the kind support of GEF-UNDP funded Sustainable Forest Management (SFM) project team at Federal as well as Provincial level by providing maximum baseline information/ data of the Kot Dhingano-Lakhat Riverine Forest Landscape. Sincere gratitude is extended to SFM Provincial Coordinator and officers of Sindh Forest and Wildlife Departments, especially staff deputed at landscape level.

EXECUTIVE SUMMARY

The Riverine forests get inundated between June and August resulting in moisture and sedimentary soil deposits which in turn promote growth and regeneration. Riverine forests are the main source of income in Sindh. They provide protection to arable lands, strengthen river embankments, and provide timber and fuelwood for local needs, pit props for coal mines, habitat for wildlife, fodder, and grazing grounds for livestock. Despite considerable ecological and environmental importance of these forests, their extent, species composition and overall condition has considerably deteriorated since the establishment of upstream dams, barrages, and protection *bunds* to protect adjoining dwellings and arable lands from repeated flooding (FAO 2020).

Kot Dhingano-Lakhat (KDL) Riverine Forest Landscape is located along the Indus River, downstream of Sukkur Barrage on the left bank near Kazi Ahmed City in Deh Kot Dhingano, Union Council Guhram Mari, Tehsil Sakrand, District Shaheed Benazirabad (formerly Nawabshah). This high conservation value forests landscape has a number of very special features, which makes it significant for biodiversity conservation in Sindh province, such as the diversity of unique and unusual forest stands, important wetlands and high diversity of aquatic as well as terrestrial birds and other wildlife species.

The landscape is comprised of Dhingano Reserved Forest 1,580 ha (3,904.030 acres) and Lakhat Reserved Forest 4,880 ha (15,957.279 acres). Both forests are also separately designated as wildlife sanctuaries under the Sindh Wildlife Protection Ordinance, 1972 (now Sindh Wildlife Protection, Preservation, Conservation and Management Act 2020) in addition to their designation as Reserved Forest under the Forest Act, 1927. The total area of the Dhingano-Lakhat Riverine landscape is 6,460 ha (15,957.279 acres). The landscape is habitat of Hog deer as well as home of other many resident and migratory birds. The main tree species are Babul (*Acacia nilotica*), Kandi (*Prosopis cineraria*), Lawa (*Tamarix aphyla*), Lai (*Tamarix dioca*), and Bahan (*Populus euphratica*).

The Forest Landscape holds a unique position for Sustainable Forest Management (SFM) in Sindh. This reserved forest is not only special in terms of its inherent natural features, but diverse forest also contains, significant wildlife populations, wetland wealth, Non-timber Forest Products (NTFPs) and involvement of surrounding local communities in the forest protection and management. This is one of the high conservation value forest landscape identified under SFM project from Sindh province. This forest landscape hosts a lake and a high abundance of key wildlife populations and forms an important link in the forest biodiversity corridor along the Lower Indus River.

The socio-economic survey (2019) reveals that there are approximately 10,000 individuals surviving in 10 villages around the forest landscape. The two main villages are Razi Jatoi and Hamzo Jatoi with 1,545 households. The local people of these villages are actively assisting the Forest Department and involved in protection and conservation of forest resources.

The long-term objectives of KDL landscape plan are to: (1) Reverse the loss of high conservation value riverine forest cover through SFM practices, (2) Enhance forest-based economic, social, and environmental benefits by improving the livelihoods of forest dependent local people, (3) Increase the proportion of forest products i.e. NTFPs from sustainably managed forests, and (4) Promote governance framework and mobilize

increased, additional financial resources from all sources for the implementation of SFM landscape management plan and strengthen community participation.

The forests within landscape are severely degraded, and these are facing severe anthropogenic pressure. Open grazing and cutting for fuelwood are serious threats to these forests which have significantly reduced the aboveground carbon stock in the area. There is a potential of carbon sequestration up to 20 tCO2/ha/year in this highly fertile landscape. This can be achieved with sustainable forest management practices and effective policy measures (Anwar Ali, 2018).

There have been a few descriptive studies of the wildlife within KDL Forest Landscape which were conducted between 2017-2019, without any formal population census of wildlife species. Recent studies show that there are more than 7 large mammal and 8 small mammal species, as well as more than 57 bird species, and over 50 species of reptiles and amphibians. In addition to these 8 species of butterflies and two species of honeybee recorded during different wildlife surveys. Of the large mammals the Hog deer (*Axis porcinus*), and Indus dolphin (*Platanista gangetica minor*) are rare.

Non-timber forest products (NTFPs) constitute an important resource source of livelihood for the local communities of KDL forest landscape. The decline of the NTFP resources is causing enormous economic, social, and environmental losses as well as accelerates the extinction of species and malfunctioning of the ecosystems.

Despite difficulties, the local communities are not only helping the staff of the forest department in the management of forest resources but are also taking collective ownership and responsibility for the protection of forest, to the benefit of future generations. In turn the community has been allowed to let their livestock graze and collect wood for fuel and construct their houses; the collection of honey and other Non-Timber Forest Products (NTFP) is also allowed (Gul Junejo 2018).

After 2008 management attention in KDL landscape was focused on issues associated with rehabilitation, regeneration, and forest protection related activities to strengthen the overall management of these forests (landscape) where participatory approach is actively taking place.

Before the demarcation of Kot Dhingano-Lakhat forest landscape by 'Survey of Pakistan' in 2018, boundaries of both the forests were unclear. This resulted in occupying land of Lakhat forest by powerful community members and they cut trees and cleared land for agricultural purposes. They used to control all activities in that area, even charging the local community for grazing and pastures for livestock, harvesting honey and firewood collection. However, Sindh Forest department after the direction of Apex Court and introduction of SFM project activities with the active support of local community and local police retained most of the illegally occupied forest land in landscape area.

In KDL landscape two sites have been identified as high conservation value forests (HCVFs). These include i) Kot Dhingano (wetland) wildlife sanctuary, and ii) Lakhat (wetland) wildlife sanctuary. These two contiguous 'Reserved Forests' provide shelter to famous game birds such as the Black and Grey partridges. In addition, the landscape also supports a thin population of hog deer. The River Indus and its adjacent wetlands constitute the 'Green Route' for many migratory birds coming from colder region of Central Asian countries during winter season and these protected wetlands are important 'flyover' zones for thousands of migrating birds. Further, *Ex Situ* conservation (captive breeding)

programme of targeted species and subsequent reintroduction, species such as the hog deer will help to conserve precious biodiversity of landscape.

Until 2008, Forest Landscape received very little attention. Activities such as the cutting of trees, firewood collection, open grazing, and the utilization of the Reserved Forest for hunting of game animals, other non-timber forest products (NTFPs), and forest land encroachment for agriculture were mostly carried on unchecked, which have resulted in forest degradation, and the destruction of the valuable biodiversity capital. A vital step to address these issues has been the drawing up of this Sustainable Forest Management (SFM) Plan to outline a long-term strategy of management interventions for KDL forest landscape. The GEF-UNDP funded SFM project has provided a basis to ensure that long-term financial support be developed for the management of these high conservation value forest resources through development of Forest Management Plan for the next 10-year period.

The main authority responsible for implementation of landscape management plan will remain the Sindh Forest Department. However, local community of surrounding area will be the implementing partners. The immediate Forest Division responsible for overseeing the implementation operations from within the Department will remain the Benazirabad District Forestry Office, with the support and input from other key line departments such as Sindh Wildlife Department, Forest Planning Division, and Social Forestry Division.

A comprehensive mid-term review will be carried out in 2026 on all aspects of the implementation of protection efforts and achievements in KDL forest landscape. This process provides an opportunity to revise the implementation strategy, refine the plan management prescriptions, or even introduce new interventions (in the case of changing circumstances). This will ensure that the management of forest landscape is still in line with the objectives and vision for this reserved forest landscape.

ABBREVIATIONS

CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of wild fauna & flora
C&I	Criteria and Indicators
DFO	Divisional Forest Officer
FAO	Food and Agriculture Organization of the United Nations
FRA	Forest Resources Assessment
FSC	Forest Stewardship Council
GEF	Global Environment Facility
GHG	Greenhouse Gases
GIS	Geographic Information System
HCVF	High Conservation Value Forest
IAS	Invasive Alien Species
IUCN	International Union for Nature Conservation
KDLRFL	Kot Dhingano-Lakhat Riverine Forest Landscape
NTFP	Non-Timber Forest Products
PES	Payment for Ecosystem Services
REDD	Reducing Emissions from Deforestation and Forest Degradation
RFO	Range Forest Officer
SFD	Sindh Forest Department
SSFMP	Sindh Sustainable Forest Management Policy
SWD	Sindh Wildlife Department
SFM	Sustainable Forest Management
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

PART 1

INTRODUCTION

1.1. BACKGROUND AND PURPOSE

Forests are highly diverse habitats harbouring most of the world's terrestrial biodiversity. This diversity of forest ecosystems, species and genetic material underpins life on Earth. According to Forest Resource Assessment (FRA) 2020, forests currently cover 30.8 percent of the global land area. The total forest area is 4.06 billion hectares, or approximately 0.5 ha per person, but forests are not equally distributed around the globe. More than half of the world's forests are found in only five countries and two-thirds (66%) of forests are found in ten countries (FAO-UNEP 2020).

Pakistan is a forest-poor country with a small forest area of 4.478 million ha (5.1 percent), which amounts to 0.021 ha per person. Contribution of forestry sector to the GNP and GDP as per official estimates seems quite insignificant, primarily due to the fact that a multitude of non-timber forest products (NTFP) and non-tangible environmental and ecological benefits of the forests are not taken into account. This is because of the fact that focus of management traditionally and historically remains on commercial timber production and that is also restricted to the forest land under the administrative control of the Forest Departments. Nonetheless, the critical role that forests play in the national economy can hardly be overemphasized (FAO 2020).

The Riverain forests or *Belas*, as these are vernacularly called, occur over an area of 0.216 m ha in flood plains along banks of major rivers, particularly the Indus and its tributaries. Main tree species include *Acacia nilotica, Tamarix aphylla, Prosopis cineraria, Dalbergia sissoo, and Populus euphratica.* 14.9 percent of riverine forests occur in Punjab and the remaining 85.1 percent in Sindh (FAO 2020).

The province of Sindh spans over 34.84 million acres out of which 8% (2,789,875 acres) approximately are designated state forestlands and rangelands under the administrative control of forestry department. This includes 595,511 acres of Riverine Forests, which as per provisions of the Forest Act 1927, fall in the legal category of "Reserved Forests". The naturally growing Riverine Forests exist along both sides of the River Indus, right from Guddu Barrage down to Indus delta. This has remained the main stay of forestry in Sindh, meeting the environmental balance and livelihood needs of peoples of Sindh. Currently these forests are heavily degraded, with no exact data on the stocking quality and extent. (Sindh Sustainable Forest Management Policy 2019).

Sindh is one of the four provinces of Pakistan and is in the southern part of the country, with rich biodiversity. Most of this biodiversity treasure is found in the riverine forest landscapes of the province. Over the last 30 years, riverine forests of Sindh have experienced a rapid decline and degradation of resources due to various reasons including poor management.

The GEF-UNDP funded 'Sustainable Forest Management (SFM) project was launched in 2017 with the objective of promoting sustainable forest management in Pakistan's Western Himalayan Temperate Coniferous, Sub-tropical Broadleaved Evergreen Thorn (Scrub) and Riverine Forests for biodiversity conservation, mitigation of climate change and securing of forest ecosystem services. This initiative was implemented by the Ministry of Climate Change through provincial Forest and Wildlife Departments in Khyber Pakhtunkhwa (KP), Sindh and Punjab.

One of the project aims was to identify, demarcate and implement on-the-ground approaches to improve management of high conservation value forests within seven landscapes - three in Punjab and, two each in KP and Sindh. The two landscapes of riverine forests selected from Sindh are Sukkur riverine forest landscape and Kot Dhingano-Lakhat riverine forest landscape. The forest management at landscape level will contribute to climate change resilience and enhanced sustainable land use by improving forest and land management and reducing carbon emissions from deforestation and forest degradation in the areas.

The management plan of Kot Dhingano-Lakhat (KDL) riverine forest landscape, comprising 6,460 ha represents one such landscapes, which forms an important integrated landmass to two already designated protected areas including, the Kot Dhingano and Lakhat wetlands wildlife sanctuaries and biodiversity hotspots along Indus River. This riverine forest constitutes a landscape that is utilized mainly for firewood collection, honey collection, livestock grazing, rehabilitated forest by regeneration and wildlife protection and conservation purposes. This land use mix in the context of multiple use is an emerging trend in the sustainable forest management at landscape level.

The Kot Dhingano-Lakhat Riverine Forest Landscape (KDLRFL) is one of the high conservation value forest landscape identified under Sustainable Forest Management (SFM) project from Sindh province of Pakistan. This is because in this landscape area of 6,460, ha, an ecological important and intact small patch of 1,580 ha Dhingano riverine forest existed. Alongside River Indus, this forest landscape hosts a lake and a high abundance of key bird

and wildlife populations. This designated Reserved Forests with associated wetlands also forms an important link in the forest biodiversity corridor along the Lower Indus River.

The forest landscape surrounds the two main villages (Razi Jatoi and Hamzo Jatoi) and eight other small villages situated around these forests which consist of 1,545 households and 10,400 forest dependent local persons. One of the two dependent local communities is actively involved in protection and conservation of forests. One of the reasons for inclusion of this landscape is that most of the forests downstream of Sukkur Barrage do not get inundated except in high floods whereas this landscape, situated between Sukkur and Kotri barrages still receives substantial annual inundation.

The KDL forest landscape has had a very interesting story. The people of the local communities of ten villages within and in the surroundings of Kot Dhingano Forest took part in protection and management of forest in the year 2008. The volunteers chosen by the community, along with the staff of the forest department, placed copies of the Holy Quran around the boundary of the Kot Dhingano Forest and it was proclaimed that henceforth nobody would be allowed to encroach upon the forest land or cut trees. Threats were issued to the volunteers by influential people to withdraw their participation and even fake FIRs were filed against them. Despite these difficulties, the local communities not only helped the staff of the forest department in the management of the forest but are also took collective ownership of and responsibility for the forest, to the benefit of future generations.

The community has been allowed to let their livestock graze and collect wood for fuel and construct their houses; the collection of honey and other Non-Timber Forest Products (NTFP) is also allowed.

The community has engaged 3 to 4 people (locally called *Rakhas*) to help the forest staff in protection and seeding operations during the flood season and protection of the forest from forest fires during the dry season. The community has dug water channels in the forest at their own cost. The *Rakhas* are also paid by the community.

The landscape presently enjoying an important conservation status, it is seen as imperative to review the present situation surrounding this forest landscape and evaluate the potential benefits and threats of all activities within and around the reserve. The development of a Forest Management Plan (FMP) for KDL landscape is further seen as a critical course of action, to ensure the proper management of this riverine forest landscape into the distant future.

The Plan has been prepared to outline the key activities to undertake within this forest landscape over the next 10-year period. The broader sustainable management objective of KDL forest landscape is to bring the land uses in the connecting forests and protected areas under an integrated management umbrella to mainstream biodiversity, ecosystem functions and resilience. It will also support the ongoing community involvement in the forestry activities, which have been implemented for the last 10 to 12 years.

Part 2 of the Plan provides a brief description of the key biophysical attributes and geography of this forest landscape. It also summarizes the present management situation and management constraints, issues and threats that need to be addressed for the sustainable management of forest resources to progress.

Part 3 of the management plan highlights the important role of the selected high conservation value areas and biodiversity hotspots found in the forest landscape.

Part 4 of this plan outlines the proposed future management strategy and management interventions for the forest landscape. The landscape management plan outlines the detailed steps to protect and conserve natural resources, but more so to ensure beneficial returns to the surrounding local community and the Province of Sindh. The final section of this document outlines the strategy for implementing the management prescriptions, which includes increasing the involvement of the local community in the management of KDL forest landscape.

This management plan will help organize forest resources and ensure that the required objectives of forest conservation are met. The Riverine forest landscape plays a critical role in climate regulation. These forests help regulate temperature and humidity and are linked to provincial climate patterns, since hydrological cycles depend on the forests.

1.2. OBJECTIVES

1.2.1. Short-term Objectives

The short-term objectives of SFM plan of Kot Dhingano-Lakhat Riverine Forest Landscape are to:

1. Support forest restoration in degraded sites within the landscape.
2. Enhance the role of local community participation in the forest resource management and protection.
3. Introduce and showcase the innovative community forestry initiatives.
4. Enhance and maximize the Non-Timber Forestry Products (NTFP) benefits.
5. Enhance the capacity of the Sindh Forest Department staff responsible for management of the forest landscape.

1.2.2. Long-term Objectives

The long-term objectives of SFM plan of Kot Dhingano-Lakhat Riverine Forest Landscape are to:

- Reverse the loss of high conservation value riverine forest cover through SFM practices, including protection, restoration, afforestation, and reforestation, and increase efforts to prevent further forest degradation and contribute to the effort of addressing climate change impacts.
- Enhance forest-based economic, social, and environmental benefits by improving the livelihoods of forest dependent local people.
- Significantly increase the proportion of forest products i.e., NTFPs from sustainably managed forests.
- Promote governance framework and mobilize significantly increased, additional financial resources from all sources for the implementation of SFM landscape management plan and strengthen scientific and technical cooperation and community participation.

1.3. LEGAL AUTHORITY AND PERIOD OF THE PLAN

This plan is called the 'Sustainable Forest Management Plan for Kot Dhingano-Lakhat Riverine Forest Landscape'. The overriding purpose of the forest management plan is to ensure that forest landscape resources and related functions are managed on a sustainable basis into the distant future. Optimizing these resources for economic, social, and environmental benefits to the people and the Province of Sindh is inherent with the approach of sustainable forest management. The term of this plan will be for ten years commencing from 2021 and ending in 2030. The implementation of this plan will be continually monitored throughout the management plan period, and a formal mid-term review will be conducted in 2026 to revise or update the management prescriptions, as necessary. The Sindh Forest Department in collaboration with local community will administer the implementation of this landscape management plan.

1.3.1 Legal Framework and Guidelines

The implementation of SFM in Sindh is based on several fundamental laws, regulations and policies enacted by the Provincial as well as Federal Governments. These legal and policy frameworks are designed to safeguard the protect Sindh's precious natural resources and maximize their benefits for the people of Sindh. The management of all activities within and surrounding of KDL Riverine Forest Landscape shall be guided by the following policies, laws, and regulatory guidelines:

1. National Forest Policy, 2015
2. Sindh Sustainable Forest Management Policy, 2019
3. National Wildlife Policy, 2018 (draft)
4. National Climate Change Policy for Pakistan, 2012
5. Sindh Forest Act, 1927
6. Sindh Wildlife Protection, Preservation, Conservation and Management Act, 2020
7. Sindh Fisheries (Amendment) Act, 2011
8. Sindh Environmental Protection Act, 2016
9. National Biodiversity Strategy and Action Plan, 2018

PART 2

GENERAL INFORMATION ON FOREST LANDSCAPE

2.1 LOCALITY INFORMATION OF KOT DHINGANO-LAKHAT LANDSCAPE

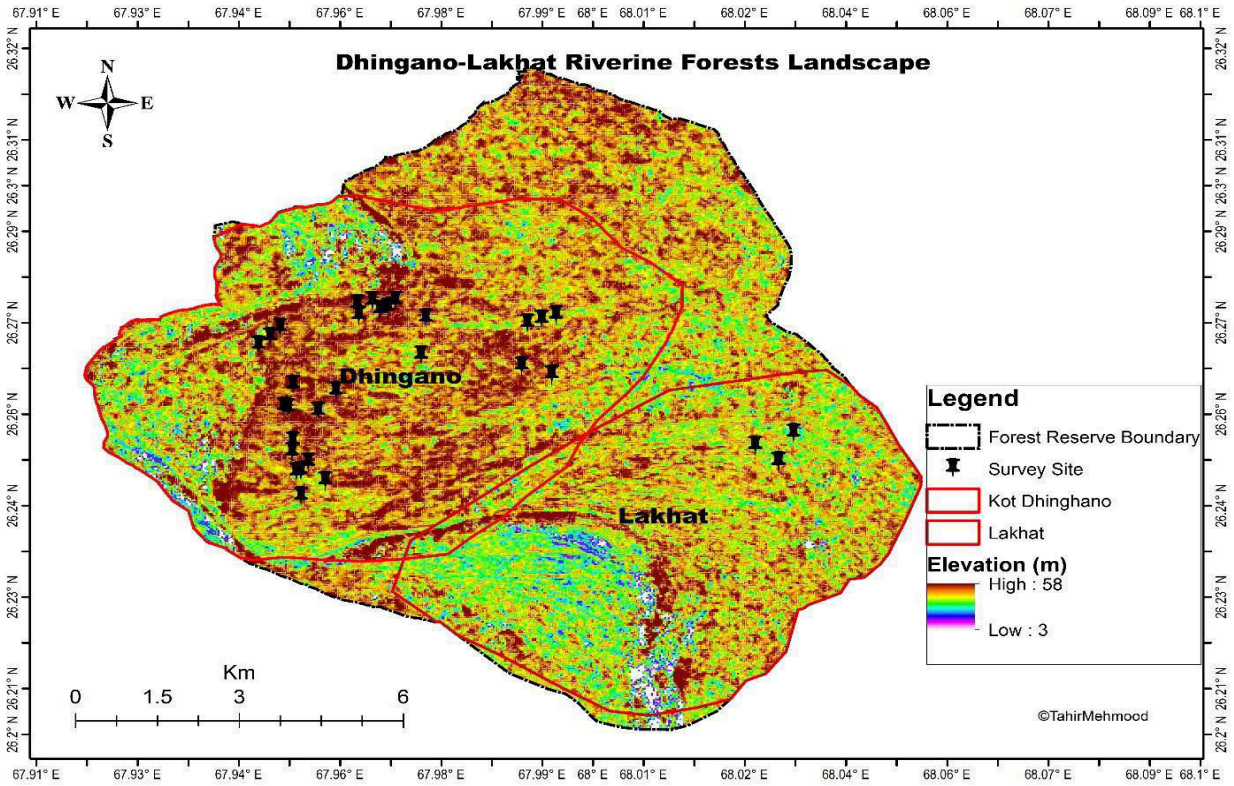
2.1.1 Location

Kot Dhingano-Lakhat (KDL) Riverine Forest Landscape is located along the Indus River, downstream of Sukkur Barrage on the left bank near Kazi Ahmed Town in Deh Kot Dhingano, Union Council Guhram Mari, Tehsil Sakrand, District Shaheed Benazirabad (formerly Nawabshah). This landscape is situated about 10 to 12 kilometers south-west of Kazi Ahmed town. In North, South, and East, the boundaries of landscape are linked with revenue lands, whereas the Western aspect boundary of the forest landscape is submerged by Indus River.

The landscape freshly surveyed and demarcated by the Survey of Pakistan in April 2018 as SFM project activity is comprised of Dhingano Reserved Forest (1,580 ha) and Lakhat Reserved Forest (4,880 ha). Both forests are also separately designated as wildlife sanctuaries under the Sindh Wildlife Protection Ordinance, 1972 (now Sindh Wildlife Protection, Preservation, Conservation and Management Act 2020) in addition to their designation as Reserved Forest under the Forest Act, 1927. The total area of the Dhingano-Lakhat Riverine landscape is 6,460 ha. The landscape is habitat of Hog deer and other wild animals as well as home of many resident and migratory birds. The main tree species are Babul (*Acacia nilotica*), Kandi (*Prosopis cineraria*), Lawa (*Tamarix aphyla*), Lai (*Tamarix dioca*), and Bahan (*Populus euphratica*).

The Abad Reserved Forest is located adjacent to this landscape. There is an opportunity of developing a corridor from the riverine landscape to Abad Reserve Forest. There is greater river meandering in this section of the River Indus with the result that the processes of erosion and accretion are common. Thus, there is an opportunity for recreating new riverine forest with traditional regeneration techniques which includes broadcasting of treated seed of native species.

Figure 2.1: Location Map of Kot Dhingano Lakhat (KDL) Riverine Forest Landscape - Sindh



Implications for Planning

KDL Riverine Forest Landscape is ecologically important forest landscape situated along the Indus River, downstream of Sukkur Barrage. Conservation of this forest will contribute towards conservation of high value biodiversity resources in riverine forest ecosystem.

2.1.2 Legal Status of Landscape and Background

Demarcation and designation of state forests as Reserved and Protected Forests was started in different localities of Nawabshah (now Benazirabad) Forest Division in 1823 and continued till 1972. The forests of Kot Dhingano-Lakhat landscape have been declared as 'Reserved Forests' under different notifications (Notification Nos. 6487 dated 17-12-1878, No. 818 dated 30-01-1883 and No. 7898 dated 27-09-1893) and were duly mutated and entered in the revenue record (Form 1-A). The fresh demarcation of the landscape was carried out during 2018 through Survey of Pakistan. A draft 'Notification' of landscape area along with details of boundary pillars and coordinates is placed as **Appendix-A**.

The riverine forests of Sindh are situated between the River Indus and its protective embankments. The existence of the forests is entirely dependent on regular inundations.

The major tree species in the northern zone is Kandi (*Prosopis cineraria*) and in the southern Sindh is Babul. Bahan *(Populus euphratica*) and Lai (*Tamarix* spp.,) occur in both zones.

Sindh was occupied by the British in 1843. The riverine forests of Sindh were raised by the local rulers as game reserves. The technique was to fence in riverine areas in which *'babul'* seed had been disseminated by livestock. The management of Sindh forests was started soon after the British occupation to ensure the sustainable supply of fuelwood.

The importance of the riverine forests of Sindh for supplying fuel to the steamers, and later the railways, has already been alluded to under the section on early history. The note on the history of management of these forests up to 1950 is highlighted in the working plans prepared by C.G. Abichandani's during 1937 and 1940. Till 1875 these forests were exploited unsystematically. From 1875 to 1895 several schemes were introduced which prescribed clear-felling of Babul, Kandi, and Lai on equal adjacent coupes and selection felling of Bahan. Regular working plans were introduced in Sindh riverine forests towards 1900.

The Sindh riverine forests of Babul and Kandi are managed under the clear-felling system with broadcast sowing in receding flood water. Aerial seeding is being increasingly employed since 1974. Yield regulation is by area. Areas threatened by river action are given the highest preference in cutting followed by burnt areas, dead-wood, windfalls and special purpose felling's and the balance of the year's prescribed yield is taken out of that year's coupe.

Table 2.1: Management Status of KDL Riverine Forest Landscape - Sindh

Forests	Management Status	Area ha.	% of Total
Kot Dhingano	Conservation, Ecological functionality, Seed Source, Socio-economic benefits.	1,580	24.46%
Lakhat	Restoration, Control deforestation, degradation, and land grabbing.	4,880	75.54%
	Total Area	6,460	**100%**

2.1.3 Land-Use

The major land-use adjacent to the Forest landscape includes agriculture activities such as the cultivation of wheat and cotton. This is so extensive, that some portions of forest lands encroached by the influential are also under agricultural practices. Land-use adjacent to the reserve falls into two distinctly different categories:

(a) Local village small holdings characterized as local inhabitants. These small-holdings or small-scale farms are mostly between 1-8ha in size. These farms often have a mixed cultivation with seasonal crops such as wheat, cotton, sugarcane, corn, or vegetables.

(b) The western boundaries of the landscape are marked by the Indus River. Although use of river and its waterways does not constitute a specific "land use", the river is still a major conduit and to some extent is utilized for its fisheries resources. However, dependence of local people on the river as a source of livelihood has decreased markedly in recent years; there is still a small group of fishermen within the local community that depend on the River resources partially for their livelihood.

2.1.4 Adjacent Communities and Socio-economic Situation

There are 10 villages located in the surrounding of KDL Forest Landscape (refer to Table 2.2 below). The most populous of these villages is Lakhat Jatoi, with Razi Jatoi Village being the next main concentration of dwellings. The other villages are spread around the boundaries of landscape. All these villages are located ranging within the distance of 1.5 - 5 kms. Major tribes living in these villages are Jatoi, Mallha, Sayyed, Junejo, Sehta, Kumbher, Daya and Hajam.

Table 2.2: List of Local Communities Adjacent to Boundary of KDL Forest Landscape, Sindh

Name of Village	Population	No. of Housing Units	Distance from Forest Landscape
Ahmed Bhan	524	71	3-5 km from boundary
Darya Khan Jatoi	436	94	3-5 km from boundary
Hamzo Jatoi	1343	230	1.5-3 km from boundary
Kamil Jatoi	286	24	3-5 km from boundary
Lakhat Jatoi	2941	413	3-4.5 km from boundary
Mahi Jatoi	443	90	3-5 km from boundary
Noor Ahmed Shah	436	94	3-5 km from boundary
Razi Jatoi	2443	349	1.5-3 km from boundary
Salih Shah	1262	156	3-5 km from boundary
Shafi Mohammad Jatoi	286	24	3-5 km from boundary

(Source: Socio-Economic Data Compilation of KDL Landscape by Shahzadi Tunio, 2019)

Based on the latest socio-economic survey (2019), there are approximately 10,000 individuals living in 10 villages around the forest landscape. Of these, 50% of the population is below the age of 30 years. Of the working population, the biggest majority are farmers (18.4%), with employment in others sectors such as labor (13.7%), animal graziers (10.7%), daily wagers (9.9%), milk selling (6.6%), fuelwood selling (6.1%), timber selling (5.6%), honey selling (5.4%), Government & private jobs (7.8%), handicrafts & embroidery (8.7%), and other businesses (7.2%).

Livestock is the second major income source for about 72% households in the area and the fodder is mainly extracted from the forest as free resource. Leaves and fruit of Kandi and Babul and some bushes/ grass grown after flood water or rain are used as fodder for animals. The forest is also used for relaxing animals in the shade during summer season.

The detail of livestock grazing in the Kot Dhingano Forest is given in the following table and shows that the forest supports 5,510 grazing animals from the surrounding villages.

Table 2.3: Livestock Grazing Pressure on Forest Landscape, Sindh

S. No	Name of Village	No. of animals grazing in the forest				
		Cows	Buffaloes	Goats/ Sheep	Donkeys/ Camels	Total
1	Haji Noor Muhammad Shah	8	42	0	0	50
2	Muhammad Safar Jatoi	19	13	11	2	45
3	Darya Khan Jatoi	352	451	887	29	1719
4	Mehdi Shah	107	8	31	0	146
5	Kot Dhingano	5	1	9	1	16
6	Mahi Jatoi	14	5	27	4	50
7	Razi Khan Jatoi	341	200	334	59	934
8	Hamzo Khan Jatoi	597	263	452	63	1,375
9	Lakhat	285	175	669	46+17	1,175
	Total	**1,728**	**1,158**	**2,420**	**221**	
					Grand Total	**5,527**

Source: Gul Junejo, Divisional Forest Officer, District Shaheed Benazirabad, Sindh Forest Department- 2019

Implications for Planning:

- The community settled around landscape, demonstrates mixed income levels, with many people still dependent on forest landscape resources to maintain their standard of living. This situation poses a great risk to forest resources. This is because low-income families are more likely to source various forms of natural resources, mostly from forests, to survive.

- Open grazing in the forests does not only lead to destruction of natural vegetation, but also inevitably leads to animals damaging new growth (regeneration). However, local people are showing reluctance against any restrictions on open grazing.

2.1.5 Local History and Culture

The dominant racial type in Sindh is the Indo-Aryans, who are of tall or medium height. Most of Sindhi of modern times belong either to the indigenous stock or are of Arab or Baloch origin. The Indus is the most important river of the province. The classical name of the river was Sindhu (Sanskrit for an ocean) and Sindh was the province created and sustained by the river, without which it would have been a desert. Its length is about 2,880 kilometers and nearly a third of that (about 944 Kms) traverses the province (Shah S.G.M, 1993).

The local people adjacent to KDL Forests Landscape are mostly engaged in agriculture, animal husbandry, forestry, and fishing. Only a small percentage is employed in other businesses. Jatoi Baloch tribe is dominant in the region with different shades of Balochi culture including language, costumes, music, embroidery, and handicrafts.

2.2 NATURAL RESOURCE OF KDL RIVERINE FOREST LANDSCAPE

2.2.1 Overview

The vulnerable riverine forests of Sindh constitute an important ecosystem with immense tangible and intangible services. Over the last four decades, it seems that a paradigm shift in the forestry sector has taken place – from focusing on narrow sustained yield goals to conserving this ecosystem for its broader functions and values. Using forest resources in a sustainable manner which leads to clear social and economic benefits for local communities is a trend that is growing increasingly popular worldwide.

The KDL Landscape is one of the most unique forests for conservation in Sindh province, particularly in the Indus downstream area. This is because in this area of 6,460 ha significant riverine forest stands of high conservation value are represented. The boundaries of riverine forests landscape were re-demarcated by Survey of Pakistan in 2018 and issuance of re-notification of landscape area is under process which would ward off the issues of illegal allotments and landownership conflicts. Alongside this, the landscape hosts an important wetland wildlife sanctuary, and a high abundance of rare and spectacular bird and wildlife species. The landscape also forms an important link in the forest corridor, and remaining wildlife habitat, along the middle part of Indus River in Sindh.

The KDL Forest Landscape is classified as 'Reserved Forests' i.e., forests under the control of Forest Departments which have been declared under Forest Act 1927 and are generally without rights and privileges. Importantly the landscape provide refuge for the rare wildlife species such as the Marbled Teal and Bristle Grassbird, a bird species now believed globally threatened and rare ungulate species like Hog deer. In addition to biodiversity conservation, the forest is providing various socio-economic, environmental, and supporting benefits. The forests in the landscape are comprised of an ecologically intact Kot Dhingano Riverine Forest which is managed on a sustainable basis through the participation of the local community, and Lakhat forests a severely degraded and encroached part of the landscape.

The local communities are not only helping the staff of the Sindh Forest Department in the management of the forest resources but are also taking collective ownership and responsibility for the forest, to the benefit of future generations. In response to their cooperation and help, the community has been allowed to let their livestock graze and collect wood for fuel and construct their houses; the collection of honey and other Non-Timber Forest Products (NTFP) is also allowed.

Kot Dhingano-Lakhat Riverine Forest Landscape plays a great role in the mitigation of climate change effects through sequestration of carbon at the micro level and serves as a source of soil and water conservation. Further, participatory sustainable management of landscape will enhance and help in payment for ecosystem services, biodiversity conservation and offsets, and flood regulation.

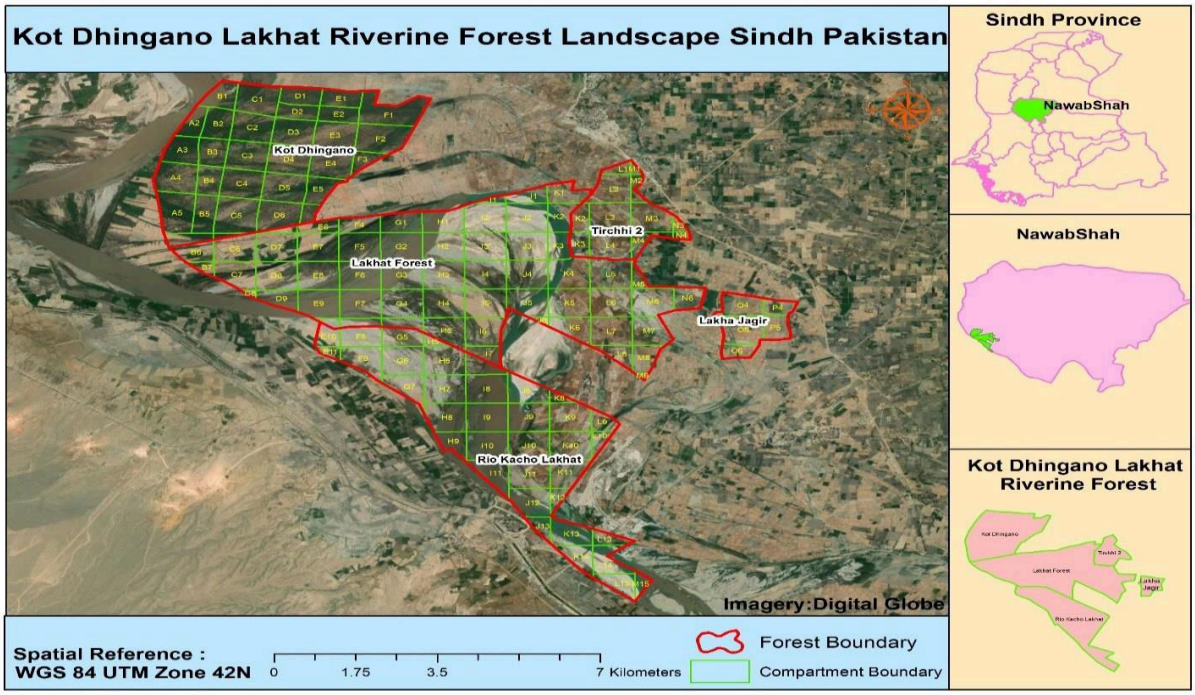


Figure 2.2: Kot Dhingano-Lakhat Riverine Forest Landscape Sindh Pakistan.

2.2.2 Climate

Climate of the region is generally hot and arid. Rainfall is scanty, erratic, and mostly occurs during monsoon season i.e., from July to September. The average annual rainfall is less than 250 mm per annum. Maximum temperature in summer rises to 50°C, and minimum temperature during winter is 8° C. Hot summers usually extend from April to October. The wind direction in summer is south and southwest, and in winter, it is north and northeast. Frost is not common, and it may occur occasionally. Although, the KDL forest landscape is without any facility of Met observatory to record rainfall data on regular basis. The climate data from nearby Met station located at Nawabshah (approximately 35km to the east of the forest landscape) is broadly representative. The meteorological data recorded during the last 10 years at Nawabshah is given in **Appendix-B.**

2.2.3 Geology

The forest landscape is characterized as broad flat land separated by low, rocky mountain range of Khirthar on the west. This land formation represents the erosional remnants of anticlines formed following the collision of the sub-continental tectonic plate with the Asian plate around 45 million years. The KDL Riverine Forest Landscape is composed mostly of sandy, clay and alluvium. The Indus River feeds the Indus submarine fan, which is the second largest sediment body on the Earth. Analysis of sediments from the Arabian Sea has demonstrated that before five million years, the Indus was not connected to the Punjab Rivers which instead flowed east into the Ganges. Earlier research shows that sand and silt from western Tibet was reaching the Arabian Sea approximately 45 million years ago, implying the existence of an ancient Indus River by that time.

2.2.4 Soils

Soil of the Indus plains of which the riverine forests of Kot Dhingano-Lakhat Landscape is a part, characteristically rich alluvium. It contains varying proportions of clay and sand, but it is nowhere uniform in composition. The predominant soil composition of riverine forests is sandy loam, though beds of clay, clay loam and sand are also present. New deposition is

almost pure sand, which becomes stable only through continuous deposition of clay, and enables it to sustain tree crop. The soil is also alluvial in the irrigated plantation. It is mostly loam with varying proportions of clay and sand. However, there is no permanent saline area exists in the riverine forests landscape of KDL. The nearby agricultural soils associated with irrigation are likely to be finer in texture and richer in organic matter and nutrients due to their history of cropping, ploughing and fertilizer additions.

2.2.5 Topography

The topography of KDL Riverine Forest Landscape can be characterized as flat and low-lying terrain. This flat and low-lying area forms part of the vast floodplain, which extends along the Indus River downstream up to delta. The terrain of KDL landscape is ideal for forestry operations. Forest recreation and ecotourism can be developed to take advantage of the natural features of the area.

2.2.6 Hydrology

The hydrological dependence of landscape is the main factor in addition to the soil type which determines the habitat for tree species found in the floodplain and the characteristic of the forest type. The hydrology of KDL Landscape can be divided into 2 main types (a) seasonally river inundation, which corresponds to the floodplain area, and (b) limited dependence on monsoon rains.

The seasonally Indus River inundated areas are the area of most concern for the development and long-term management of forests in the landscape. This is of concern for forest management because much of the highly degraded forest is found in the seasonally flooded areas.

The riparian zone (namely riverbanks) is characterized in KDL landscape by flat alluvial terrace and river levees (flood protection bund). Almost uniform in elevation, this riparian zone is generally inundated by floodwater only every 2-3 years. This smaller flood like situation normally takes place in the area between July and September. In addition to the Indus River, there is a Dhingano lake within the landscape. The role of this lake is important during the dry months of the year. This lake is 17.6ha in size, previously dried-up due to sediment load, and is now rehabilitated under SFM project activity. It contains some freshwater fish resources and serves as home to numerous rare water birds such as the Marbled Teal.

Implications for Planning

- The seasonal floods, which are un-common in these low-lying areas, can severely affect forest restoration work in the landscape. This factor has serious implications towards the success of regeneration and forest health.

2.2.7 Vegetation

The prominent tree species of the natural riverine forests of KDL landscape include *Acacia nilotica* (Babul), *Prosopis cineraria* (Kandi), *Tamarix dioica* (Lai), *Populus euphratica* (Bahan). The tree species are dependent on the soil associations, hydrology, and topographic conditions in the area. A description of the forest types in similar conditions along Indus River in the region of Sindh, is reported in the 'State of Forestry in Pakistan' (PFI, 2016) and 'Sindh Forestry Since Independence' (SFD,1999). The main type of forest in this landscape is the Alluvial Floodplain Forests. This forest is best described divided into 2 subclasses of forest based on the hydrological characteristics of the area. These subclasses are described as (a) Riparian Alluvial Terrace Forest usually found closest to the main River,

and (b) Seasonally Flooded Alluvial Floodplain Forest. This landscape is not known for its high diversity of tree species from a variety of family and genera.

A varying proportion of the ground cover is perennial, and, in the rainy season, there is normally profuse regeneration of summer annuals whose seeds germinate in July and, after flowering and seeding, the plants die back usually by November. The associated perennial species of grasses and shrubs include *Calotropis procera* (Akk), *Salsola foitida* (Lani), *Saccharum spontaneum* (Kana), *Cynodon dactylon* (Dubh), *Alhagi maurorum* (Kandaro). Other non-native (exotic) tree species are *Eucalyptus camadulances* (Sufeda), and *Prosopis juliflora* (Mesquite). A list of trees, shrubs and grasses found in the forest landscape area is given in **Appendix-C**.

While recognizing the significance of physiographic and edaphic factors on plant succession in the area, the fact remains that, at present, biotic factors (local people and their domestic stock) are exercising a major influence on the vegetation through cultivation, grazing and tree felling.

Implications for Planning

- The KDL landscape has potential to fulfil a major function of providing a seed source for further forest restoration and rehabilitation.

- The KDL forest landscape has potential to promote SFM practices and community participation.

2.2.8 Wildlife

The forest has emerged as a biodiversity hotspot, providing a suitable habitat to the species like the hog deer, wild boar, jackal, wild cat, grey partridges and other game and non-game wildlife species.

A few descriptive studies of the wildlife within KDL Forest Landscape have been conducted during 2017-2019, without any formal population census of wildlife species. Recent studies show that there are more than 7 large mammal **(Appendix-E)** and 8 small mammal species (**Appendix-F**), as well as more than 57 bird species **(Appendix-H)**, and over 50 species of amphibians and reptiles **(Appendix-G)**. In addition to these, 8 species of butterflies **(Appendix-D)** and two species of honeybee have been recorded during different wildlife surveys.

Of the large mammals the Hog deer (*Axis porcinus*), and Indus dolphin (*Platanista gangetica minor*) are rare. Similarly, among reptiles Narrow-head soft-shell turtle (*Chitra indica*) and Indian Rock python (*Python molurus*) are also very rare in the area.

The keystone bird species can be grouped into three categories, i.e., resident, migrant, and vagrant species based on IUCN and Bird Life International list. The *resident* species are native to Pakistan throughout the year and do not migrate. The *migrant* species are those which perform seasonal journey during September/ October from their breeding areas to Pakistan due to severe winter. *Vagrant birds* are those species that always change their location and move to areas outside their normal range (Rajpar and Zakaria, 2012). The finding based on the number of bird individuals and species recorded highlighted that resident bird species (i.e., 66.667% based on number of detections and number of species; 79.122%) dominantly utilized the Kot Dhingano Riverine forest throughout the year while migrant bird species (i.e., 26.516% based on number of detections and no of species; 20.411%) may use this unique Riverine habitat only during migratory season (i.e., October to

February). Likewise, results also revealed that vagrant bird species may pay a visit the Kot Dhingano Riverine forest in search of food (**Table 2.4**).

Table 2.4: Status of Keystone bird species detected in KDL Riverine Forest Landscape

Status	No of Species	%	Total No of Bird Individuals	%
Resident Birds	38	66.667	5268	79.122
Migrant Birds	15	26.516	1359	20.411
Vagrant Birds	4	7.017	31	0.457
Total	**57**		**6658**	

Implications for Planning:

- In the future a detailed population account of wildlife species, particularly flagship species should be carried out to determine the distribution and density of species populations in the KDL landscape.

- The function of prime wildlife habitats in the landscape requires further investigation to ensure minimal disturbance and negate other long-term impacts on the important wildlife populations.

2.2.9 NON-TIMBER FOREST PRODUCTS (NTFPs)

Non-timber forest products (NTFP) include all the materials (excluding timber) collected from the forests and associated habitats, and used to support local livelihoods such as food, fibers, medicines, fuelwood, etc. A large number of households generate some of their income selling these products. NTFP thus constitute an integral part of the forest landscape and of the social and cultural structure of those living around it.

In the past, the rationale for conserving forests was simply to sustain the forests' productive role for the timber extraction. However, over the years, the pervading view that forests primarily provide timber as source of substantive revenue is losing ground. Instead, now local people are gaining significant benefits from non-timber forest products. NTFPs in riverine forests, such as Kot Dhingano-Lakhat landscape are often considered as common property resources. These include fuelwood, fodder, fencing, poles, eatable ground plants like mushroom, and a variety of other foodstuffs, such as game, fruit, vegetables, honey, acacia gum, etc.

Non-timber forest products (NTFPs) constitute an important resource source of livelihood for the local communities of KDL forest landscape. The decline of the NTFP resources is causing enormous economic, social, and environmental losses as well as accelerating the extinction of species and malfunctioning of the ecosystems. Brief description of some of the NTFPs resources of KDL are given as under:

The potential of NTFPs in Kot Dhingano-Lakhat Landscape is same as in Sukkur landscape except fish catch. Kot Dhingano is one of the two sites of riverine landscapes where SFM project activities were conducted. It is a classic example of community protected forest in Sindh which has been given high importance by the local community due to several ecosystem services. A study was conducted to Riverine Forests of Kot Dhingano by PFI in 2019 to identify, quantify and valuate the ecosystem services provided by this forest.

However, since this forest landscape is mainly a community managed resource, where community is obliged to collect fuelwood, collect honey, and graze their domestic animals in the area. According to the findings of the study, 76% population of forest landscape is dependent on agriculture for their livelihood and farming, livestock rearing, and daily paid labour are the main sources of income. A total of 200 households were surveyed through a semi-structured questionnaire in which the following information was collected.

- Household Socio-economic profile
- Quantity of timber collected from the forests on annual basis
- Quantity of fuelwood consumed daily in the household
- Quantity of fuelwood collected from the forests on weekly/monthly basis
- Sources of Household Energy
- Quantity of fodder collected from the forest
- Number of livestock grazed in the forests
- Quantity of Non-timber forest products (honey, gum, medicinal plants, raw material for roofs, ceiling, baskets etc.)
- Role of forests in flood protection and soil erosion control.

There has never been any attempt to document the economy of the riverine forest adequately and credibly. It appears that the direct income from forests (from a combination of the forest products: timber, firewood, fodder, bee keeping, and other products) would match if not exceed the income from agriculture. Together the value of fodder for livestock and firewood consumed directly puts the net income estimate at more than 2.5 million per acre of forests annually. Add to it other products and services (honey production, timber harvest, job creation and others) and this will change the benefit picture even further. These are not theoretical values, but real goods and services produced and traded in the marketplace (Rafiq M. 2017).

Livestock grazing/ Fodder: Presently this landscape sustains grazing pressure of a total of 5,527 animals comprising of 1,158 buffaloes, 1,728 cows, 2,420 goat/ sheep and 204 donkeys and 17 camels from within the forest landscape and adjoining areas, which freely graze in this forest. Livestock rearing is very common in the area. Almost every household (HH) keeps livestock for domestic use and sale at the time of emergency.

Livestock is the second major income source for about 95% HHs in Razi and Hamzo villages. Fodder for livestock is extracted free from the forest landscape. Animal grazing and collection of fodder for animals is a daily activity of the community members from all the dependent villages around the forest. The forest is also used for relaxing animals in the shade during summer season. Leaves and fruit of Kandi and Babul and some bushes/ grass grown after flood water or rain are used as fodder for animals. No permission from any authority is being sought by herders for grazing livestock in the forest (Tunio, S 2019).

The community of KDL forest landscape in 2017 reported that they are depended on the riverine forests for a multitude of products and services. This included grazing and fodder for their thousands of cattle, goats, and sheep. Accounting for the grazing and fodder value, back of the envelop calculations yielded revealing facts (Rafiq, M. 2017):

- Each animal, on average, consumes daily fodder worth Rs.100/-
- Value of the daily fodder consumption: 6,000 X 100 = Rs. 600,000

- Value of Annual Consumption: 600,000 x 365 = Rs.219 million
- Annual fodder value per acre of forests: Rs 146,000 (net of any costs)

Fuelwood Collection: Local communities are a partner in the forest resource management with Sindh Forest Department, and most of the local people in and around forest landscapes meet their household fuelwood needs. Fuelwood collection is carried out for domestic cooking needs and is not viewed by local communities as an economic activity.

In the absence of natural gas, Households of Razi and Hamzo Jatoi villages use firewood as a source of energy for cooking and heating purpose. In Lakhat, natural gas is available, but still 50% of the cooking and heating needs are fulfilled with firewood. It was reported that the need for firewood also arises when there is low gas pressure and during festivals, when there is food cooked in bulk for weddings or in the event of a death in the village. Study reveals that an average consumption of firewood in a HH for a day is about 5 to 10 kilograms which, if purchased from the market, would cost them about 50 to 100 rupees (Tunio, S 2019)**.**

Another study conducted by Pakistan Forest Institute experts' team in 2019 assessed those 99% households of Kot Dhingano-Lakhat use fuelwood as the main source of energy for cooking and heating. Out of these about 77% household collect fuelwood from the forest, 20% from farmland and only 1% purchase fuelwood in the local market. Average HH consumption of fuelwood is estimated 3,408 Kg/year (85 maund/ year), whereas total volume of fuelwood collection is calculated about 76, 415 maund/ year.

Honey Collection: Wild Honeybee *Apis florea* or the dwarf Asian honeybee and *Apis dorsata* or giant honeybee have been reported from this landscape. Survey undertaken by Honeybee Research Institute, NARC Islamabad in 2018 recognizes honeybees as keystone species, crucial to the maintenance, sustainability, and improvement of biodiversity and habitats of Kot Dhingano-Lakhat forest landscape. Bees are noted for their role in plant pollination and are key indicators of the health of forest areas. They are important for rural livelihoods from the income derived from the sale of honeybee products, as well as their traditional family use for medicinal purposes. Honey harvesting communities play a large role in conserving, protecting, and ensuring sustainable management of forest resources that serve as bee habitat and forage areas, as this will improve the value chain and sustain other crops of value. This baseline study will further establish the conditions of the honeybee harvest areas and the supply side of the value chain, specifically to characterize and quantify the "value" to both the environment and socio-economy of honeybee propagation and sustainable use.

The study recorded 51 kinds of trees, 26 shrubs and various vines and ferns as well as various animals. Nineteen kinds of trees were found being used for honeybee propagation, either for the establishment of colonies, use for forage, or for the building of rafters. The bee habitat was seen to be in serious degradation.

In Kot Dhingano-Lakhat forest landscape some 27% of households are involved in wild honeybee activities with an estimated 241 households in the project area. The predominant type of honey gathering is opportunistic, meaning harvest is done whenever one is found in its natural hive. However, there is now a shift for some 34% of households towards more sustainable practices including: use of smoke, honey head harvesting, the use of a plastic

bag for transporting the honey head, group harvesting, the collection of honey for bulk sales and the setting up of cluster groups with defined areas for rafter installation.

The peak honey harvest months are from April to May mainly by male head of household and male members. The average volume of honey harvested per household is 5 liters and total volume of honey harvested comes to some 2,060 liters. The average estimate household income from the honey sold was computed by multiplying the total of households involved with the median price, which showed an estimated 7000-8000 per household. For the forest area where some 75% of produce came, the 241 households sold the volume of honey harvest at 800-1000 per liter in 2017 which earned them an estimated income of 7-8 thousand the entire honey harvesting season. Considering the current low household income from their main occupation (at 5000-6000 per month), the honey livelihood contributed significantly to offset income and food deficits.

A conservative estimate of the honeybee resource is approximately 2,000 colonies within the 3875 acres of Kot Dhingano harvesting area. There are some 20,000 to 25,000 bees in a hive which can produce some 1 to 1.5 liters of honey in 20-30 days. This affirms a relatively healthy bee resource population. However, the forest habitat may be degraded by the concentration of users in an area.

The production of wild honey can be significantly increased through use of modern harvesting methods and following proper timings (daytime) and right seasons. There is a huge scope for wild honey in the local, national, and international market. Hence, it can fetch higher prices, if properly extracted, hygienically packed, and labeled (mentioning area, type of forest where harvested would add the value) and stored. Honey production can be a strong source of livelihoods for forest dependent communities, if they will be given training in production, processing, packaging and linked with markets (Tunio, S. 2019).

Fishing: The fishing inside Dhingano forest was once a very good income generating activity for Mallha (fisherman) communities residing around the forest. They used to harvest fish in the main River, Dhora (depressions) and lakes inside forest landscape and sell it in the local market and nearby towns. Reduced water flow in the river and low rain fall, has dried dhora's and ponds which has resulted in significantly decreasing the fishing activity to two months only - August and September (monsoon season). This has compelled fishers to live in extreme poverty and or change their occupation. Due to illiteracy and lack of employable skills, wood collection from the forest for sale is considered as the easy and free source of livelihood by most of the Mallha community. Increasing poverty level in Mallha and other poor communities has forced them to cut and sell trees to meet their ends. Presently only 12 households of Razi Jatoi village are involved in fishing activity for income generation (Tunio, S. 2019).

Medicinal Plants: The study found that older people of local communities still use some medicinal plants available in the forest area, from whom the knowledge has been transmitted to the present generation. It was observed that younger people are knowledgeable only about plants used to treat common ailments, such as cuts, wounds, scabies, joints pain, cold and cough. It was also observed that women are more knowledgeable about the medicinal plants as compared to men.

It was reported that no medicinal plants are being collected for commercial purposes, due to lack of knowledge about the demand and market. Hence further research is required to enlist the valuable medicinal and aromatic plants, which can be a good source of livelihood

for local communities. Help can be sought from the institutions working on herbal healthcare (Tunio, S).

Hunting: Kot Dhingano and Lakhat forest were home to a variety of water birds including migratory and resident birds. Hunting of birds and animals was also common in the past. Due to reduction in water flow in the river and wetlands (lakes), there has been a serious negative impact on the important habitats of water birds. The number of migratory birds that use these waterbodies during the winter season has declined. A strong watch and ward system implemented in coordination with the local community has also discouraged hunting of bird and animals in the area. At present, black partridge (teeter) is commonly found in the forest and still being hunted by some locals and outsiders illegally for their own consumption. However, the abundance of the bird has declined in recent years. Among wild animals, hog deer, and wild boar are still found in the forest, but no frequent hunting was reported due to protected status of landscape under both forest as well as wildlife laws (Tunio, S).

Recreation: Recreational activity is only done after floods and or heavy rains. After rains and floods, the area, especially the forest, gets green. Ponds and ditches are filled with water which attracts surrounding tourists. People from distant villages, cities, mostly relatives and friends of the local community are taken to the forest for recreational purposes after floods. No recreational activity is being carried for income generation as was reported during the study (Tunio, S). The KDL landscape related sustainable ecotourism potential is discussed under section 2.4 separately.

Basketry Weaving and Mat Making: Usually women in rural areas do weaving and mat making for their own consumption. This can be promoted as an income generating activity by giving them training in quality, designing and development of varieties of basketry and mat products. Reed, straws (lai) and other weaving material for basketry making is also plentiful in the area and can be cut into any size as per weaving and knitting requirement. Market for these products can be sought in bigger cities by linking them with potential outlets. The income generated and saved from the above activities will help empower women, giving them a greater say in their family decision making, and improve their overall living standard (Tunio, S).

The PFI study carried out in 2019 estimated 88% HHs collect Lai *Tamarix dioca* and Kana *Saccharum spontaneum* for basket and mat making. The total Kana and Lai collection as raw material is 147 tonnes per year. A total 14 Households are involved in basket making with annual Basket Production of 29,400. The average basket making is 5-10 per day per household with basket price ranging between Rs. 150-400. The annual income per HH is estimated around Rs. 315,000 per year and total estimated income is Rs. 4,420,000.

Acacia Gum collection: Flow of gum is more in hot weather therefore tapping is normally done in summer season between June-September. Acacia gum is a precious edible commodity, also used for other purposes as well. However, in KDL riverine landscape its production and marketing are not properly regulated. Gum *acacia*, also known as gum Arabic, is an edible polysaccharide used in the food, pharmaceutical, cosmetic and textile industries, as an emulsifying, suspending and stabilizing agent. *Acacia* gum is common variety of the gum obtained from Babul tree of riverine forests in the province. However, its quantitative statistics are not yet studied at landscape levels to determine the exact monetary value of the product.

Timber: The community residing around the forest depends on the forest for wood required for the construction of their houses, making furniture for family use and in building sheds for

the livestock. Houses are made of bricks, mud, or straw made shelters (Jhugyun); wood is used as essential part in the home construction. It was reported that the entire community is allowed by the village heads and forest department to get wood from the forest for construction purposes (Tunio, S 2019).

According to PFI assessment carried out in 2019, 70% households (HHs) of KDL landscape collect timber mainly for domestic purposes. Average HH collection of Timber is estimated 18 cft/ year and total collection of timber is around 11,494 cft.

2.2.10 Other Elements of Biodiversity

Biodiversity is 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.

As with the natural vegetation and wildlife of KDL forests, there has been no detailed study on different components of biodiversity within the landscape. Biodiversity covers an enormous array of biota (living organisms) including natural vegetation, other plants such as wildlife, invertebrate fauna, and micro-organisms. Apart from the natural vegetation and wildlife fauna, which have been summarized in previous sections, there is little available information on other elements of biodiversity except a small study on butterflies.

Implications for Planning:

- To capture real potential of biodiversity in KDL landscape, there is a need for further studies to identify and evaluate these resources.

2.3 EXISTING CARBON STOCK AND FUTURE POTENTIAL

2.3.1 Overview

Forests are the most important terrestrial carbon sink, and carbon sequestration is one of the key ecosystem services provided by the forests. The importance of forests has increased many folds in view of their crucial role in climate change mitigation. Forests not only act as a sink of carbon but also become source of emissions when forest are cut. Thus, protection of forests is very important for addressing the challenge of climate change. Besides, trees as renewable natural resources and have a high potential in contributing to transition to fossil-free energy systems. However, there might be trade-offs between the extensive use of forest for reducing human CO_2 emissions and their ability to store carbon.

Reducing emissions from deforestation, forest degradation, sustainable forest management, conservation and enhancement of forest carbon stocks known as REDD+ has emerged as a promising option for forest-based climate change mitigation in developing countries. Under the REDD+ programme, developed countries will provide incentives to the developing countries to keep their forests standing and thus help in reducing GHG emissions. One of the key requirements for carbon-based forest management is measurement, reporting and verification (MRV) of carbon stocks in the forests (UNFCCC, 2010).

Riverine forests are the most important forest types of Sindh. Sindh Forest Department controls 241,198 hectares areas in the Riverine tract of the province which are categorized as Riverine Forests, locally known as Kacho forests. These forests are located along both the banks of River Indus in in different districts and have been declared as "Reserved Forests" under Forests Act, 1927. The rich alluvial soils support enormous growth of *Acacia nilotica* (Babul), *Populus euphratica* (Bahan), *Tamarix aphylla, Tamarix dioca* (Lai) and *Prosopis cineraria* (Kandi). Riverine forests are the most productive forests of Sindh, producing wood material for domestic and commercial purposes. The rotation of various species varies from 6 years to 40 years, depending upon market demand of wood (SFD, 2018).

The annual inundation of the riverine areas during the monsoon season act as a lifeline for the existence and flourishing of the Riverine forests. There has been large-scale degradation of riverine forests due to severe decrease in flow of freshwater down the Guddu Barrage. Following are the main factors responsible for degradation of Riverine forests:

1. Severe reduction in flow of fresh water in Indus through floods.
2. Population pressure for meeting the local needs of the people.
3. Increase in the high lying areas due to low floods.

Riverine Forests of Shaheed Benazirabad Forest Division
The total area of Shaheed Benazirabad (formerly known as Nawabshah) district is 447818.7 ha. There are 10 riverine forests exists in Shaheed Benazirabad Forest Division. These forests are present in the form of individual forest blocks ranging in area from 232 ha to 7,733 ha. All the forest areas of this Division lie along the left bank of the river Indus except a portion of Mehrabpur forest is on its right bank. These forests are located between 26° 15' to 27° North latitude and 67°38' to 68°31' East longitude over a length of about 70 km. Forests are mainly located in Lakhat Forest and Kot Dhingano. Lakhat Forest is situated at about 10 kms south west of Kazi Ahmed town. (Sangi, 2000).

2.3.2 Methodology

(a) Forest Carbon Inventory

Terrestrial carbon inventory in the riverine forests of Shaheed Benazirabad was conducted during January-March 2018. Inventory team was constituted for the field inventory comprising a forestry graduate as a team leader, two Foresters/ Forest Surveyor, a driver, and a helper. This team jointly comprised of PFI and Sindh Forest Department staff. Before start of the field work, the team was properly trained for the field work and acquainted with the inventory design. The existing maps available in the working plan documents and office records of Forest Department were used for field inventory.

Before designing the forest inventory, relevant literature and guidelines were collected and extensively reviewed to devise a methodology in conformity with international standards. The inventory methodology consists of the following key elements.

(b) Inventory Design

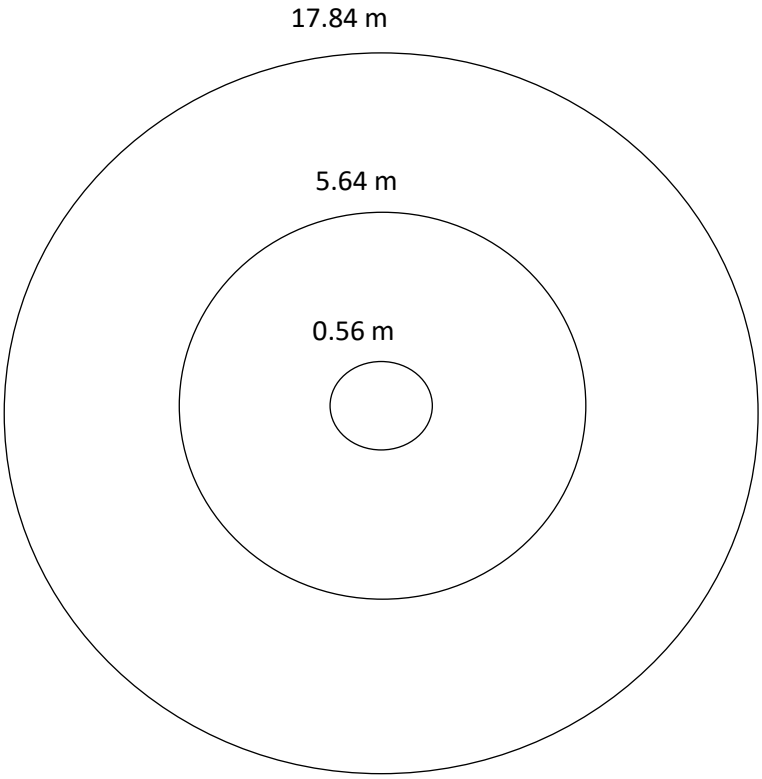
Systematic random sampling technique was used for collection of the field data. This sampling design is efficient in reducing the possibility of bias, determining a valid sampling error, and ensuring uniform coverage of the target area. Sample plots were laid out on geo-referenced maps of forests using a grid of 770x770 m. The coordinates of the centers of the sample plots were noted from the maps and uploaded on to GPS and navigated in the field accordingly. Beside forest compartment maps, GT sheets were also used to locate the

actual position of the sampling units in the field. The plots were permanently marked on the ground by inserting iron rods in the centre of the sample plots for verification and future monitoring.

(c) Field Measurements

The inventory aimed at estimating biomass and carbon stock in different carbon pools of riverine forests landscape through nested circular plot approach to collect the data. Circular plot shape was chosen for the inventory due to its easiness in establishment particularly in sloping terrains and to reduce the problem of edge effect associated with rectangular plots. As illustrated in the Figure 2.3, three subplots were established within each plot for specific purposes. The outermost circular plot with radius 17.84m was used for measurement of trees. The wider circular plot can be easily and accurately established with the help of Haglöf Vertex. Two options are available in Haglöf Vertex VL5 for measurement of distance i.e., laser and ultrasonic. However, if Haglöf Vertex was not available, then ordinary measuring tape was used to lay out the sample plot. The second circular plot with radius 5.64 m was used for measurement of shrubs and sapling; and the innermost plot with radius of 0.56 m was used for measurement of leaf, litter, and grasses as well as soil.

Figure 2.3: Nested Circular Plot



i) Above Ground Tree Biomass (AGTB)

Above-ground biomass (AGB) consists of all living vegetation, both woody and herbaceous, above the soil surface including stems, stumps, bark, twigs, seeds, and foliage (IPCC, 2006). AGB is divided into two categories, upper story and under story. The wider circular plot of 17.84 m radius (0.1 ha) was used for measuring the attributes of all trees with Diameter at Breast Height (DBH) ≥ 5cm. The plots were laid out with the help of Laser Based Vertix Hypsometer (VL5) which automatically corrects slope of the radius. DBH was measured with dia tape at 1.37 m above ground on uphill side. Heights of randomly selected

trees in this circular plot were recorded through Vertix Hypsometer. AGTB was calculated through locally developed allometric equations for major tree species. However, for minor tree species the equations available in literature (e.g., Chave et al., 2005) were used. The list of allometric equations used in the study is given in the below table.

Table 2.5: Allometric Equations used for Biomass Estimation

S. No.	Species	Allomteric Equation	Source
1.	*Acacia nilotica*	$M=0.0569(D^2H)^{0.9745}$	Current study
2.	*Tamarix dioca*	$M= 0.477(D^2H)^{0.5755}$	Current study
3.	*Prosopis cineraria*	$M=0.112(\rho D^2H)^{0.916}$	Chave et al., 2005
4.	*Eucalyptus camaldulensis*	$M=0.023(D^2H)^{0.9985}$	Ali, 2017
5.	Other Species	$M=0.112(\rho D^2H)^{0.916}$	Chave et al., 2005

ii) Above Ground Shrub Biomass (AGSB)

Second circular plot with radius 5.64 m (100 m^2 area) was used for measuring biomass of shrubs and saplings. All shrubs of the plot were cut and weighed on the spot. Representative samples were collected, put in bags and their fresh weight was recorded. The samples were taken to PFI for further analysis in the Lab. The samples were dried in the oven at 105°C till constant weight using a digital balance. Moisture content was determined by the following formula:

MC%= (Fresh Wt. of sample – Dry Weight of sample)/Fresh weight of sample x100

iii) Leaf-litter, Herbs and Grasses (LHG)

Third circular plot with radius 0.56 m (1 m^2 area) was used for measuring all leaf, litter, herbs, and grasses which were destructively sampled. The material was weighed on the spot and a well-mixed subsample of 100 g was collected for drying in the oven to determine the ratio of oven dry to fresh biomass.

iv) Bellow Ground Biomass (BGB)

This pool consists of living roots. Fine roots of diameter less than 2 mm are excluded due to the difficulty of separating them from soil organic matter (IPCC, 2006). This is the most difficult pool of forest ecosystem to measure accurately. BGB can be estimated by digging out soil cores, extracting and weighing roots, and drying in the oven. Then the carbon content of the roots is estimated. Due to the difficultly of digging and extracting roots, carbon accounting generally depends on regression equations developed through destructive sampling. These equations predict root biomass based on above-ground biomass (Brown, 2002).

BGB was estimated using default values from IPCC Guidelines (2006). In all pool's biomass was converted to carbon stock by multiplying with 0.47 as suggested by IPCC (IPCC, 2006).

v) Dead Wood

This pool consists of all dead wood including standing and fallen dead trees, stumps, and roots with diameter more than 10cm. This pool usually contains carbon in the range of 10-20% of the above-ground pool in mature stands (Delaney *et al*., 1998). However, in young forests and plantations this pool is usually insignificant and therefore ignored in field measurements.

Different methods are applied to estimate carbon in the dead wood pool. Dead standing trees are measured like living trees, but their biomass is reduced by 20% for loss of

branches and by 2-3% for loss of foliage (McDicken, 1997), that is, their biomass considered to be 77-78% of that for living trees.

vi) Soil Organic Carbon

Soil organic carbon is an important pool of carbon in the forest ecosystem. This pool is also affected by landuse change and management activities. For measuring soil carbon, samples were collected from 0-15 cm and 16-30 cm for determining bulk density and soil carbon concentration (Subedi et al., 2010). Bulk density was determined on the spot through sample corer and recording fresh weight of the sample. The samples were oven dried in the laboratory at 105C^{o} till constant weight. Sub-samples of 50 g were taken for soil carbon determination. The soil carbon was determined through Loss on Ignition (LoI) method using a muffle furnace in the laboratory (Schumacher, 2002; Rehman et al., 2011). Soil organic carbon was calculated by the equation given by IPCC (2003) as follows:

$SOC = \rho * d * C * 10$

Where ρ is the bulk density of the soil; d is depth of soil sample; and C is carbon content in the sample.

(d) General Parameters Recorded

The following parameters were measured at each sample plot location:

- Date
- Name of Data Recorder
- Plot No.
- Location: Name of District, Forest Division, Forest Subdivision/Forest Range, Forest Block, Forest Compartment and Forest Area
- Land use Class: Forest Land, Grass Land, Crop Land, Wetland, Settlement, Other Land
- Forest Type: Natural Forest, Plantation
- Stand Composition
- GPS Coordinates
- Elevation
- Crown cover

(e) Sample Size

The total number of sample plots was determined through the following formula:

$$N = \frac{(CV)^2 x t^2}{E^2}$$

Where N= Number of required sample plots
CV= Coefficient of Variation
t= Student t-test value (1.96 at 95% Confidence Level)
E= Allowable Error

It was learned from the local forest officers and the existing studies that there is high level of variation in the forest due to severe degradation and fragmentation. Therefore, CV was assumed as 100. The number of the required sample plots was calculated as follows:

$$N = \frac{(100)^2 x 1.96^2}{10^2} = 400$$

Thus, it was estimated that 400 sample plots will be sufficient for the given sampling precision. However, due to non-availability of valid forest maps, it was further assumed that

for 400 sample plots to fall in forest, we will take 800 sample plots on the map. Therefore, 831 sample plots were laid out on the maps prepared for the inventory.

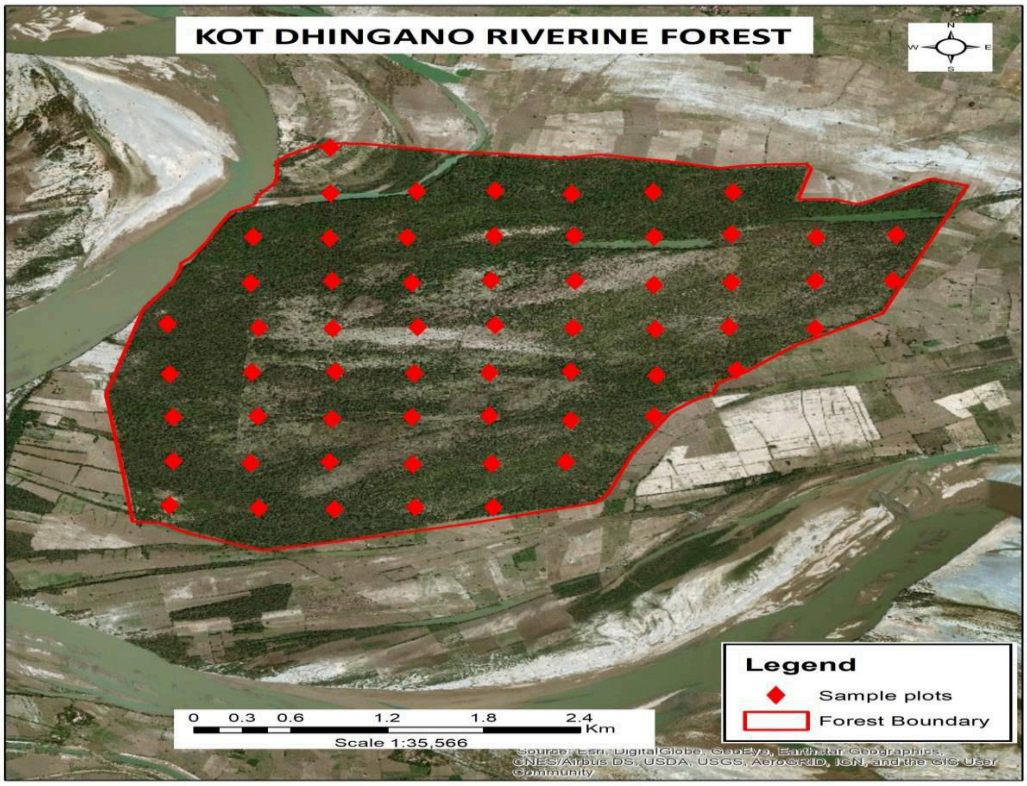
2.3.3 Distribution of Sample Plots

A total of 80 sample plots were laid out in the KDL forest landscape for data collection. The distribution of sample plots in forest areas are given in Table 2.6.

Table 2.6: Distribution of Sample Plots in Forest Landscape

Forest Area	Forest Area (ha)	Number of Sample Plots
Kot Dhingano	1,580	80
Lakhat	4,880	0
Total	**6,460**	**80**

Figure 2.4: Map of Kot Dhingano Forest Landscape showing Sample Plots



2.3.4 Estimated Carbon Stock

The total carbon stock in the SFM Project area is 45588.8 tonnes. Out of this 70.70% is in the soil, 16.05 % in aboveground biomass, 9.0% in belowground biomass and 4.25% in litter. Distribution of carbon stocks in both forest areas of Kot Dhingano landscape is given in below Table.

Table 2.7: Distribution of carbon stocks in Kot Dhingano Riverine Forest Landscape

Forest Area	Existing Forest area (ha)	AGC tonnes	BGC tonnes	Litter C tonnes	SOC tonnes	Total C (tonnes)	Carbon Density (t/ha)
Kot Dhingano	984	7321	4103.3	1938.5	32226	46573	47.33
Lakhat	0	0	0	0	0	0	0
Total	**984**	**7321**	**4103.3**	**1938.5**	**32226**	**46573**	**47.33**

(Source: Anwar Ali, Pakistan Forest Institute Peshawar, 2018)

2.3.5 Carbon Sequestration Potential

It was observed during field inventory that the forests are severely degraded, and these are facing severe anthropogenic pressure. Open grazing and cutting for fuelwood are serious threats to these forests which have significantly reduced the aboveground carbon stock in the area. However, there is a potential of carbon sequestration of 20 tCO2 per hectare per year in this highly fertile landscape. This can be achieved with sustainable forest management practices and effective policy measures**.** (Anwar Ali, 2018).

2.4 SUSTAINABLE ECOTOURISM POTENTIAL

2.4.1 Overview

The current interest in nature-based ecotourism is partly a realization of the ability of tourism to be used as a source of positive conservation tool by increasing funding or awareness. However, in part it results from operators exploiting a new commercial market with little concern either for the conservation benefit or even whether they are causing damage. Ecotourism encompasses two ideas: one is experiencing love for biodiversity or wildlife and the other is causing minimal environmental damage.

Ecotourism can have considerable benefits for biodiversity conservation by providing economic incentives for protecting a species and habitat. The benefits can be local, in terms of a contribution from nature reserve fees to the local community, increased local employment or the opportunity to provide accommodation. Some-times the benefits cab be largely provincial or national, as little of the profit goes to the conservation site but there are considerable benefits to hotels, restaurants, car hire companies or governments. A problem is often then that the people who benefit differ from those that bear the costs.

There are many examples of successful ecotourism but also others where tourism is damaging to conservation. As ecotourism may bring people to the most important and sensitive sites there is the real potential to cause more damage than benefit. However, much will depend upon the extent to which there are strong controls as a result of land ownership, social pressures, or regulations. It can be unwise to encourage ecotourism unless there is a clear mechanism of control including the motivation, physical ability, and authority to restrict damaging activities.

In case of Kot Dhingano-Lakhat Forest Landscape, presently very limited scope exists to regulate such activity at large scale. However, in view of remarkable natural features and combination of diverse biodiversity heritage including pristine forest stands, beautiful wetland (Lake), riverside scenic attraction, rare sightings of hog deer and Indus dolphin, unique local culture, and festivities within landscape and in the surrounding areas clubbed with various religious and archeological sites at easy motoring distance make it an important future ecotourism site in central Sindh.

2.4.2 Steps Needed for Sustainable Ecotourism

A sustainable ecotourism in Kot Dhingano-Lakhat Riverine Forest Landscape will requires the following prior interventions.

1. *Prioritize objectives.* The objectives should be sustainable management of forest landscape resources, wildlife conservation, expand local employment, and provide education facilities to increase general conservation awareness. Initially it might be limited to attract dedicated naturalists with a specific objective, such as bird watching, wilderness experience or camping, wildlife photography, etc.

2. *Devise a strategy.* The strategy should decide that how many visitors could be accommodated and of what type. Create a business plan, calculating the investment and likely number of participants. Building slowly allows the experience gained to be used. The most useful technique is to visit elsewhere and observe service standards, facilities, and products.

3. *Assessment of the current situation.* Review the biodiversity. What are the potential components of biodiversity that may attract the tourists or are sensitive to tourism? What is the distribution and status of each component? Is it changing and what are the threats?

Assess the forest landscape in relation to tourist routes, transport, and accommodation. Review the infrastructure, facilities, staff, tourist services, educational services and consider their use, quality, and finances. Further, what is currently preventing tourists from visiting. Speak to potential visitors to discover what they are looking for.

4. *Possible costs and benefits of changes.* Increased tourism may cause some conservation problems and it is thus important to consider whether there is a net benefit. The damage can be direct, such as increased disturbance or trampling, or indirect, such as the demands for firewood, polluting activities, or hotels. Tourism may also result in cultural change including increases in crime or strengthen it through interests in arts, and crafts, which may retain meaning for local people.

5. *Plan zoning and regulations.* Zooning is often a key element of ecotourism, but this is dependent upon sufficient control mechanisms. The zones may include areas for extensive use with facilities, areas of less intensive use and sensitive areas where access is forbidden. Regulations are usually much easier to set up at the start than after operations have started.

6. *Ensure required infrastructure and facilities.* Often a change in the extent of ecotourism is only possible with an investment in accommodation, transport, or signs.

7. *Review procedures.* Sustainable ecotourism results from a persistent attention to detail such as good publicity, an effective brochure, good personal communication, efficient and friendly guidelines, and alignment with national and provincial tourism policies.

8. *Training*. It can always be useful to provide training to the local guides as per the expectations of tourists. It is some time appropriate to establish certification schemes by which an individual is tested and evaluated on his knowledge and interest.

9. *Provide education*. The layout of visitor centers, trails and notice boards needs to be considered within the general facilities and infrastructure, such as car parks. Directions are more likely to be followed if the necessity is explained, they are positive, expressed simply and provide helpful information at the same time, such as please keep on the path so as not disturb the breeding birds' and animals. Guidelines on responsible behaviour are more likely to be respected if accompanied by useful information like routes, species present or ecology.

10. *Benefit sharing*. Consider how benefits can be shared so that all gain. Ensure a share of landscape entry fee may go to the local community. It may be appropriate to have different fee structure for locals and visitors.

11. *Monitor the successes and failures*. Effective monitoring mechanism should be devised to detect any adverse consequences. It is also useful to collect data on the origins of visitors, how they heard of the site and their reaction to the experience and facilities. Monitor the success of different field guides, brochures, and other information materials.

12. *Periodic Review*. As ecotourism develops and the situation changes there will be new opportunities and problems. A process of continual review is important.

2.4.3 Ecotourism Guidelines

In view of ecological sensitivity of the KDL forests landscape the following tour operator and visitor guidelines should be followed in perfect letter and spirit to avoid any adverse impact of ecotourism.

Guidelines for tour operator:

- Enforce the visitor guidelines in a consistent manner, bearing in mind that guidelines must be adapted to individual circumstances.
- Hire a professional team. Place an emphasis on naturalists who will not only talk about the forestry, wildlife, biodiversity, and geology, but also guide visitors before entering the area.
- Ensure that for at least every 15-20 visitors there should be one qualified naturalist/ guide to conduct and supervise the visit.
- It is the responsibility of the tour operator to ensure that no evidence of visits remains behind. This includes garbage of any kind.
- Respect ecological important and historic sites within the protected landscape sites.

Guidelines for visitor:

- Do not disturb, harass, or interfere with the wildlife.

- Never touch the animals.
- Maintain a distance of at least 25ft from all nesting birds, and 50ft from other animals, such as hog deer.
- Give animals right of way.
- Do not position yourself between wildlife species and its path to the water, nor between a parent and its young.
- Keep noise to a minimum.
- Do not feed the animals, either in captivity or open in the wild.

- Do not walk on or otherwise damage the fragile plants.

- Leave nothing behind and take only memories and photographs.

    - Leave no litter ashore.
    - Do not take souvenirs, including skeletons and bones, plants or other organic material, or anything that may be of historical or scientific value.

- Do not interfere with scientific research related plots.

- Do not smoke during excursions in the wilderness area (fire hazard).

- Stay with your group or with one of the trained guides when enter the ecologically sensitive zone.

2.5 MANAGEMENT CONSTRAINTS OF KDL LANDSCAPE

2.4.1 Overview

Before deciding on forest management prescriptions for the Kot Dhingano-Lakhat landscape, it is important to first understand the history, and present problems and opportunities, associated with the landscape.

The importance of the riverine forests of Sindh for supplying fuel to the steamers, and later the railways, has already been alluded to under the section on early history. The following note on the history of management of these forests up to 1950 is based on C.G. Abichandani's working plans (1937 & 1940):

Till 1875, these forests were exploited unsystematically. From 1875 to 1895 several schemes were introduced which prescribed clear-felling of Babul, Kandi, and Lai on equal adjacent coupes and selection felling of Bahan. Regular working plans were introduced in both the Lower and Upper Sindh forests towards 1900. The major prescriptions of these plans in force from 1900 to 1935 were as follows:

i) Division of the area into many felling series, each averaging about 2,000 acres in area. These numerous small sized-felling series were necessary because of scarcity of local labour and of the difficulties in disposing of the produce from these scattered forests.

ii) Clear-felling on equal adjacent areas on a rotation of 30 years for all species.

iii) Reservation of all Babul in the northern zone for meeting timber requirements, and in the southern zone retention of advance growth up to 9 inches girth at the base.

iv) Exclusion of 10% of the gross area of each riverine forest from the annual coupes as a safeguard against riverbank erosion.

The application of the policy of clear cutting on equal adjacent coupes to these irregular forests entailed considerable financial sacrifice in cutting immature trees and not cutting the over-mature. The revised working plan, which remained in force from about 1915 to about 1935, therefore switched over to annual felling coupes according to the condition of the growing stock. The main objective was to harvest the over-mature trees which were deteriorating. The annual coupe comprised both the stocked and un-stocked areas to equalize annual yields, and blanks were to be regenerated artificially. The working plan for the forests of the southern zone increased the size of advance growth to be retained to 15 inches girth. About 15 selected babul trees per acres of 16-36 inches girth were reserved to meet the requirements for timber. In the northern zone whole reservation of Babul was replaced by retention of Babul advance growth up to 12 inches girth and all dense stands of *babul* up to 3 feet girth. Regeneration in both zones was by coppice, root suckers, and broadcasting sowing (G.M. Khattak 1976).

Working plan for the riverine forests of Lower Sindh (Hyderabad Forest Division) aims at the maximum sustained production of timber and planting of blanks which receive inundation or can be lift irrigated. The stocked areas which are inundated annually are to be managed under the clear-felling system with the following sequence of operations:

i) Fell by the end of May.
ii) Lease out for temporary cultivation for one winter crop.
iii) After the land is ploughed by the lessee in September, broadcast babul and kandi seed in 75:25 ratios.
iv) If lessee is not available, carry out soil working at own.
v) Continue broadcasting seed in flood waters for three years.
vi) Protect from grazing for five years.

Rotation prescribed is 20 years for Babul and 30 years for Kandi. Yield is regulated by reduced area with a volume check. The annual harvest is made up by felling in the following order of priority:

- Erosion strips (areas threatened by river action); burnt areas; dead wood; windfalls, special purpose felling's; felling in the annual coupe.

Felling would be stopped when the prescribed yield is completed but burnt areas are to be harvested even over the prescribed yield and the excess worked off in the future years (Ahsan Ahmad's 1972).

The Sindh riverine forests of Babul and Kandi were managed under the clear-felling system with broadcast sowing in receding flood water. Aerial seeding is being increasingly employed since 1974. Yield regulation is by area. Areas threatened by river action are given the highest preference in cutting followed by burnt areas, dead-wood, windfalls and special purpose felling's and the balance of the year's prescribed yield is taken out of that year's coupe (G. M. Khattak 1976).

In Sindh, first time aerial seed sowing operation was carried out in 1974, when 2,428 ha of riverine area, which was blank but received inundation, was sown with remarkable success from specially equipped aircraft (Kermani W.H. 1974).

Deforestation and forcible encroachment on forest land have been the main problems in the riverine forests of Sindh. During the last two to three decades, thousands of acres of riverine forest land in Sindh have been forcibly encroached upon by the influential and are still being used for agricultural purposes. In such a scenario, in the year 2008, the local community of Kot Dhingano Riverine Forest was involved by the Sindh Forest Department to help in the protection of the forest from deforestation and encroachment.

Despite difficulties, the local communities are not only helping the staff of the forest department in the management of the forest but are also taking collective ownership and responsibility for the protection of forest, to the benefit of future generations. In turn the community has been allowed to let their livestock graze and collect wood for fuel and construct their houses; the collection of honey and other Non-Timber Forest Products (NTFP) is also allowed (Gul Junejo 2018).

After 2008 management attention in KDL landscape was focused on issues associated with rehabilitation, regeneration, and forest protection related activities to strengthen the overall management of these forests (landscape) where participatory approach is actively taking place.

The following section of this plan will outline some of the major issues and challenges associated with the management of this forest reserve today. These management factors have been organized into sections; (a) constraints, (b) opportunities, (c) issues, and (d) threats.

2.4.2 Constraints

(a) The KDL Landscape and Management Arrangements

The KDL riverine forests are one of the SFM landscape in the district Benazirabad of Sindh province covering a total area of 3000 hectares. The landscape is located along the Indus river at approximately 12km from Kazi Ahmed. There are only 21 personnel responsible for administration and enforcement at the KDL landscape. Of these there are one (1) Divisional Forest Officer (DFO), one (1) Range Forest Officer (RFO), one (1) Forester, two (2) Forest Guards, and sixteen (16) Nighaban (mostly from local community) dedicated to managing the landscape affairs. The present manpower position is insufficient to manage important forest and associated biodiversity resources of landscape. However, there is likely to be a sufficient staff available during implementation of management plan in future at the KDL riverine forest landscape to ensure the sustainable forest management at landscape level. In addition to this communicational, vehicular (transport), staff office and residential facilities for management staff are also in poor condition.

Implications for Planning:

- In view of the size of the KDL landscape, the administrative and protection staff (manpower) is spread-out thinly and can only focus on Dhingano forest stands and surrounding regeneration on a regular basis. However, the management of whole landscape without appropriate physical presence of the Sindh Forestry Department staff and volunteers from local community may not work accordingly.

2.4.3 Opportunities

(a) Natural Attractions and Recreational Opportunities

KDL forest landscape has enough potential for the development of ecotourism activities for the People of Kazi Ahmed and distant nature lovers. Of interest to tourists are the natural characteristics of the area including the intact high-quality riverine forest with high concentration of rare and interesting wildlife species, especially birds. Of scenic interest, is the beautiful Dhingano Lake surrounded by dense forest stand, and the Indus River on the edge of the landscape.

The natural features mentioned above are significant and attractive enough to lure visitors for sightseeing within the landscape area. In addition to this, the same natural features can also form the backdrop to develop recreation activities. In this way, “recreation activities” that can be developed in the area, can also function as a major attraction for visitors to the area. The potential recreation activities, which are suitable for development within landscape, will be prioritized.

Implications for Planning:

- The natural attractions and recreational opportunities within the landscape warrant consideration for the development of different ecotourism spots with care and quality.

- Suitable sites should be developed, and appropriate infrastructure put in place to capitalize on the attractions of forest landscape to generate income for the local people and the Provincial Government.

- Planning should include comprehensive zoning of all activities to be carried out in the landscape to minimize the negative impact on sensitive environmental sites.

2.4.4 Issues

(a) The Encroachments of Forest Land for Agriculture

Sindh Forest Department in recent years after direction of the Supreme Court of Pakistan has made a very clear policy that encroachment into designated forest lands will not be tolerated, and in fact, will be dealt with swiftly and severely. The full weight of the law will be used to remove squatters, and wherever possible, those found to be responsible for damages to forest lands and their resources will be prosecuted.

Before the demarcation of Kot Dhingano-Lakhat forest landscape, boundaries of both the forests were unclear. This resulted in occupying land of Lakhat forest by powerful community members (about 10 to 12 influential persons from Lakhat village) and they cut trees and cleared land for agricultural purposes. They used to control all activities in that area, even charging the local community for grazing and pastures for livestock, harvesting honey and

firewood collection. After occupying Lakhat, they started encroachment in Dhingano forest area which led to resistance with the villagers. This conflict was so severe that two people died due to this conflict. The case is still pending with court of law.

In 2018, the Forest department demarcated forest landscape area through the help of 'Survey of Pakistan' and retained illegally occupied forest land in Kot Dhingano-Lakhat forests with the support of local community and the Police Force. At present Dhingano forest is 100% retained and covered with trees whereas 50% Lakhat forest is in control of Forest department. The remaining 50% is still under the control of land grabbers and is under cultivation. Further, more than 1500 acres of degraded Lakhat forest land was restored through regeneration with native tree species during the last three years (2017-2019) with active support of the local community.

Implications for Planning

- Community consultation has come up with consistent feedback from the local villagers during re-demarcation of Reserved Forests land. However, continued pressure from surrounding politically backed influential land grabbers will be remain a serious issue for the Forest Managers and local community dependent on these forestry resources in the area.

(b) Degraded Forests

The KDL landscape is mainly comprised of Kot Dhingano Reserved Forest and Lakhat Reserved Forest. This is the only forest in Sindh that is being protected with the help of the local community and is sustaining. The Kot Dhingano forest is mainly being used by the local community for grazing their animals, honey, and fuel wood collection. The Lakhat forest is adjacent to Kot Dhingano forest and is mainly disturbed by river flow. The area of Lakhat forest has been divided in two portions. The one portion is under the river course and the other portion is under encroachment. The boundary demarcation of forest landscape was carried out by Survey of Pakistan in 2018 under SFM project.

The Kot Dhingano and Lakhat riverine forest landscape have been selected to be managed under Sustainable Forest Management (SFM) Project. The main activities of the project are focused on managing the forests on a sustainable basis for which it is necessary to identify the degraded areas of the landscape as well as causes of degradation so that management measures may be taken to address the causes of degradation and to improve the health of forests (Gul Junejo, 2019).

i. Kot Dhingano Forest

The total degraded area of Kot Dhingano forest is 705 acres out of 3815 acres. The compartment wise detail is as under.

Table 2.8: The Compartment wise Degraded areas in KD

S.NO.	Compartment No.	Area (Acre)
1	12	34
2	13	63
3	14	63
4	15	47
5	16	51
6	17	97
7	18	86

8	20	95
9	22	92
10	24	40
11	25	37
	Total:	705

Source: Identified Degraded Areas of Kot Dhingano Forests (2019) by Gul Junejo.

The location of the degraded areas of Kot Dhingano forest is shown in the map attached as. The main causes of the degradation observed in Kot Dhingano are.

- Overgrazing
- Drought (Not receiving annual floods regularly)
- Fires.
- Cutting of trees.

ii. Lakhat Forest

The area of Lakhat forest is mainly without trees. The area of forest is either under encroachment or under river course. The area under encroachment is being cultivated by the encroachers. The area under cultivation is 3275 acres, whereas the area under river course is 4270 acres (Gul Junejo, 2019).

Based on field inventory it was estimated that only 39% of the forest cover is intact though is in degraded condition. The remaining 61% forest cover has been converted into farmland or other land uses. Out of the total 5,679 ha, only 1,591 ha have canopy cover (Anwar Ali, PFI). The existing forest cover in both forests of landscape area is given in the below table.

Table 2.9: Estimates of Forest Cover in KDL forest Landscape

Forests within Landscape	Forest Area as per Re-demarcation Plan (ha)	Existing Forest Cover (ha)	Existing Forest Cover (%)
Kot Dhingano	1,580	984	63.75
Lakhat	4,880	607	14.68
-	6,460	1,591	39.21

(Source: Anwar Ali, Pakistan Forest Institute Peshawar, 2018)

Implications for Planning:

- The KDL forests constitute an important wildlife habitat in the downstream Sukkur Barrage. For the future sustainability of forest functions and wildlife habitat in KDL landscape, it will be important to rehabilitate the degraded areas.

(c) Research

There are no on-going research activities related to forestry and associated non-timber forest products taking place within the KDL Forest Landscape.

Implications for Planning:

- Based on the unique characteristics of this high conservation value forest landscape and its forest resources, research activities will be actively encouraged within the KDL Riverine Forest Landscape.

- Restrictions will apply for research activities within the landscape area, and guidelines will be drawn up for researchers to carry out their activities in a sustainable manner. For example, researchers will not be allowed to collect forest resources in large quantity that are rare or threatened.

2.4.5 Threats

The main threats that arise within the landscape and from the adjacent land use activities to the KDL riverine forest landscape are summarized as follows:

(a) Adjacent Land-Use

The main adjacent land-use is agriculture. The agriculture activities are dominated by the cultivation of wheat, cotton, and other seasonal crops.

As the income from agriculture crops soars, the land within the forest landscape will become an ever increasingly tempting proposition, for land-less people or neighboring influential persons. Forest land leased by the revenue department or illegally grabbed land (encroachments) creates unrest among the local community which is dependent on the forest for timber and non-timber resources. Use of forest land for agriculture activity may deprive the local community from all resources they are extracting from the forest. Therefore, if anyone intends to grab forest land, it is considered a big threat to their livelihood and causes conflicts amongst them.

(b) Community Vs Forest Department

The local community considers using forest freely as their birth right. They consider themselves the owner of the forest. Therefore, whenever forest official stops local community from cutting trees, or using wrong methods of harvesting non-timer resources, they take it as threat to their interest and come in conflict with forest staff. Forest land allotted to locals (only the most powerful group who have politically backed) are not ready to vacate land as they possess a lease agreement and consider it as their legal right. The community which is growing crops on the forest land is not ready to handover land back to forest department and is creating hurdles for local forest management. Further, during different government's tenures, forest land was being allotted to local influential persons without the consent of forest department by Revenue Department. The same influential groups grabbed more forestland adjacent to the allotted one. The Supreme Court's (SC) order regarding cancellation of all allotted forest land in 2018 has created an environment of tension among the two departments. After SC's order, a district level committee has been formed to identify and report about forest land. However, progress on the matter is still slow.

(c) Forest Fire

The KDL Riverine Forests Landscape has a rare history of major forest fire breaks. The small-scale impact of these occasional fire incidents occurs in areas with heavy grass

growth. Quite often they are started intentionally by local graziers for improving grass growth. In riverine forests, fires are common in Kandi *Prosopis cineraria* forests because the tree growth does not suppress grass beneath them, and their dead lower branches persist for a long time. Areas with *Saccharum* grass*,* which is highly susceptible to fire, must be separated from the rest with the help of fire lines established along compartment roads. Given the nature of the forests (Riverine) and the active presence of a local population, both around and within the reserved forest, such forest fire events of low to medium scale will remain a key threat to address management interventions for this landscape.

(d) Illegal Tree Cutting

The peak days of illegal wood cutting in the KDL Forest Landscape appear to have passed. At present these activities are not an eminent and active threat. The local community of Kot Dhingano and Lakhat forest still collects timber to be used for home construction, furniture and building sheds for their livestock. However, after some ugly incidents and conflicts between land grabbers and surrounding local community, the community themselves imposed ban on cutting of healthy trees in 2008. They also decided to control illegal cutting through the appointment of forest guards. About 4 people (one from each village around Dhingano forest) were appointed as the "Nighaban" (locally called *Rakhas*) by the community, whose responsibility was to guard the forest and to stop illegal wood cutting. The remuneration for all the six guards was being paid in kind by the community. Later, under the SFM project the forest department increased the number of guards from 6 to 10 (4 for Dhingano and 6 for Lakhat) and started paying them accordingly.

(e) Other Illegal Activities (poaching forest resources, hunting)

Although these activities are not prevalent, nor carried out on a large scale, there is evidence of small-scale poaching, illegal harvesting of forest products, and illegal hunting within KDL Forest Landscape. Some of these activities include the illegal netting of birds, the small-scale cutting of wood for domestic building needs, grazing, and honey collection. Hunting is notably less common today as compared to 10-12 years ago.

Part 3

HCVF Sites of KDL Landscape

3.1 IDENTIFICATION AND SELECTION OF HCVFS

The maintenance of biodiversity is a major objective of the High Conservation Value Forests (HCVFs) management. This will not only promote heterogeneity of habitat within landscape but also ensure productivity of ecosystem on sustainable basis.

A designated wildlife protected areas within managed Kot Dhingano-Lakhat Riverine Forest Landscape offers safeguards against the known and unknown impacts of various extractive resource uses. This forest landscape contains two wildlife sanctuaries declared under the provisions of Sindh Wildlife Protection, Preservation, Conservation and Management Act 2020 (formerly known as Sindh Wildlife Protection Ordinance 1972). These HCV protected areas are meant to conserve not only wildlife heritage, but also have potential to provide opportunities for eco-tourism, outdoor recreation, environmental education, and integrated forest management on sustainable basis. They can also serve as long-term benchmarks for ecological monitoring. The amount of land currently designated as wildlife sanctuaries within Kot Dhingano-Lakhat reserve forests is less than 3% of the riverine landscape. However, in view of inadequate sizes of these protected areas, surrounding forest habitats and other land features needs to be merged as part of these protected wetlands to transform them as adequately representative HCVF's. Although from the perspective of management, present status of these biodiversity hotspots is very poor, and they can be termed as neglected protected areas.

The very purpose of designating these HCVF areas within the landscape is to conserve the ecological integrity and for this, it is necessary to ensure that the total area of these HCV sites is adequate to maintain viability of ecosystem. The two sites identified are relatively undisturbed, so that these would remain in a natural state to serve as biodiversity hotspots. However, presently a GIS-based boundary demarcation and delineation of core areas of

these two HCVF sites namely 1) Kot Dhingano (wetland) wildlife and 2) Lakhat wildlife sanctuaries in Kot Dhingano-Lakhat landscape requires more focused approach for resource management. The basic criteria used for the selection of these ecological significant HCV sites are:

1. Presence of rare or uncommon species of plants and animals.
2. Existing status of protected area under wildlife laws.
3. Minimum level of disturbance by external factors.
4. Friendly attitude of local communities towards conservation.
5. Available secondary data and newly acquired information through different studies.

3.1.1 HCVFs in Kot Dhingano-Lakhat Riverine Forest Landscape

The Kot Dhingano-Lakhat Riverine Forest has been designated as a HCVF based on baseline information compiled under SFM project. Of the six major HCV categories listed in the Forest Stewardship Council (FSC) guidelines, four including HCV 1, 3, 4, and 5 were present in the two identified areas, whereas remaining two were not detected.

Two sites have been selected as HCVFs within Kot Dhingano-Lakhat riverine forests landscape. These include i) Kot Dhingano (wetland) wildlife sanctuary, and ii) Lakhat (wetland) wildlife sanctuary. These two contiguous reserved forests provide shelter to famous game birds such as the Black and Grey partridges. In addition, the landscape also supports a thin population of hog deer. The River Indus and its adjacent wetlands constitute the 'Green Route' for many migratory birds coming from colder region of Central Asian countries during winter season and these protected wetlands are important 'flyover' zones for thousands of migrating birds. A brief account of these sites is as follows:

3.1.2 Kot Dhingano Wildlife Sanctuary (Wetland)

Overview: Kot Dhingano is a part of Dhingano/ Lakhat Riverine Forest Landscape, of Shaheed Benazirabad Division. This landscape constitutes mix areas of riverine forests and wetland. It is within easy driving distance from the national highway (Kazi Ahmed). In the year 2008, the local communities of 8 villages in surrounding of Kot Dhingano riverine forest made the commitment to extend their help in protection and management of forest.

The main tree species of this forest are *Babul*, *Kandi, Lai* and *Bahan*, whereas this forest also provides suitable habitat to important Marbled Teal (*Marmaronetta angustirostris*), Bristled Grass Bird *(Chaetornis striata*), Hog Deer, Jackal, and Wild Boar, and Jungle Cat, Black and Grey partridges. The landscape is also a source of fisheries (Rahu and Thala), kana, sar, honey, pods, thatching material, etc. The wild honey is harvested by community people is famous for its purity.

Within Kot Dhingano, the high conservation value (HCV) wetland and associated forested land with total area covering 60 acres is home for many migratory and resident waterfowl. The waters of this small lake and surrounding vegetation support a variety of birds, animals, and plant life.

Protected Area Status: The HCV wetland portion of this forest was designated as a wildlife sanctuary in 1977 under the provisions of Sindh Wildlife Protection Ordinance, 1972 (now SWPPCM Act 2020). The great majority of bird's species are winter visitors, a few are breeding migrants and the remainders are resident breeders. The River Indus and its tributaries lie along the 'Green Route' flyway for migratory birds coming from the colder regions of Central Asian countries to the comparatively warmer lands in Sindh.

As per definition, a wildlife sanctuary is designated as undisturbed breeding grounds for the protection of wildlife and access thereto for public shall, except in accordance with the rules, be prohibited and no exploitation of forest therein shall be allowed except for reducing fire-hazards, epidemic or insect attacks or other natural calamities. However, government may authorize for scientific or for aesthetic enjoyment or betterment of scenery.

The total area of the sanctuary is 75 acres but the HCVF will also include the surrounding forest stands. The combination of water body and woodland will provide habitat for a variety of birds including water birds, passerine birds as well as threatened game animals such as Hog Deer *Cervus porcinus* (Pharo). This HCVF possess rich faunal assemblages, possibly including the rare, marbled duck.

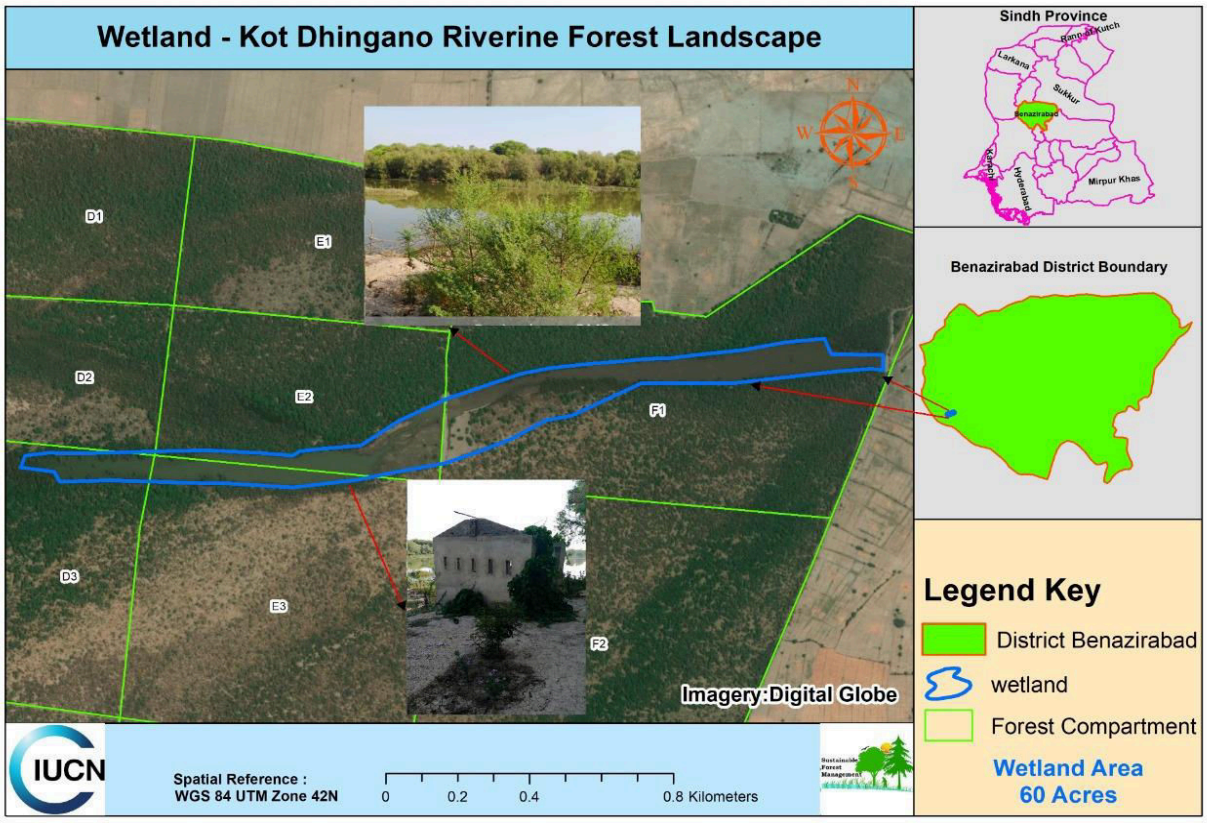


Figure 3.1: Wetland – Kot Dhingano Riverine Forest Landscape

3.1.3. Lakhat Wildlife Sanctuary (Wetland)

Overview: Lakhat forest along with wetland wildlife sanctuary is a part of Dhingano/ Lakhat Riverine Forest Landscape, of Shaheed Benazirabad Division. Prior to SFM project interventions, this designated forest area was completely devoid of tree growth. However,

now the designated forest areas have dense vegetation growth. The ongoing restoration work has provided an opportunity towards recovery of lost glory. However, still many portions of this landscape are being highly deteriorated and encroached upon for raising agriculture crop.

Within the Kot Dhingano-Lakhat landscape, there is another potential high conservation value (HCV) site comprised of wetland and surrounding degraded woodlands. This Lakhat wildlife sanctuary has the potential to sustain a variety of wildlife species including wintering as well as resident waterfowl and passerine species. It is situated at 26° 05´ N / 68° 20´ E and is within easy driving distance from the national highway (Kazi Ahmed). The total area of the sanctuary is 250 acres which need to be further expanded as HCVF with the inclusion of surrounding forestlands. In conjunction with nearby Kot Dhingano Lake and river segment it constitutes a biodiversity hotspot wetland complex.

Protected Area Status: The HCV wetland portion of Lakhat forest was declared as a wildlife sanctuary in 1977 under the provisions of Sindh Wildlife Protection Ordinance, 1972 (now SWPPCM Act 2020). The HCVF wetland and associated wooded habitat of Lakhat, covering an area of about 100 acres, constitute important wildlife habitat of landscape. However, presently this biodiversity hotspot is devoid of surrounding vegetation and some parts of it are submerged into the riverbed. This riverine lake and verdant vegetation exist in the peripheral area of the lake, which was once rich in bird and animal life needs to be restored. Forest wetlands are considered as the most productive and precious asset, as they play an important role in flood control, and provide water during droughts.

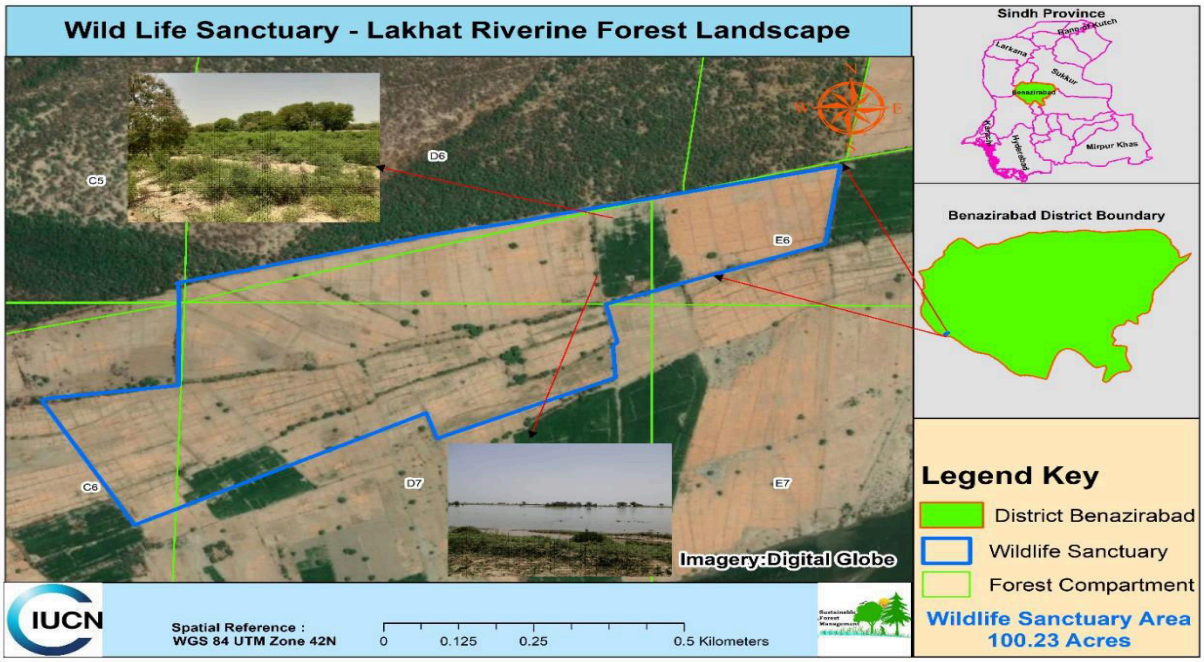


Figure 3.2: Wildlife Sanctuary – Lakhat Riverine Forest Landscape

3.2 EX-SITU CONSERVATION OF HOG DEER

The prime objective of *Ex Situ* conservation (captive breeding) of Hog Deer is to achieve a desirable population that would be large enough, to reintroduce in their wild habitat where

the species were historically distributed but now become threatened due to human intervention, i.e., habitat loss and uncontrolled hunting. Once, the population of *Axis porcinus* becomes sufficient, then they will reintroduce into the wild in their native/ original riverine habitats (Kot Dhingano-Lakhat Riverine Forests Landscape).

3.2.1 HCVFs as Biodiversity Hotspots

The riverine ecoregion is one of the most diverse regions of Sindh in social, cultural, and biological terms. The region has vast alluvial plains containing forests and wetland landscapes. It hosts a high number of valuable species wealth and unique ecosystems with tremendous biological diversity. The appropriate ranking and mapping of these biodiversity hotspots will further project the significance of ecological importance of Indus riverine ecosystem.

Hotspots are priority areas of habitats for biodiversity conservation and characterized by exceptional levels of plants and animal species. There are places in both forest landscapes that are both biologically rich and seriously threatened. In KDL landscape two HCVFs have been identified, whereas, in addition to these areas, one highly important *ex situ* conservation area has been established as threatened hog deer captive breeding center, which may be termed as a hotspot. This is an ecologically important area, where success in conserving species can have an enormous impact in securing landscape biodiversity for sustainable management.

The people living around the KDL riverine forest landscape with important biodiversity hotspots know the real worth of these natural resources in their lives. They graze their livestock, gather fuelwood, and hunt for honey. The trees help prevent drought and flood damage by drawing up groundwater and anchoring soils with their roots i.e., provide a range of ecosystem services. In general, the present status of biodiversity of riverine forests looks rather low, perhaps because of past large-scale degradation. However, there are areas of high species richness like hog deer habitats. These hotspots need scaling up of their status or enhanced protection to perform their services in full capacity for promotion of sustainable ecosystem services.

3.2.2 Captive Breeding Program

Nowadays, captive breeding of different ungulate species to raise animal stock for reintroduction purpose is known as widespread conservation activity. Notably, captive breeding program is one of the *ex-situ* conservation activities, to increase the populations of threatened or endangered species to prevent extinction. Under this program, the species are kept in an enclosure under intensive care to breed in controlled environment as close as possible to their natural habitat. For this purpose, an area of 2-acre land has been fenced in riverine landscape Kot Dhingano to establish captive breeding centers and provided semi-natural conditions (i.e., habitat, food, water, and shelter) to perform multiple activities, such as rest, forage, hide, mate, and breed to increase their numbers in the captivity. An appropriate proportion of animal numbers has been selected (one-male and 3-4 females) and released into the enclosure for breeding purpose. Several offspring can produce from selected genitors to avoid inbreeding depression and to preserve genetic variability to obtain a demographically stable population.

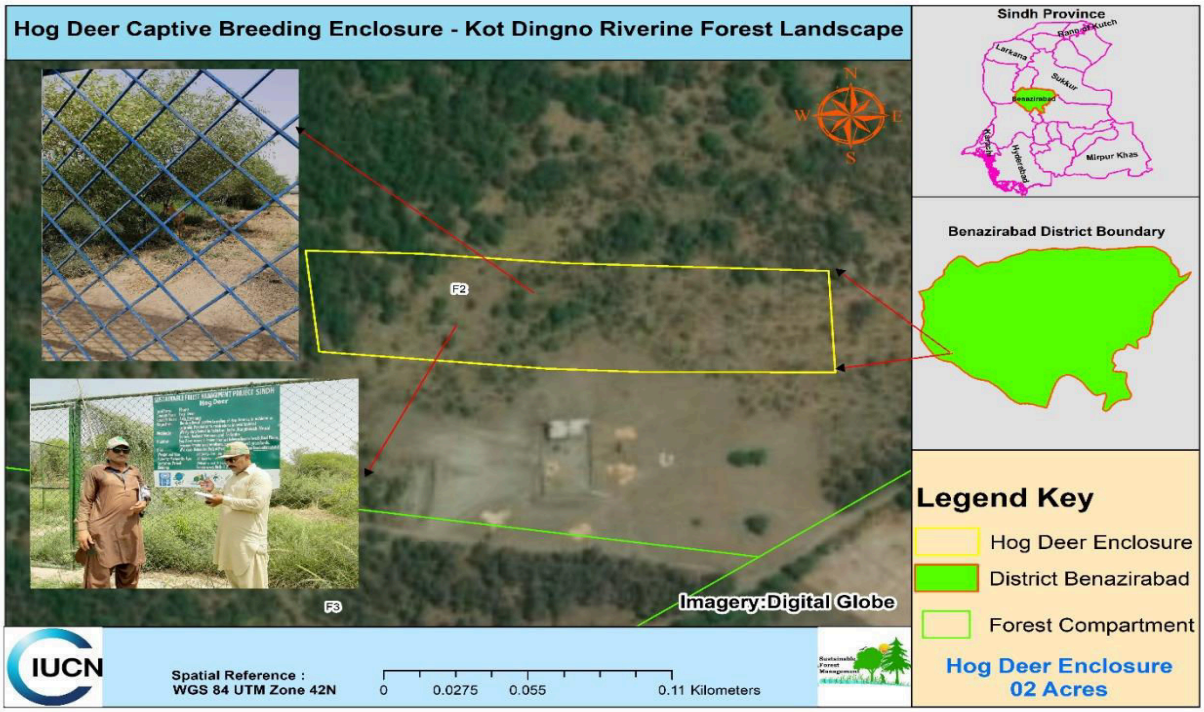


Figure 3.3: Hog Deer Captive Breeding Enclosure – Kot Dhingano Riverine Forest Landscape

3.3 ISSUES AND RECOMMENDATIONS

3.3.1 Key Issues

1. In the past, agroforestry lease policy of 2005 has been counterproductive for the productive forests of Sindh. This policy has failed to achieve its objectives. As a result, even after expiry of leases, the recovery of leased out forest lands looks like an uphill task. Supreme Court of Pakistan also invalidated the Agroforestry lease policy introduced by the Sindh Government.

2. Encroachment and land grabbing of productive forest lands.

3. Unchecked largescale livestock grazing in both landscapes has serious implications on long-term sustainable management of riverine forests.

4. Weak measures to protect profuse regeneration with limited manpower resources.

5. Unregulated rampant and extensive fuelwood collection.

6. No mechanism in place to check poaching and illegal wildlife hunting.

7. Weak working relationship between forest and wildlife departments at operational level.

3.3.2 Recommendations

1. During implementation of riverine forest landscape management plans of both sites, the identified HCVFs, should be given due importance to preserve valuable natural resources and ensure the connectivity between the remaining natural areas for biodiversity conservation (e.g., animal migrations) to access different types of habitats and other resources, for the recolonization of empty habitats and for genetic exchange within populations.

2. Forest managers should avoid cutting of Bahan trees in these HCVFs and encourage regeneration by avoiding cattle grazing or other site disturbance. If less than 20 trees exist in the stand and no other seed or pollen source is nearby, seeds from the nearest stand and plant should be brought to increase the diversity and viability of the population.

3. Sustainable forest management practices should be implemented to ensure that these areas are not degraded during any tree felling operations prescribed under management plans.

4. After acquiring further detailed baseline information on each identified HCVFs during implementation of landscape plans, a separate conservation strategy and action plan should be developed to address long term management issues of these biodiversity hotspots.

5. A further enhancement in wildlife protection, stricter enforcement and anti-poaching measures are the best management strategies to reduce threats to the HCV species. Further, SFM practices will ensure that these areas are not degraded during felling operations.

Part 4

Management Prescriptions

4.1 INTRODUCTION

Until 2008 the Kot Dhingano-Lakhat (KDL) Riverine Forest Landscape received very little attention. Activities such as the cutting of trees, firewood collection, open grazing, and the utilization of the Reserved Forest for hunting of game animals, other non-timber forest products (NTFPs), and forest land encroachment for agriculture has mostly carried on unchecked. Most of these activities, in the past, have resulted in forest degradation, and the destruction of the valuable biodiversity capital.

A vital step to address these issues has been the drawing up of this Sustainable Forest Management (SFM) Plan to outline a long-term strategy of management interventions for KDL forest landscape. The management planning process for KDL landscape has revealed numerous opportunities arising in this reserve. These opportunities will not only provide immediate benefits to this ecologically high conservation value riverine forest landscape but provide multiple benefits to the people of surrounding areas. The involvement of the local community in the implementation of management activities provides a unique opportunity that supports the protection and enhancement of forest landscape resources, while at the same time provides vital income generation opportunities for the surrounding community and for the Provincial Government of Sindh.

Through the support of the GEF-UNDP funded SFM project, the fundamental problems associated with the management of this high conservation value riverine forest landscape have been documented with different baseline studies and moved forward to address them on the ground. These funds have also enabled management interventions to ensure that long-term financial support be developed for the management of this landscape. The proceeding section of this Forest Management Plan will outline a course of management action and interventions for the next 10-year period for this Forest Landscape.

The overall management strategy designed for this KDL forest landscape management plan is based on a logical framework approach. This simply means that actions, strategies, and interventions are based-on, and designed to address, the situation and issues on-the-

ground. This logical-framework approach is a simple yet pragmatic approach towards the management of this forest landscape and the activities therein.

Management Interventions fall under the following key categories; (a) interventions for protection of forest landscape, (b) forest restoration and habitat improvement (c) Management zoning (d) forest fire prevention and control, (e) research strategy, (f) visitor management (g) HCV areas management interventions, (h) and (i) carbon sequestration.

4.2 INTERVENTIONS FOR PROTECTION OF FOREST LANDSCAPE

4.2.1 Overview

The KDL riverine forest landscape is a protected by nature of its classification as a designated 'Reserved Forest' which has been declared under the Forest Act 1927 and is generally without any rights and privileges. The landscape also contains within it, two wetland wildlife sanctuaries declared under the provisions of Sindh Wildlife Protection Ordinance 1972, now Sindh Wildlife Protection, Preservation, Conservation and Management Act, 2020. However, in the present scenario due to different pressures and poor management the landscape resource protection is difficult task, if:
1. The public is not aware that the forest landscape and its valuable biodiversity are legally protected and are not free for the taking.

2. The community settled in the surrounding or in adjacent area to the forest landscape is not aware of the actual boundary of the KDL landscape.

The management interventions prescribed in this landscape plan as designed to address these above-mentioned issues. The necessary protection interventions are described as under:

4.2.2 Boundary Consolidation

Giving due consideration to this issue, boundary demarcation will be carried out in two phases.

1: The landscape boundary that is already gazetted will be marked and maintained properly based on the formal survey carried out through Survey of Pakistan in 2018.

2: In line with fresh survey the boundary should be demarcated, re-marked, and mapped as per the new notification/ gazette.

Apart from demarcating and marking the boundary, further steps will be taken to make clear the forest landscape protection status and obvious to the public and nearby communities. To do this, appropriate signage will be installed to establish the ownership and authority of the Sindh Forest Department. In this regard two types of signage will be installed as follows:

1. Large Signboards, which provide information about the name of the forest landscape, its size (in hectares), its boundary map, and the legal status of the forest landscape.

2. Small Signboards, which are installed at regular intervals around the boundary of the reserve, to provide additional information about the boundary as well as information about the prohibited entry and activities in the forest landscape.

In addition, informative brochures, maps, and website, will be developed for the awareness raising.

4.2.3 Monitoring of Landscape Boundaries

Standard monitoring of boundaries and other activities within the landscape area will remain an extremely important factor to ensure the protection of the forests and its associated biological resources. The main form of boundary monitoring recommended is on the ground checking of boundary positions. This activity can also lead to create good relationships with adjacent communities or landowners. Other modes of monitoring such as aerial surveillance through drones, and the monitoring of environmental indicators are also very effective. The key forms of monitoring which need to be carried out in the KDL Forest Landscape include:

1. On-the-ground boundary monitoring: Physically checking the boundary jointly by landscape protection staff and community 'Nighaban' through vehicular movement. This activity can also be combined with the boundary marking activities.

2. Aerial surveillance through use of drone is already in practice which needs to be further strengthened and organized. In addition, the help of aerial photography and satellite imagery may also be used on need basis.

3. Monitoring of different environmental impact indicators, to ensure continued health of forests and wildlife habitats in the landscape and control outside interferences.

4.2.4 Implementation Strategy regarding Boundary Protection

Summary:

1. If any issue arises regarding boundary, it will be settled, in the light of latest forest landscape survey conducted by Survey of Pakistan (2018) and the authenticated boundaries will be notified.

2. The boundaries which are unambiguous and have no dispute will be re-marked as soon as possible.

3. The boundaries which need to be settled, will be demarcated, and re-marked after appropriate settlement.

4. Signage and other communication and awareness materials will be put in place.

5. All possible forms of boundary monitoring including physical, aerial, and environmental indicators will commence accordingly.

4.3 FOREST RESTORATION AND HABITAT IMPROVEMENT

4.3.1 Status of Forest Degradation

The condition of forests in landscape is mix of old growth, various stages of regeneration and severe degraded areas. After extensive field survey and verification based on satellite imagery of Google, a map of degraded forest within KDL landscape has been developed by the Divisional Forest Officer in 2019. The degraded areas of Kot Dhingano forest were identified by considering the canopy cover of mature trees (areas having less than 30% canopy cover) and forest health (areas affected by fire) were considered as degraded areas and were measured with the help of field surveying and remote sensing. The forest area was visited to locate the degraded areas and sample plots were demarcated with the help of GPS at different locations of Kot Dhingano forest. The polygons of degraded areas prepared with the help of GPS were super-imposed upon Google Earth. With the help of these sample plots, the other degraded areas of Kot Dhingano forest were identified by comparing the areas with sample plots and measured on Google earth. Thus, all the degraded areas of Kot Dhingano forest were identified, measured and such map was prepared which is referred below in **Figure 4.1**.

The map so prepared was verified on the ground by visiting the mapped areas thoroughly and discrepancies (if any) were removed, and final map was prepared. Similarly, the area of Lakhat forest was visited and found that the area was having no tree cover. The forest area of Lakhat forest was either under river course or under cultivation. Both areas i.e., area under cultivation(encroachment) and area under river course were identified on Google earth and mapped.

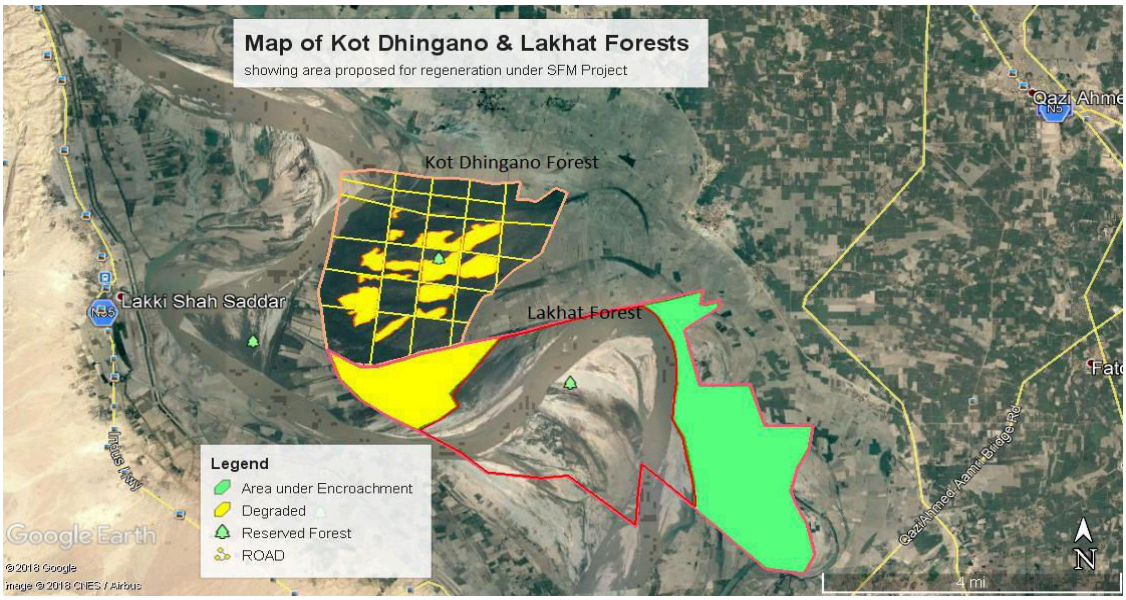


Figure 4.1: Status of Forest Degradation in KDL Riverine Forest Landscape.

Degraded forest in KDL forests is scattered in patches, throughout the landscape, and appears both in intact Dhingano forest and little vegetative or denuded Lakhat forest. The most serious forest degradation appears in this part of landscape mainly due to

encroachment and deforestation. Some of these areas are totally denuded of trees and encroached for agriculture.

The total area of degraded forests in KDL Riverine Forest Landscape is summarized as follows:

1. In Kot Dhingano degraded forest area is around 18% (705 acres).

2. Degradation in Lakhat forest after last three years (2017-19) successful regeneration is still around 50%.

4.3.2 Forest Restoration in KDL Landscape

The Sindh Forest Department has already taken concrete steps to support forest restoration in the Kot Dhingano-Lakhat landscape for the livelihood support of local community and broader interest of sustainable forest management rather than sole objective revenue generation.

1. Forest protection and restoration activities have been initiated in 2008 with the help of local community and further geared up during implementation of ongoing SFM project since 2017.

2. The knowledge and experience of the community has already been acknowledged as a major opportunity for the SFD to build upon for the future management and conservation of this forest landscape. Most of the economic activities in landscape directly benefit the local community, and in result supporting biodiversity conservation.

4.3.3 Justification for Forest Restoration

Following few prominent reasons to protect and restore Kot Dhingano-Lakhat Riverine Forest Landscape.

1. The landscape mainly functions to support NTFPs activities for the livelihood of local communities under participatory management arrangements.

2. The landscape functions to contribute towards climate change mitigation as a carbon sink

3. They generate revenue for the Sindh Forest Department through involvement of corporate sector.

4. The landscape functions as important eco-tourism spot or site for the nature lover people of central Sindh.

5. The landscape functions as ecologically high conservation value forest resources to support the important wildlife populations including hog deer, river dolphin and numerous species of migratory birds.

6. The important biodiversity of forest landscape is a major asset of Sindh Forest Department for all the economic purposes associated with biodiversity conservation such as future gene pool as well as ecosystem services that benefit society such as, pollination and the prevention of erosion.

7. Forest degradation in landscape may invite great risk of forest fire, which can damage important forest resources and the livelihood of local people in the area.

4.3.4 Forest Restoration Technique

It is important to deciding on an appropriate strategy for restoring degraded forest lands within KDL landscape. In this regard multiple factors for restoring the degraded forests will work to enhance the management effectiveness. Within this landscape, wildlife conservation, promotion of NTFPs, carbon sequestration, captive breeding of hog deer and provisions for eco-tourism will be the key features to make it a complete management package. The focus on restoring degraded floodplain forests will be central to maintaining the ecological health of landscape.

The most successful forest restoration activity in the degraded sites targeted by SFD has been the protection and conservation of regenerated trees or new growths through applying best silvicultural techniques. In this respect, forest restoration work within landscape will proceed with caution. The short-term solutions in the name of proven techniques should be avoided. In the short-term, financial resources will be concentrated on more immediate forest management and protection interventions, which will serve to protect, conserve, and help restore these forests indirectly.

In this Landscape case, the overarching strategy for forest restoration is that this activity will be continued on trial basis. The different restoration efforts and techniques will be scaled-up throughout the management plan period with research-based approach to tackle the severely degraded areas like Lakhat Reserved Forests.

4.3.5 Priority Sites of Landscape for Restoration

There is approximately 60% of forest landscape area can be termed as degraded forests in the KDL Reserved Forests. Of this approximately 300ha is partially degraded in Kot Dhingano forest, whereas 1462ha area of Lakhat forest is highly degraded or devoid of tree cover. The forest restoration work will focus intensive efforts on both the degraded sites. Further, priority will be given on sites, which have a clear history of problems associated with their natural regeneration.

Currently restoration work is already being undertaken in degraded areas, which is retrieved in floodplain sites of Lakhat forest, a part of the landscape. The present rational for this is the fact that these forests, mostly closest to Indus River, contain a high value diversity of wildlife species including key stone species like the hog deer.

The choice of forest restoration sites and to support the ecological functions is summarized as follows:

1. The sites provide important habitat for wildlife conservation and assist in linking up corridors for migratory birds and provide space for movement of other terrestrial animals in the area.

2. The sites are highly degraded but act as a viable seed source for natural regeneration.

3. The sites more easily accessible and logistically easier to access with available means of transportation.

4. The sites provide habitat for flagship wildlife species especially those species which are rare, threatened or keystone with ecological importance.

5. The sites provide essential flood mitigation functions or potentially contribute to control the soil erosion.

6. They maintain the integrity and conservation of biodiversity in general, and all other significant components of riverine ecosystem therein.

4.3.6 Restoration Plan and Implementation

Forest restoration activities have already been carried out in the KDL riverine forest landscape under SFM project from 2017. The key partner of the SFD in carrying-out this work is the local community. This partnership was started in 2008 and helped in protection of Dhingano forest with the approach of sustainable resource use policy. The strategy for implementation of restoration plan will include:

- The key strategy for forest restoration in Forest Landscape will be to build on and enhance the ongoing efforts with active role of local community.
- Another key strategy will be to assume that restoring the most degraded forest of landscape is mostly going to happen during first phase of Plan Period.
- The funds will be directed towards specific steps to move forward the technology and techniques associated with forest restoration. This will include experimenting (R&D) in different forest areas within the landscape. It will also mean the provision of funds for technological improvements in all aspects of the forest restoration work.
- The highly degraded forests will be the main target of intensive restoration works.
- Forest restoration works will be focused on sites, which have a clear history of problems with their natural regeneration and require human intervention. These sites will be monitored for a period of 3-5 years to observe the natural regeneration success results.
- Forest restoration works will focus on degraded sites which provide key ecological functions such as the enhancement of habitat for wildlife and wildlife corridors.
- A process of trials with different techniques will be applied for these restoration sites. The main steps to enable this, such as establishing research activities will be vital for the restoration of forest to move forward.

4.3.7 Wetland Restoration

In addition to the forest restoration activities, other conservation, and restoration activities in Kot Dhingano-Lakhat forest landscape will be encouraged. One such activity is the ongoing Dhingano wetland restoration work being carried out by the SFD. This activity is seen as vitally important for wildlife conservation in the landscape. An entire ecosystem relies on the integrity of these wetlands and its restoration is considered a vitally important activity, which should continue.

4.3.8 Carbon Sequestration Assessment

Reducing emissions from deforestation, forest degradation, sustainable forest management, conservation and enhancement of forest carbon stocks known as REDD+ has emerged as a promising option for forest-based climate change mitigation in developing countries like Pakistan. Under the REDD+ programme, developed countries will provide incentives to the developing countries to keep their forests standing and thus help in reducing GHG emissions.

Carbon stock assessment was conducted in the riverine forests of Shaheed Benazirabad Forest Division of Sindh province under Sustainable Forest Management. The total forest area of the Shaheed Benazirabad Forest Division is 5,679 ha. It was shocking to know that 4,880 ha forest of Lakhat in Shaheed Benazirabad has been completely converted into crop land. The highest density was found in Kot Dhingano with 209 trees/ ha. The average diameter at breast height was recorded as 13 cm and average tree height was estimated 6.70 m. approximately 97% of the trees have diameter less than 30 cm. Very few trees larger than 30 cm diameter are available in Kot Dhingano forests. To enhance carbon stock of landscape forests and tape financial benefits following steps will be undertaken:

1. Develop a measurement, reporting and verification (MRV) mechanism which is one of the key requirements under REDD+ for carbon-based forest management (UNFCCC, 2010)

2. Ensure increase in forest carbon stock of landscape by effective implementation of forest restoration plan to earn financial benefits through sale of carbon credits in the local as well as international carbon markets.

3. Capacity building of management staff in carbon assessment need to be enhanced on regular basis to meet the requirements of REDD+ mechanism/ trading.

4. Encourage transformation of timber-based forest management economy into carbon incentives related climate mitigation.

4.3.9 Management and Protection of Non-Timber Forest Products

Riverine forests of KDL landscape like others provide non-timber forest products (NTFPs) and services such as timber, firewood, pit props for mines, forage for livestock. They also support biodiversity and game animals. Other non-timber forest products include tannin from bark, gum, honey and even fish from lakes and depression of old riverbeds. Forests act as carbon sinks, moderate climate, stop soil erosion and protect soils and settlements from the ferocity of flood waters.

The NTFPs of Riverine landscapes are highly important and economically valuable for local people of the area. The well-regulated sustainable harvesting and marketing of NTFPs is always helpful if carried out scientifically and in environment friendly manner. The local people who gather the NTFPs get the smallest returns, whereas the middleman and bigger traders get the maximum profit. This is because the retail prices of NTFPs are significantly higher compared to the buying prices from the forest communities. During the implementation of landscape management plan, the existing NTFP harvesting system will be improved on following lines:

1. As per market standards, the existing system of trade will be improved for the wellbeing of rural communities, so that it will protect the rights of the product collectors at the forest level.

2. The role of forest managers will be enhanced to regulate the safe NTFPs collection methods and devise effective marketing mechanism as per the market dynamics.

3. The Forest Department must create awareness among local people to harvest forest products sustainably at grassroots level so that the local communities of riverine forests make their contribution in mainstreaming natural resource development.

4.4 MANAGEMENT ZONING

In the KDL landscape case, zoning is mostly concerned with areas of significance for conservation, and "acceptable human activity" within the forest landscape as per principles of SFM. Acceptable human activities can be grouped into two categories:

1. Activities, which support the protection status of the forest landscape and the conservation of biodiversity that includes forest restoration, wetland protection, *Ex Situ* conservation or any other natural resource protection related activities.

2. Activities, which utilize the landscape resources in a non-extractive or sustainable manner for socio-economic benefit. In KDL context, these activities include low impact ecotourism (wildlife watching, recreational fishing, camping, etc.), capacity improvement of carbon sink, sustainable harvesting of NTFPs, scientific research, and future introduction of sustainable hog deer trophy hunting in buffer zone areas of the landscape.

After mid-term review of landscape management plan in 2026, a well thought out zoning plan with complete details of what activities are suitable in which location of landscape will be developed to conduct these useful activities in an organized manner. During second phase of plan implementation (2026-2030) such planning will help focus on management interventions and channel funds into appropriate places.

4.5 FOREST FIRE PREVENTION AND CONTROL

4.5.1 Organization

The KDL Riverine Forests Landscape has a rare history of major forest fire breaks. However, small scale fires are common in Kandi *Prosopis cineraria* forests because the tree growth does not suppress grass beneath them, and their dead lower branches persist for a long time.

The responsibility regarding forest fire control and prevention will rest jointly with the Sindh Forest Department, District Disaster Management Authority and Local Community. Forest Landscape Managers in the field will follow the long-term fire prevention and management strategy of the SFD by using latest fire control tools described in the Monitoring Protocol. In the event of a fire, the coordination of firefighting response will rest jointly with the SFD and Local Community. The SFD has the manpower and equipment to control fires. The key management action requires is to ensure that the District Forestry Office remains in a ready state of preparedness to prevent forest fires or control them if they should occur.

4.5.2 Prevention and Preparedness

Timely measures to prevent forest fire are a most important step to avoid irrevocable damage to landscape resources. Prevention starts with raising awareness in the surrounding community to the forest landscape. Awareness raising activities should be carried out if climatic conditions or extensive human activities (indicators) show a low to moderate risk

that forest fire could occur. Further, KDL forests management team should always remain in a state of preparedness to control forest fires in the landscape area. This means there needs to be a committed and on-going course of action throughout the management plan period regarding forest fire preparedness. The following course of action will need to be undertaken in the management period to ensure forest fire prevention and preparedness:

1. Awareness raising and education activities regarding forest fires for prevention and control will be a regular feature during the whole management plan period.

2. Key indicators will be monitored such as persistent dry weather, and the build-up of fuel loads on the forest floor.

3. Other forms of surveillance, such as remote sensing, aerial surveys and ground patrols will all be contributing actions to monitor and prevent fires and raise the alarm if a fire should occur.

4.5.4 Equipment and Training

Forest firefighting is a specialized task and requires state of the art firefighting equipment's to control fully stocked old growth forests of Kot Dhingano and nearby profuse regeneration. Appropriate equipment's storage facility will be constructed at Dhingano Forest Hut to ensure the operational capability of firefighting events. Further, these firefighting equipment's and machinery such as high-pressure water pumps need to be checked and maintained in good working condition on a regular basis. All these actions will be undertaken during the management period.

Similarly, periodic training of specific staff (Forest Guards) and community members (Nighaban) of team in the field of firefighting is an essentially prerequisite. This is necessary to ensure that fire-fighters stay safe and maximize the impact of fire control techniques. It will be important for landscape managers to tap-into this kind of training on a regular basis, to keep personnel at the landscape level up to date with the latest forest-fire related-skills. The support of local community in events of such forest fire is important to provide vital back-up support to the department in terms of trained manpower. Training should include first aid treatment, emergency evacuation procedures, use of radio communication and fire suppression techniques for various situations, water delivery techniques, and the creation of fire breaks. In addition, annual programs for fire-drills should be established, and mock-up firefighting exercises carried out to keep all personnel and related supporting organizations ready for this kind of activity.

4.5.5 Immediate Fire Control Strategy

The key initial strategy when a fire alert is raised will be to implement "urgent fire outbreak suppression". This means getting personnel to the fire as soon as possible, with hand-tools and water, and attempt to contain any fire before it gets too large or out of control. Depending on the fire situation and outlook, the next step will be to activate the other key elements of fire suppression, such as logistical support, the involvement of heavy machinery, etc. In all fire scenarios due care must be given to supporting the fire crews. Even in small-fires situations, it is vital to supply adequate drinking water and food. This should also include the provision of temporary staff rest camps, when required. The availability of medical support should also be kept in mind in all situations. The establishment of a forest fire logistical support team, which focuses on the task of supplying logistical support to fire crews will be an important part of the fire control strategy.

4.5.6 Implementation Strategy and Plan

A strategy must be planned to prevent forest fires from occurring in the KDL Forest Landscape, and to control them whenever they occur. The key interventions required to be implemented during management period are summarized as follows:

1. Launch the forest fire awareness raising campaigns to educate the surrounding communities and visitors regarding forest fires prevention and control measures during high fire risk seasons regularly.

2. Prepare inventory on access maps, contact lists of adjacent community trained firefighters, contact details of other relevant organization at district level and contact lists of key heavy machinery suppliers and other related support mechanisms.

3. Monitor key fire risk indicators such as the dry weather and build-up of fuel loads on the forest floor.

4. Establish a small weather observatory at landscape level to monitor local climate conditions on regular basis and make annual analysis of data to facilitate forest managers in better management of forest resources.

5. Establish fire-tower at fire sensitive location within the KDL landscape to monitor and prevent such incidents particularly during dry weather conditions.

6. Implement other forms of surveillance, such as remote sensing, aerial surveys by use of drones, ground patrols to monitor fire risks and prevent fires, issue alerts on mobile messages and raise the alarm if a fire should occur.

7. Conduct appropriate forest fire control training and improve firefighting skills of concerned forestry and community manpower.

8. Implement an annual mock forest fire, or fire drills, to ensure all fire control mechanisms are in place and ready.

9. Ensure proper maintenance of all essential firefighting equipment's both at the District and Forest landscape level for any emergency.

4.6 RESEARCH STRATEGY

4.6.1 Current Status

At present there are no formal research activities being planned and undertaken in the forest landscape. However, there is immediate needs for some scientific studies and research to streamline the resource base of the forest landscape for effective management. The immediate research needs identified include:

1. Regular and periodic baseline studies of different wildlife species, their populations, behaviour, preferred habitats, local as well as international status, and ecological needs for survival on sustainable basis. These studies are required to provide input into the landscape management and habitat restoration program.

2. Ecological studies to boost ongoing forest restoration activities at landscape level and spread best practices in similar surrounding areas. The scope of these studies may include different environmental factors such as climate, soil, hydrology. This will be important to understand that how these tree species and associated plants survive in the floodplain environments and the conditions necessary to improve planted tree performances in these areas.
3. A comprehensive study on the viability of the sustainable use of game birds and trophy hunting of hog deer and wild boar, suggesting appropriate management and sustainable harvesting guidelines as a future activity.

4. Studies on all aspects of biodiversity including species, genetic and ecosystem diversity pertaining to landscape.

5. Research and studies related to the potential and valuation of Non-Timber Forest Products (NTFPs) and their role in biodiversity conservation.

6. Specific studies of targeted endangered and threatened wildlife species, such as hog deer, Indus dolphin, Marbled teal, Darter, which are rarely found in landscape area.

7. Environmental impact studies of activities within or around the reserve, such as ecotourism, birds watching, camping, and NTFPs harvesting activities.

8. Socio-economic studies to understand the behaviour of local communities and possible pressure on natural resources.

9. Periodic studies regarding forest growth, trend, and their carbon sequestration potential.

10. Comprehensive study on identification of alien invasive species, such as *Prosopis juliflora* and *Parthenium* commonly known as gajar booti, and their impact on local flora and fauna

4.6.2 Implementation of Research Plan

Above mentioned research activities and other new emerging studies would be given priority during the initial stages of management plan implementation. In this regard, provisions for financial resources will be taken care in the plan budget. However, in view of this high conservation value riverine forest landscape's significance and ecological function as important wildlife habitat, the research activity that is considered essential to undertake immediately will be wildlife baseline and population density studies. Therefore, for additional funding, request will be made to Higher Education Commission and other research funding organizations such as Scientific Committee of WWF Pakistan, UNDP Small Grant Program facility, and the Centre for Agriculture and Biosciences International (CABI) Pakistan. Similarly, other research needs for forest research management will also not be overlooked during plan implementation period.

Priority will be given to the local researchers and research institutions. However, possibilities should be explored to link some of the studies with renowned international research programs. The involvement of concerned faculties of local universities, such as Sindh University Jamshoro, Shah Latif University Khairpur, and Sindh Agriculture University, Tando Jam will help in implementation of research activities pertaining to the outlined areas of studies. It will be important for forest managers of KDL landscape to create links with these research institutions throughout the management plan implementation period.

4.7 VISITOR MANAGEMENT INTERVENTIONS

4.7.1 Overview

The visitor management strategy for landscape should be designed to strengthen the present visitor scope and recreation activities of nature lover, students, and local public. The key purpose of building capacity of Forest Department staff is to strengthen their ability to manage high value forest resources and associated wildlife diversity and habitat effectively in line with principles of the sustainable forest management.

The main purpose of these activities is, to:

1. Maintain and protect ecologically important forest resources and quality of ecosystem services they are rendering.

2. Enhance the economic opportunity for local communities living in the area and strengthen their participatory role in ongoing forest restoration activities.

4.7.2 Facilities Required for Ecotourism and Visitors

There is enough scope for local tourist community for site seeing. To facilitate recreational and ecotourism activities in the landscape area, it is necessary to initiate a few facilities both inside and outside the Forest Landscape. All facilities and visitor activities will cease to operate if these basic requirements are not taken seriously or inadequately planned. It will be critical for the future sustainability of forest recreational activities in the area. The key components along with basic amenities to be developed include:

1. Information Centre.
2. Camping facilities.
3. Walking trail network.
4. Observation Platform for panoramic view forest landscape.
5. Platform for river and lake boat safari activity.
6. Hideouts for bird watchers.
7. Guide or interpreters' facility.

4.7.3 Formulation and Implementation of Interpretation Plan

A specific interpretation plan containing standard operating procedures (SOPs) and guidelines will be developed along with communication tools and aids throughout the management plan period. This will require budget provisions and should be a priority to be developed in parallel with any physical construction works.

Interpretation materials to be developed will include displays, posters, signboards, brochures, leaflets, guided walks and so on. The different user-groups will require different techniques for effective communication. This will ultimately be the responsibility of Sindh Forest Department to manage and develop these communication materials as part of visitor management.

It will be important, in the later stages of the management plan period, that an active public awareness campaign be launched through popular promotional techniques which may include T-shirts, caps, badges, special events, as well as direct marketing to tour operators,

schools, and other interest groups. This will require a specific budget and a well-planned communications strategy closely linked with the Interpretive Plan. Key benefits of the activity will be to: i) promote the Sustainable Forest Management message, ii) influence tourist behaviour towards nature conservation, and iii) enhance economic activities for the local people.

4.8 HCVFS MANAGEMENT INTERVENTION

4.8.1: Overview

Sindh Forest Department has been managing the forests of KDL Riverine Forest Landscape since partisan (1947). The two 'Reserved Forests' of landscape area is divided into forest compartments of various manageable sizes; wherein intensive forest operation and rehabilitation activities take place. The principle of Sustainable Forest Management (SFM) calls for forest management to strike a balance between: (1) timber production and profitable management, (2) biodiversity conservation and environmental protection including carbon sequestration, and (3) meeting of social and economic expectations of local forest-dependent communities. There are at least three (3) villages out of ten (10) around the landscape which are regularly engaged as part of its management operations. Further, specific undisturbed natural wetland areas/ sites have been designated as wildlife sanctuaries, environmentally important sites for *ex situ* conservation of Hog deer (a flagship ungulate species of landscape) and set aside as high conservation value forest (HCVF) areas.

This landscape management plan includes section of identified high conservation value forest (HCVFs). The two HCVFs areas in KDL riverine forest landscape i.e. Kot Dhingano and Lakhat Wildlife Sanctuaries was initiated in conformity with Principle No. 9 of the Forest Stewardship Council (FSC)'s Principles and Criteria. In addition to this, Ex Situ conservation site as biodiversity hotspot for captive breeding of hog deer has been also set-aside.

The Plan covers a ten-year period of 2021 to 2030. In this update of the HCVFs, some snapshots of the findings from field assessments conducted by various individual experts and relevant institutions have been provided, as well as results from the discussions held with SFM Provincial Coordinator. As a living document, this Plan is subject to further periodic reviews and updates as and when necessary and expedient, by SFD in collaboration with concerned stakeholders. SFD long-standing policy in this regard should be to further explore, study and understand the said forest landscape resources in a continuous effort to improve and to sustainably manage forest and biodiversity capital. The HCVF areas that have been identified and mapped, are to be managed in tandem with the rest of landscape management plan.

To sum up, the two HCVF areas that had been identified and set aside were based on records and data gathered from surveys of the areas, as well as inputs received from relevant stakeholders and various other sources. They are:

1. The Kot Dhingano (Wetland) Wildlife Sanctuary HCV area in Dhingano forest, involving a total area of 60 acres.

2. The Lakhat Wildlife Sanctuary and adjacent forest areas HCVF, covering a total area of 100 acres.

4.8.2: Scope for Other HCVF

Other HCVF areas within forest landscape will be accordingly added to the above list over time, as and when appropriate, so that the list could be expanded to cover as many as possible of the six categories of HCVFs areas. The HCVF Management as part of landscape plan will continue to be revised periodically from time to time on regular basis. The total land area initially identified as high conservation value forests is small enough to sustain a viable long-term wetland and wildlife resources. However, with the passage of time and findings of periodic evaluation, the percentage will be increased substantially.

4.8.3: Future Management Guidance for HCVF

The following general line of activities will ensure smooth management of the HCVF's and continued usefulness and relevance:

1. Demarcation and maintenance of the boundary of the HCVF areas.
2. Preparation of Multi-Resource Inventory of identified HCVF areas.
3. Maintenance of database and documentation and marking on the ground of relevant features and resources.
4. Regular monitoring and tracking of ecological changes.
5. Periodic assessment of forest trees and other resources to monitor growth rates, health condition and phenological behavior.
6. Collaborative Research and Development on population biology, reproductive system, breeding programme, etc.

Part 5

Implementation and Monitoring

5.1 IMPLEMENTATION MECHANISM

5.1.1 Overview

The Kot Dhingano-Lakhat Riverine Forest provides a unique case for sustainable forest management at landscape level in Sindh. The important element, which make it unique from other similar riverine forests in the province, is the ongoing active participation of the local community in protection and management of precious forest and other non-timber forest resources. The community involvement as a management partner of Sindh Forest Department provides a highly favorable conditions to ensure long-term sustainable management of this landscape.

The key advantages of involving the local community in the long-term management of KDL forest landscape includes:

2. The cooperation of local people in forest conservation and protection is already well established since 2008 or more than 12 years. The socio-economic development of surrounding eight villages of the area is partly dependent on the resources of forest landscape.

3. The participation of local community in core management activities, and the involvement of volunteers, can be used to highlight the positive actions that the SFD is taking towards sustainable forest management.

4. The community Nighaban (volunteers) has been working with SFD from 2008 on forest fire fighting, monitoring, enforcement, and forest restoration activities.

The SFD is encouraging the cooperation and participatory role of Kot Dhingano and surrounding communities in the protection of forest landscape resources. This will be allowed to take shape in a step-by-step manner and to strengthen mutual and larger interest of sustainability. At a later stage, this will not only help in conservation of overall biodiversity and natural heritage of the area but also enhance socio-economic conditions of the local rural population in a more holistic way.

In view of above an agreement between the SFD and Local Community need to be designed during implementation of landscape plan to support the management forests and related biodiversity. Any such agreement with local community will legitimize the role of local people and provide some grounds to function more pro-actively to protect and manage the landscape resource. Further to this, the authority of the SFD will remain unchanged.

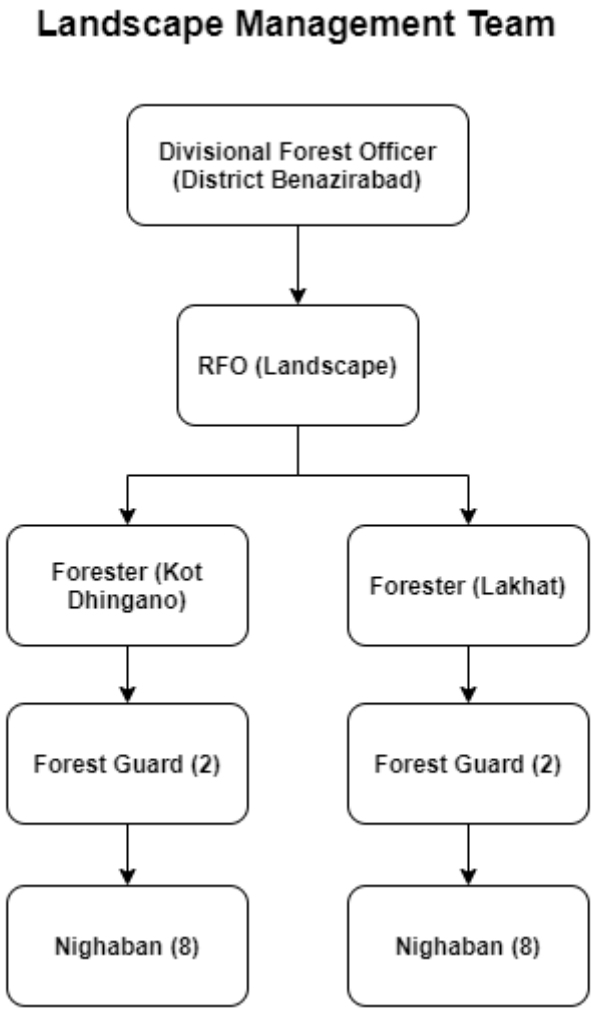
5.1.2 Management Structure

The main authority responsible for implementation of landscape management plan will remain the Sindh Forest Department. However, the local communities of the surrounding area will be the implementing partners. The immediate Forest Division responsible for overseeing the implementation operations from within the Department will remain the Benazirabad District Forestry Office, with the support and input from other key line departments such as Sindh Wildlife Department, Forest Planning Division, and Social Forestry Division.

The implementers of management activities on the ground will continue, as is at present, being jointly carried out by the SFD and local community. In the future, the role of local community is expected to grow into a position, to take an additional forest management activity. In the long-term this will greatly reduce the cost of managing this forest resource - to the Provincial Government of Sindh.

The long-term staffing and logistical requirements of the landscape management will be arranged by the SFD. It is expected that the department will appoint experienced personnel to look after; (a) boundary maintenance and surveillance, (b) forest restoration and protection activities, (c) education and awareness activities, (d) forest fire monitoring and control, (e) extension activities such as research development planning, (f) ecotourism activities, (g) wildlife and wetland conservation activities, (h) NTFPs harvesting related operations, and (i) other biodiversity conservation activities.

Figure 5.1: The Proposed Management Organization Chart for KDL Forest Landscape



5.1.3 Involvement of Other Stakeholders

The involvement of other stakeholders is vital for the future success of sustainable forest management for KDL Forest Landscape. This involvement will be encouraged to evolve and take shape in many forms, such as: consultations, regular meetings, discussion forums or special committees. There are many agencies, organizations and their activities including line departments (wildlife, fisheries, tourism, livestock, and agriculture departments), universities, and NGOs like WWF and IUCN, which may impact the long-term management of landscape resources.

The involvement of other stakeholders will also take shape in the form of planned special events designed to raise awareness in the local community and encourage more active participation in forest and biodiversity conservation activities.

5.1.4 Enhancing Management Capacity

Enhancing the management capacity of the SFD at landscape level is seen as a vital step to ensure the long-term viability of the management prescriptions outlined in the Forest

Landscape Management Plan. Without appropriate facilities, suitable machinery, and skilled manpower, it will be difficult to ensure effective and sustainable long-term management of high conservation forest resource.

The core management of forest landscape, along with protection of valuable biodiversity resources in the KDL forests, takes place at the Benazirabad Forestry Division. The equipment, machinery and facilities at the landscape will need to be upgraded to increase the management capabilities of the management staff. Requirements such as vehicles, telecommunications, firefighting equipment's and towers, access roads, and boats, all come under the purview of enhancing management capacity and will be put-in-place throughout the management plan period. Enhancing the capacity of local community to assist core landscape staff is also a key target of this management plan.

5.2 BUDGET AND FINANCE

Innovative partnerships with the private sector and NGOs can significantly contribute and scale-up funding for a range of forestry and biodiversity protection and conservation efforts to be needed in KDL forests landscape. Significantly increased funding is necessary if further forest degradation is to be prevented. Public sector finance being inadequate, both market and non-market-based mechanisms (e.g., payment for ecosystem services, including REDD-plus) can better channel private sector finance into conservation. Strong partnerships between Sindh forest department, other line departments, such as wildlife, agriculture, livestock, fisheries and tourism departments, non-governmental organizations, local community network and private sector organizations will be required for long term sustainability and smooth implementation of landscape management plans. The main components for financing the long-term management of the KDL Riverine Forest Landscape are:

1. The immediate funding will come from the Provincial Forest Department's regular non-development budget. This funding will provide the immediate upfront capital needs to be management interventions started. Then prominent chunk of financial resources will be tapped through Annual Development Programme by developing project.

2. The HCVF components, strengthening of community capacity and biodiversity conservation is already a priority area and donors can be approached for additional funding support.

3. The SFD in collaboration with community may initiate some ecotourism activities to generate some income to fund forest management activities in landscape area.

4. Research Plan implementation will require long-term partnership with HEC for technical as well as financial resources.

5.3 TIMEFRAME

This KDL Riverine Forest Landscape Management Plan is for a period of 10 years (2021-2030). The overall timing of management interventions is outlined in the management intervention timeline shown in management workplan at pages 67 to 69.

A few critical actions will need to be undertaken immediately to establish an appropriate management environment for forest management to move-ahead in KDL Forest Landscape.

1. The most critical of these interventions that needs to be initiated immediately is to prevent forest land encroachment or land grabbing by influential persons. This is because many management and protection activities cannot proceed without this basic prerequisite in place.

2. The second important step to undertake in the initial phase of implementation is to further establish a conducive and stronger working environment, or formal partnership with the local community.

3. All other actions are outlined in detail in the previous section (Part 4 Management Prescriptions) and are summarized in Work Plan.

5.4 MONITORING AND REPORTING

Monitoring as an important tool of management planning process in most of the riverine forests is not linked to development of forest policies in Sindh. Existing state of forest monitoring and reporting seems inconsistent and inefficient to help in forest management at the provincial level. Sindh Forest Department strongly realizes the need for a robust and effectively harmonized forest-related Monitoring Reporting System (MRS) to achieve the Sustainable Forest Management (SFM) goal and SDG targets of the Forestry Sector. A reliable monitoring system for Riverine Forests at landscape level will facilitate the Sindh Forest Department in reporting to national and different international stakeholders.

The structure of MRS related activities have been described in the Monitoring Protocol developed for the SFM Riverine Forest Landscapes. The framework has been developed mainly for the two riverine forest landscapes including Kot Dhingano-Lakhat Forest Landscape. However, it can be used for the other forestry programs and projects of SFD. The designated Sindh riverine forest management unit will frequently need data and information on following indicators:

1. Forest growth and yield.
2. Changes in Forest Area.
3. Area under forest cover.
4. Species and Composition.
5. Forest biodiversity conservation.
6. Wildlife protection.
7. Seasonal, annual targets and progress of regeneration.
8. Impact of Non-timber Forest Products on socio-economic.
9. Carbon sequestration and climate change.
10. Boundaries, encroachment and lease out of forest lands for agroforestry.

11. Forest budgets, revenues, and expenditures.

12. Extent of damages (fire, illegal felling, theft, and epidemics).

13. Community participation and benefit sharing.

In the light of outlined process provided in the 'Monitoring Protocol" the monitoring mechanism for SFM activities in KDL riverine forest landscape will be strengthened based on following strategic guidelines:

- Functional cooperation between landscape management teams.
- Promoting RS-based Forest monitoring with standardized methodologies.
- Encouraging low-altitude remote sensing for intensive monitoring.
- Providing resources for survey-based Forest monitoring and reporting.
- Authentication of data and information before dissemination.
- Creation of a centralized forest database under Working Plan Division.

The key forms of monitoring which will be carried out during implementation of landscape management plan include:

1. On-the-ground boundary monitoring. Physically checking the boundary on-foot or using vehicular transport. This activity can also be combined with the boundary marking activities.

2. Remote sensing using aerial photographs through drone or satellite imagery.

3. Annual helicopter surveillance around designated forest landscapes, if possible.

4. Collecting of samples, and monitoring other environmental impact indicators, to ensure environmental quality and ensure continued health of forests and wildlife habitats in the landscapes.

The implementation of landscape management plan will require regular periodic (quarterly) monitoring by using specific indicators and activities. The key areas for monitoring and subsequent reporting will include:

- The outcomes and achievements of management prescriptions.
- The outcomes and achievements of visitor activities.
- Any positive or negative impacts (enhancement or degradation) at the forest landscape levels.

All monitoring outcomes and findings will be reported to the Forest Landscape Management Committee (FLMC) through Conservator Forests and Chief Conservator Forests for review and decision making. The District Forest Officer (DFO) should be responsible for compiling and furnishing of monitoring reports and recommendations for FLMC.

5.5 INDICATORS

Each management prescriptions will have its own specific set of indicators to determine if it is being carried out appropriately and effectively. Some of the important ecological, economic, and social indicators to determine the success of Sustainable Forest Management in the riverine forest landscape will be:

- Increase in revenue collection from timber and non-timber forest products (Economic).
- Increase in number of visitors to the forest landscape (Economic).
- Positive or negative feedback from visitors to HCVFs area (Socio-economic).
- Decreased in total area of degraded forest land (Ecological).
- Increase in total carbon stock of forest landscape (Ecological/ economic).
- Decrease in gaps in canopy structure or increase in closed canopy forest (Ecological).
- Increase in wildlife populations and diversity at landscape level (Ecological).
- Changes in water quantity, quality, and hydrological functions (Ecological).
- Positive feedback from local community towards SFM practices in operation (Socioeconomic).
- Decrease of negative impacts from landscape surrounding landholders (Socioeconomic/ Ecological).

The use of modern tools and technologies in forest monitoring, such as remote sensing, navigation systems and geographic information systems to improve forest management and decision-making is now widely recognized. In this regard, a wide range of technologies, such as drones, laser scanners, environmental sensors, and decision-support tools such as bigdata analytics are used for forest monitoring and assessments. These technologies have the potential to improve and contribute towards sustainable forest management by enabling:

- full oversight of operations with improved data collection; and
- Optimized decision-making.

5.6 MONITORING OF HIGH CONSERVATION VALUE FORESTS (HCVFS)

In view of the size of the landscape**,** it is important that the monitoring is both economical and easy. A much better option would be to work out the basic habitat requirements of the different species, probably with the help of a 'Biologist' hired from a Provincial Wildlife Department, concerned department of University, or relevant NGOs working in the area. Much of this information is likely to be known already and just needs to be put together. This would result in certain habitat features being identified as important to many or all the keystone species, such as:

- Condition and habitat requirements of wetland and dependent wild animal species.
- Large hollow trees used as nesting cavities by birds.

- Patches of undisturbed forest habitats.
- Standing dead or snagged trees.

5.7 PLAN REVIEW

A comprehensive mid-term review will be carried out in 2026 on all aspects of the implementation and achievements in KDL forest landscape. The review will focus on:

- The efficacy of implementation mechanisms,
- The coordination and management between key partners particularly between Sindh Forest Department and Local Community,
- The changes due to management interventions (positive/negative) into forest and associated wildlife condition/ health,
- Effectiveness of forest protection at landscape level,
- The status and improvements in NTFPs resource base,
- The status and achievements of forest habitat restoration and regeneration,
- The functionality and progress analysis of HCVFs,
- The sustainability of financial resources and constraints,
- The priorities of management interventions for the remaining half of the plan period.

This process will provide an opportunity to revise the implementation strategy, refine the plan management prescriptions, or even introduce new interventions (in the case of changing circumstances). This will ensure that the management of forest landscape is still in line with the objectives and vision for this reserved forest landscape.

Work Plan of Management Prescriptions for Kot Dhingano-Lakhat Riverine Forests Landscape 2021-2030

Management Prescriptions	Responsibility	Phase 1					Phase 2						
	Implementer	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	PK(Rs.)	Funding
Operations & Provision of Services													
Organization of local community.	SFD / LC											00	No Cost
Responsibility sharing with local community.	SFD / LC											00	-
Establish MOU between SFD & Local Community.	SFD											00	-
Explore legal provision for agreement with LC.	SFD / LC											00	-
Establish regular Overseeing Committee.	SFD / LC											00	-
Forest Landscape Protection													
Issuance of landscape boundary notification.	SFD											00	-
Landscape boundary re-marking.	SFD												SFD
Mapping of boundary problem areas.	SFD												SFD
Develop SOP's for boundary surveillance.	SFD / LC												SFD
Install and ensure maintenance of signboards	SFD / LC												SFD
Boundary surveillance through drone.	SFD												SFD
Physical patrolling through Nighabans.	SFD / LC												SFD
Forest Restoration & Habitat Improve													
Recover encroached forest land of Lakhat.	SFD												No Cost
Focus on restoration of degraded forest lands in 11 compartments of Kot Dhingano.	SFD												SFD
Develop separate compartment wise plan for Lakhat forest restoration activities.	SFD												SFD
Protect and manage forest regeneration areas.	SFD / LC												SFD
Fully rehabilitate wetlands in landscape area.	SFD / SWD												SFD/ SWD
Manage *Ex Situ* conservation facilities for re-introduction of threatened species.	SFD / SWD												SFD/SWD
Increase carbon stock for REDD+ credit claims.	SFD												No Cost
Identify mechanism for upscaling of NTFPs resources.	SFD												SFD
Ensure full community participation in forest restoration works.	SFD / LC												No Cost

Management Prescriptions	Responsibility	Phase 1					Phase 2						
	Implementer	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	PK (Rs)	Funding
Monitor silviculture treatment work in high rising areas.	SFD / LC												SFD
Identify & Encourage other partners as stakeholders in forest habitat restoration work.	SFD												No Cost
Management Zoning													
Identify the low impact ecotourism zone.	SFD												SFD
Designate wildlife watching hotspots.	SFD / SWD												SFD
Establish wetlands related recreational zone.	SFD / SWD												SFD
Further, comprehensive Zoning Plan will be developed & implemented after Mid-Term Review in 2026.	SFD / SWD												SFD
Forest Fire Prevention & Control													
Procure forest fighting equipment.	SFD												SFD
Initiate firefighting training program for staff.	SFD												SFD
Establish small weather observatory station.	SFD												SFD
Establish forest fire monitoring tower.	SFD												SFD
Launch regular forest fire awareness campaigns.	SFD / NGO's												SFD
Conduct mock exercises for fire control.	SFD / LC												SFD
Develop map of forest fire risk/ vulnerable areas.	SFD												SFD
Ensure regular cleanliness operations in forest fire prone areas.	SFD / LC												SFD
Prepare detailed fire control plan.	SFD												SFD
Ensure aerial surveillance during dry season.	SFD												SFD
Research Strategy													
Carry out study on Alien Invasive Species.	SFD / CABI												SFD/CABI
Carry out wildlife population surveys.	SWD / Universities												SFD/SWD
Initiate study on carbon assessment & projection.	SFD / PFI												SFD/REDD
Feasibility study for Hog deer trophy hunting.	SWD / IUCN												SWD/SFD
Study on endangered wildlife species.	SWD / WWF												SWD/SFD
Carry out forest restoration ecological study.	SFD / University												SFD

Management Prescriptions	Responsibility	Phase 1					Phase 2						
	Implementer	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	PK (Rs)	Funding
Study on NTFPs potential and Marketing.	SFD / University												SFD
Visitors Management Interventions													
Establish visitors 'Information Centre'.	SFD												SFD
Identify & development of camping sites.	SFD												SFD
Develop visitors walking trails.	SFD												SFD
Establish platform for panoramic view	SFD												SFD
Visitors Management Interventions (Continued).													
Develop hideouts at bird watching sites.	SFD / SWD												SFD
Provide interpreters & Guide facility.	SFD												No Cost
Arrange River Boat Safari.	SFD												SFD
HCVFs Management Intervention													
Develop management strategy for HCVFs.	SFD												SFD
Explore other potential HCVFs sites.	SFD												SFD
Gather more authentic data on HCVFs.	SFD												SFD

Note: Cost in Pak Rupees for each management intervention will be determined on the prevailing market rates at the time of plan approval by Sindh Forest Department.

REFERENCES

Ali A. (2018). *Carbon Stock Assessment in High Conservation Value Riverine Forests of Sukkur and Shaheed Benazirabad, Sindh*. Pakistan Forest Institute (PFI), Peshawar.

FAO-UNEP (2020). *The State of the World's Forests 2020*. Forests, biodiversity, and people. Food and Agriculture Organization of the United Nation, Rome, Italy.

FAO (2020). *Forestry Sector Review: Pakistan 2019*. Food and Agriculture Organization of the United Nations, Islamabad, Pakistan.

GEF-UNDP. (2015). *Sustainable Forest Management to Secure Multiple Benefits in Pakistan's High Conservation Value Forests* (Project Document). Ministry of Climate Change. Government of Pakistan.

Government of Sindh (2019). *Sindh Sustainable Forest Management Policy 2019* - Approved by Sindh Cabinet on November 21, 2019. Sindh Forest and Wildlife Department.

IUCN Pakistan. (2018). *Sustainable Forest Management – Best Practices in Pakistan* (National Workshop Report).

IUCN Pakistan. (2020). *Monitoring Protocol for Riverine Forest Landscapes – Sindh*.

IUCN Pakistan. (2020). *Report on High Conservation Value Forests – Kot Dhingano-Lakhat and Sukkur Riverine Forest Landscapes (Sindh).* IUCN Pakistan, Islamabad.

IUCN Pakistan. (2020). *Inventory of Ecosystem Services – Sindh Riverine Forest Landscapes.* IUCN Pakistan, Islamabad.

Juenijo G. (2019). *Sustainable Management of Kot Dhingano Riverine Forest through Local Community Participation* (Paper on best practices presented in the SFM Narran Workshop), IUCN-Pakistan.

Juenijo G. (2019). *Identification of Degraded Areas of Kot Dhingano and Lakhat Forests*. SFM Sindh Project Unit.

Kabir M. (2018). *Report on Baseline study of Avian Fauna of Dhingano-Lakhat Riverine*. SFM Sindh Project Unit.

Khan M.A. (2018). *Base Line Studies of Small Mammals in Riverine Forests of District Nawabshah*. SFM Sindh Project Unit.

Khattak G.M. (1976). *History of Forest Management in Pakistan-III 'Irrigated Plantation and Riverain Forests'.* The Pakistan Journal of Forestry, October 1976.

Kella L. (2019). *Sindh Forest Working Plan Code 2019*. SFM Sindh Project Unit.

Mehmood T. (2018). *Baseline studies of Herpeto-fauna of Dhingano-Lakhat Reserve Forests, Sindh, Pakistan*. SFM Sindh Project Unit.

Memon S.H. and Bhatti M.A. (1999). *Important Trees, Shrubs & Herbs*. Sindh Forest and Wildlife Department.

Mirza B. Baig. Paul J. Burgess. John H. Fike (2020). *Agroforestry for healthy ecosystems: constraints, improvement strategies and extension in Pakistan*. Springer Nature B.V. 2020.

PFI. (2019). *Progress Report – Sustainable Forest Management (SFM) Project*. Pakistan Forest Institute, Peshawar.

Rafique M.K. (2018). *Assess the Current Status, Technical and Economic Feasibility of Wild Honey Produced by Apis florea in Kot Dhingano, Shaheed Benazirabad and Training of Local Community on its Harvesting, Processing, Packing and Marketing.* National Agricultural Research Council (NARC), Pakistan.

Rafiq M. (2017). *The Government's Capacity Needs for Sustainable Forest and Wildlife Management in Sindh, Pakistan* (Final report). SFM Sindh Project Unit.

Rajpar M.N. (2019). *Feasibility for Establishment of Breeding Centre and Re–introduction Methodology of Captive Breed Stock in the Wild for Restoration and Rehabilitation of Hog Deer – Axis Porcinus in Kot Dhingano and Keti Shah Riverine Forest Sukkur.* SFM Sindh Project Unit.

Rajpar M.N. (2018). *Report on Survey of Keystone Birds Species and Hog Deer in Kot Dhingano-Lakhat Riverine Forest*. SFM Sindh Project Unit.

Shakil M. (2018). *Report on baseline study of large mammalian fauna of Riverine Forests of Nawabshah Sindh, Pakistan*. SFM Sindh Project Unit.

Shah H. and Muhammad S. (2016). *State of Forestry in Pakistan.* Pakistan Forest Institute, Peshawar.

Shah S.G.M (1993). *Sindh – The Land and its People* (Vol. XXI, 1993 No.2). Sindh Quarterly, Karachi.

SFD (1999). *Sindh Forestry Since Independence*. Sindh Forest, Wildlife and Environment Department. Government of Sindh.

Survey of Pakistan (2018). *The Boundary Demarcation of Two Forests in Shaheed Benazirabad Division under SFM Project*. Government of Pakistan, Islamabad.

Sutherland, W.J. (2000) *The Conservation Handbook – Research, Management and Policy*. Blackwell Science Ltd, USA 150-53.

Tunio S. (2019). *Dependency of local community for Timber and Non-Timber products on Kot Dhingano and Lakhat forest landscape* (Report). SFM Sindh Project Unit.

GLOSSARY & KEY DEFINITIONS

Afforestation: Direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

Agroforestry: Agroforestry practices include land use systems that deliberately integrate trees or shrubs with agricultural crops and livestock in the same land management system (Nair 1993).

Biodiversity: Biological diversity means 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.

Database: One or more structured sets of data, managed and stored as a unit and generally associated with software to update and query the data.

Deforestation: It is the human-induced conversion of forest to non-forest land uses. It is typically associated with large immediate reductions in forest carbon stock, through land clearing.

Ecosystem: a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Ecosystem-based management: Management systems that attempt to simulate ecological processes with the goal of maintaining a satisfactory level of diversity in natural landscapes and their pattern of distribution to ensure the sustainability of forest ecosystem processes (CCFM 2006).

Environmental goods and services: Benefits humans get directly or indirectly from ecosystem functions. Ecosystem functions are the "habitat, biological or system properties or processes of ecosystems" (Costanza et al. 1997). They include clean air and water, soil retention, and wildlife habitat (CCFM 2006), to name a few.

Forest: An ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife (Helms 1998).

Forest Biodiversity: Forest biological diversity is a broad term that refers to all life forms found within forested areas and the ecological roles they perform. As such, forest biological diversity encompasses not just trees, but the multitude of plants, animals and micro-organisms that inhabit forest areas and their associated genetic diversity (CBD).

Forest degradation: Reduction in forest biomass through non sustainable harvest or land-use practices. It can also result in substantial reductions of forest carbon stocks from selective logging, fire and other anthropogenic disturbances, and fuelwood collection. (Asner *et al.*, 2005)

Forest landscape restoration (FLR): is the ongoing process of regaining ecological functionality and enhancing human well-being across deforested or degraded forest landscapes. FLR is more than just planting trees – it is restoring a whole landscape to meet present and future needs and to offer multiple benefits and land uses over time.

HCVFs: As defined by the FSC – High Conservation Value Forests (HCVFs) are forests of outstanding and critical importance due to their environmental, socio-economic, cultural, biodiversity and landscape value.

Invasive alien species: Invasive alien species (IAS) are species whose introduction and/or spread outside their natural habitats threaten biodiversity. Or Those plant and animal species which thrive in new natural environments to which they have been introduced, either deliberately or by accident.

Landscape: A landscape is defined as a geographical area that is coherent and multi-functional. Coherence in the landscape comes from naturally and/or socio-economic processes that link actors, areas, and other components across the landscape. At the same time landscapes are multi-functional – where there are a range of land uses, claims on the land, stakeholder interests and governing institutions (Graaf et al., 2017).

Monitoring: Monitoring is the systematic gathering and analysis of information to assess whether something is changing. Monitoring is more than a single assessment; monitoring must be performed at regular intervals that are appropriate for the subject matter, cost efficient and not overly burdensome. The information is analyzed, and the results are evaluated and used for decision-making (Evans and Guariguata 2008).

Non-timber Forest Products: All forest products except timber, including resins, oils, leaves, bark, plants other than trees, fungi, and animals or animal products (Helms 1998).

Protected Forests: The forests which have been declared as Protected Forests under the provision of the Forest Act 1927 and have some rights and concessions of grazing, grass cutting and collection of dry wood etc.

REDD-plus: reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.

Reforestation: Planting of forests on lands that have previously contained forests but that have been converted to some other use. (IPCC, 2007).

Reserved Forests: The forests under the control of Forest Departments which have been declared as Reserved Forests under Forest Act 1927 and are generally without rights and privileges.

Sustainable forest management: a dynamic and evolving concept that aims to maintain and enhance the economic, social, and environmental value of all types of forests, for the benefit of present and future generations (UNFF).

Working Plan: A Working Plan is a written document giving prescriptions for scientific management of forests.

GLOSSARY OF VERNACULAR TERMS

Vernacular	English Equivalent
Abadgar	A cultivator
Abkalani	The river inundation season or river flood
Beldar	Temporary employee looking after irrigation
Bund	An embankment
Bhan	Settlement of cattle owners or squatting place of maldars
Coolie	Labourer
Chhand	Thinning
Chhat	Broadcasting
Chowkri	Compartment
Chirline	Demarcation line cleared of all growth
Deh	A village with lands belonging to it
Dhand	Water left after floods, a marsh, a miniature lake
Dhora	A natural water channel
Dhori	A low-lying area formed by river action
Gharo	A creak, a natural water channel
Ghat	A cattle tract
Gud	Weeding
Goath	A village
Hari	Tiller of soil
Kacho	Land newly formed due to deposition by river, unstable land
Kalar	Saline soil
Khal or Kasi	A small watercourse irrigating 1/ 5^{th} or 1/ 7^{th} of 16 ha compartment
Kharif	Summer crop
Khauf	Erosion strip
Khatedar	Landowner
Landhi	Temporary hut
Main	Small watercourse irrigating a compartment of 16 ha
Maldar	A cattle owner
Minor	Irrigation channel
Nok Safai	Cutting of grass and other growth from the watercourse
Nucca	Pipe 10 cm dia 1.9 m long fixed in khal to irrigate the plot
Panchari	Grazing fees
Pako	Stable land
Patri Safai	Cutting of grass and other growth from the footpath along the watercourse
Peech	Irrigation command area or irrigated by an out-let
Paho or Paha	Compartment line
Rej	Watering
Rabi	Winter crop
Shikargah	Game reserve
Taluka	Component of a Sub-division of a district under the charge of a Mukhtiarkar
Taapoo	Cultivation of vegetables/ fruit plants in unstable kacho areas
Wahur	By river, an old riverbed serving as water channel
Zamindar	Landowner

APPENDICES

Appendix A: Draft Notification of Kot Dhingano Reserved Forest.

Appendix B: Meteorological Data of Temperature related to landscape.

Appendix C: List of Trees, Shrubs and Grasses Found in the Forest Landscape Area**.**

Appendix D: Butterfly Species Recorded from Kot Dhingano-Lakhat Forest Landscape.

Appendix E: Reported sighting of large Mammals in Kot Dhingano-Lakhat Forest Landscape.

Appendix F: Small Mammals of Kot Dhingano-Lakhat Riverine forest Landscape.

Appendix G: Amphibians and Reptiles of Kot Dhingano-Lakhat Riverine Forest Lakhat.

Appendix H: Relative abundance of Avian Species Detected in KDL Forest Landscape.

Appendix I: Images from Kot Dhingano-Lakhat Forest Landscape.

Appendix- A

EXTRAORDINARY **Registered No. S-**

The Sindh Government Gazette

PUBLISHED BY AUTHORITY

KARACHI, DATED, ……., 2021

PART I

GOVERNMENT OF SINDH
SINDH REVENUE DEPARTMENT

DRAFT
NOTIFICATION

Karachi, the …., 2021

No. ……. (……)/ 21. – In exercise of the powers conferred vide section ……. of the Sindh Forest Act – 2011, the Topographic Survey and Mapping of Kot Dhingano Afforestation Division, Shaheed Benazirabad with reference to permanent BM1 at Kot Dhingano forest 26 15 42.38743, Longitude 67 58 14.42675 Co-Ordinates in WGS-84 and Easting 397213.456, Northing 2905082.770 (in meters) in UTM (zone 42North), the list of boundary pillars delineating outer boundaries of Forest Kot Dhingano (Area: 3904.030 Acres) falling in Taluka Sakrand are as per the schedule specified here under:-

(……)

Secretary to the Government of Sindh
Sindh Revenue Department

SCHEDULE OF BOUNDARY PILLARS OF FOREST KOT DHINGANO

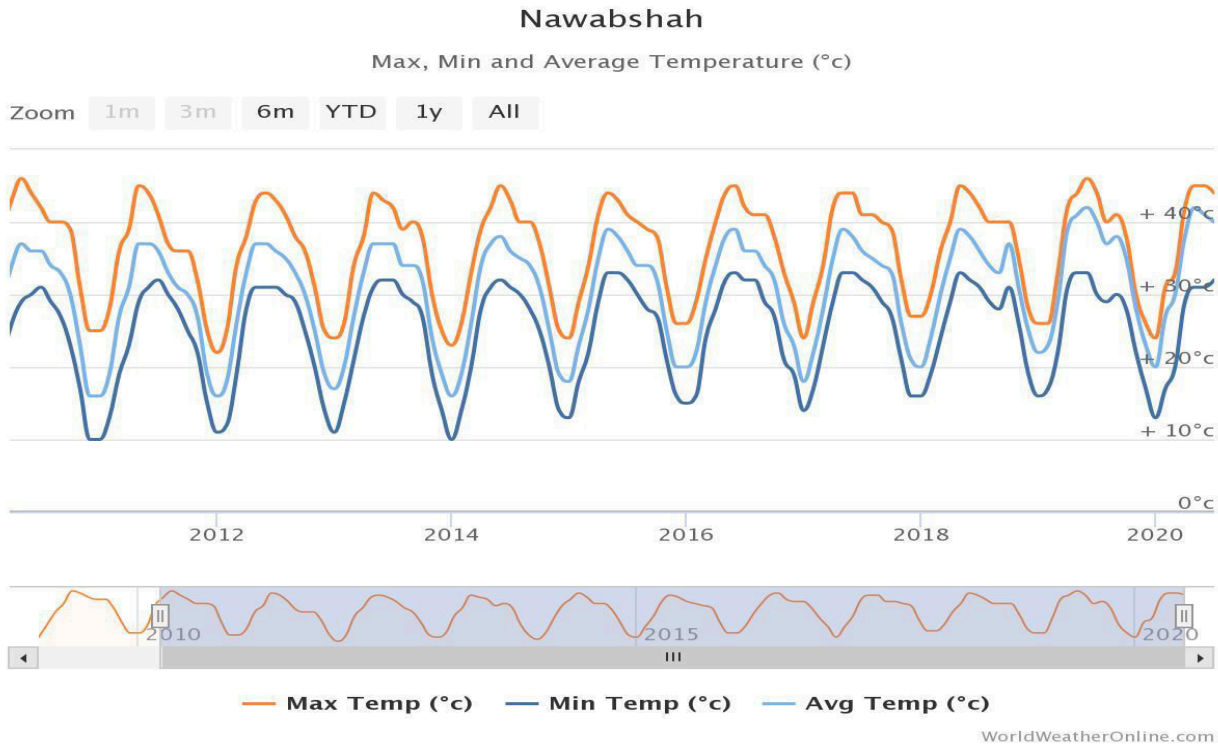
S. NO	KOT DHINGANO BOUNDARY PILLARS	COORDINATES		DIRECT HORIZANTAL DISTANCE B/W FBPs IN METERS	CO-ORDINATES IN UTM METERS	
		LATITUDE	LONGITUDE		EASTING	NORTHING
1	Pillar No. 01	26 17 02.30839	67 58 07.32978	……	397036.18	2907543.21
2	Pillar No.01 to 02	26 17 00.70671	67 58 18.51520	314.120	397346.01	2907491.47

3	Pillar No.02 to 03	26 16 59.90577	67 58 38.30020	549.306	397894.55	2907462.47
4	Pillar No.03 to 04	26 16 58.11299	67 58 58.30020	557.458	398448.82	2907402.94
5	Pillar No.04 to 05	26 16 55.75431	67 59 12.52947	401.277	398842.09	2907327.28
6	Pillar No.05 to 06	26 16 56.64207	67 59 26.59712	391.143	399233.29	2907351.54
7	Pillar No.06 to 07	26 16 56.73582	67 59 33.54934	192.845	399426.13	2907352.93
8	Pillar No.07 to 08	26 16 43.78501	67 59 30.51040	407.286	399338.74	2906955.13
9	Pillar No.08 to 09	26 16 43.63034	67 59 40.46787	276.226	399614.88	2906948.23
10	Pillar No.09 to 10	26 16 42.82234	67 59 40.72762	25.887	399621.89	2906923.31
11	Pillar No.10 to 11	26 16 42.30781	67 59 45.88820	144.020	399764.91	2906906.37
12	Pillar No.11 to 12	26 16 51.72891	68 00 01.05978	510.976	400187.95	2907192.96
13	Pillar No.12 to 13	26 16 49.31564	68 00 09.51302	245.934	400421.83	2907116.91
14	Pillar No.13 to 14	26 16 36.75208	68 00 04.07791	414.901	400268.1	2906731.54
15	Pillar No.14 to 15	26 16 19.74171	67 59 56.73766	561.568	400060.46	2906209.77
16	Pillar No.15 to 16	26 16 03.86249	67 59 49.48730	528.336	399855.5177	2905722.78
17	Pillar No.16 to 17	26 15 54.87454	67 59 34.78746	492.699	399445.66	2905449.42
18	Pillar No.17 to 18	26 15 44.28479	67 59 20.51798	512.686	399047.29	2905126.7
19	Pillar No.18 to 19	26 15 35.73640	67 59 12.22291	349.462	398815.13	2904865.5
20	Pillar No.19 to 20	26 15 33.42985	67 59 11.43992	74.223	398792.85	2904794.7
21	Pillar No.20 to 21	26 15 31.66165	67 59 04.96959	187.561	398612.93	2904741.71
22	Pillar No.21 to 22	26 15 18.27860	67 58 56.54974	473.449	398376.12	2904331.74
23	Pillar No.22 to 23	26 15 03.78887	67 58 49.72545	484.291	398183.3	2903887.49
24	Pillar No.23 to 24	26 14 56.25724	67 58 48.25772	235.280	398140.75	2903656.09
25	Pillar No.24 to 25	26 14 32.79915	67 57 07.92429	2875.780	395351.34	2902956.59
26	Pillar No.25 to 26	26 14 47.45192	67 57 03.79113	465.182	395240.32	2903408.33
27	Pillar No.26 to 27	26 15 03.64757	67 57 01.90035	501.055	395191.9	2903907.04
28	Pillar No.27 to 28	26 15 19.92157	67 56 59.49239	505.143	395129.15	2904408.27
29	Pillar No.28 to 29	26 15 34.51585	67 56 56.63062	455.994	395053.41	2904857.93
30	Pillar No.29 to 30	26 15 49.99305	67 57 01.01008	491.445	395178.76	2905333.12
31	Pillar No.30 to 31	26 16 03.24876	67 57 04.61251	421.598	395288.89	2905740.08
32	Pillar No.31 to 32	26 16 14.37684	67 57 10.48669	376.270	395447.70	2906081.19
33	Pillar No.32 to 33	26 16 28.82851	67 57 18.73080	500.000	395679.97	2906523.97
34	Pillar No.33 to 34	26 16 43.21776	67 57 27.10844	500.000	395915.91	2906964.8
35	Pillar No.34 to 35	26 16 53.25354	67 57 34.17265	365.697	396114.33	2907271.99
36	Pillar No.35 to 36	26 17 06.13059	67 57 45.16966	500.000	396422.51	2907665.72
37	Pillar No.36 to 37	26 17 07.20973	67 57 54.48646	265.084	396680.44	2907604.55
38	Pillar No.37 to 01	26 17 02.30839	67 58 07.32978	360.990	397036.18	2907543.21

Source: SFM Coordinator Sindh.

Appendix- B

Meteorological Date of Temperature related to landscape



Appendix- C

List of Trees, Shrubs and Grasses Found in the Forest Landscape Area

S. No.	Local Name	Botanical Name
1	Babul, Babbur,	*Acacia nilotica*
2	Khaor, Khombhat	*Acacia Senegal*
3	Siris, Srian	*Albizzia lebbeck*
4	Kandero, Camel Thorn	*Alhagi maurorum*
5	Neem	*Azadirachta indica*
6	Akk	*Calotropis procera*
7	Kirar	*Capparis aphylla*
8	Lasura, Gedori	*Cordia myxa*
9	Liar	*Cordia rothii*
10	Chabar	*Cynodon dactylon*
11	Tali, Shisham	*Dalbergia sissoo*
12	Gulmohar	*Delonix regia*
13	Dubh	*Desmostachya bipinnlata*
14	Sar	*Erianthus srundinaoeus -*
15	Gul-e-Nishtar	*Erythrina variegata*
16	Sufeda, Beed-Mushk	*Eucalyptus spp:*
17	Chamar, Chabar	*Eleusine compressa*
18	Peepal	*Ficus relegiosa-*
19	Muhwa	*Madhuka indica*
20	Amb, Mango	*Mangifera indica*
21	Jungle Jalebi	*Pithecolobium dules*
22	Kandi, Jand	*Prospois cinereria*
23	Devi, Mesquitte	*Prosopis glandulosa*
24	Mesquitte, Devi	*Prosopis juliflora*
25	Bahan, Indus Poplar	*Populus euphratica*
26	Sarkanda, Kano, Sar	*Saccharum arundinaceum*
27	Kanh, Sarkana	*Saccharum munja*
28	Simal	*Salmalia malabarica*
29	Lani	*Salsola foetida*
30	Jar, Khabbar	*Salvadora oleoides*
31	Khabbar, Peelo	*Salvadora persica*
32	Jantar	*Sesbania bispinosa*
33	Jaman	*Eugenia jambolana*
34	Lau or lawa, Frash	*Tamarix articulata*
35	Lai	*Tamarix dioica*

Appendix- D

Butterfly Species Recorded from Kot Dhingano-Lakhat Forest Landscape

S. No.	English Name	Species
1	The Poineer	*Belenois aurota*
2	The Small Salmon Nawab	*Colotis amata*
3	The Little Orange Tip	*Colotis etrida*
4	The White Arab	*Colotis vestalis*
5	The Crimson Tip	*Colotis danae*
6	The Plain Tiger	*Danaus chrysippus*
7	The large grass yellow	*Eurema hecabe*
8	The peacock pansy	*Junonia almanac*

Source: Dr. Khalid Mahmood, Curator, Pakistan Museum of Natural History, Islamabad.

Appendix- E

Reported sighting of large Mammals in Kot Dhingano-Lakhat Forest Landscape

S. No	Species	Scientific Name	Total Annual Sighting	Average Annual Sighting per Respondent
1	Fishing cat	*Prionailurus viverrinus*	7	0.21
2	Red fox	*Vulpes vulpes*	21	0.63
3	Indus dolphin	*Platanista gangetica minor*	5	0.15
4	Wild boar	*Sus scrofa*	20	0.60
5	Jackal	*Canis aureus*	23	0.69
6	Hog deer	*Axis porcinus*	3	0.09
7	Smooth coated otter	*Lutrogale perspicillata*	6	0.18

Source: Muhammad Shakil, Shah Latif University Khairpur (2018).

Appendix- F

Small Mammals of Kot Dhingano-Lakhat Riverine forest Landscape

S. No.	Name of Species	Scientific Name	Taxonomic Position	IUCN Status
1	Indian Crested Porcupine	*Hystrix indica*	Class: Mammalia Order: Rodentia Family: Hystricidae	Least Concern LC
2	Collared Hedgehog	*Hemiechinus collaris*	Class: Mammalia Order: Eulipotyphla Family: Erinaceidae	LC
3	Indian Crested Porcupine	*Hystrix indica*	Class: Mammalia Order: Rodentia Family: Hystricidae	LC
4	Five-striped Palm Squirrel	*Funambulus pennantii*	Class: Mammalia Order: Rodentia Family: Sciuridae	LC
5	House Mouse	*Mus musculus*	Class: Mammalia Order: Rodentia Family: Muridae	LC
6	Indian Gerbil	*Tatera indica*	-	LC
7	Short-tailed Bandicoot Rat	*Nesokia indica*	-	LC
8	Indian Desert Jird	*Meriones Hurrianae*	-	LC

Source: Muazzam Ali Khan, Pakistan Museum of Natural History, Islamabad (2018).

Appendix- G

Amphibians and Reptiles of Kot Dhingano-Lakhat Riverine Forest Lakhat

S. No.	Name of Species	Scientific Name	IUCN Status
Amphibians (Frogs and Toads)			
1	Indus valley toad	*Duttaphrynus stomaticus*	LC
2	Common Asian Toad	*Duttaphrynus melanostictus hazarensis*	LC
3	Skittering Frog	*Euphlyctis cyanophlyctis cyanophlyctis*	LC
4	Tiger Frog / Bull Frog	*Hoplobatrachus tigerinus*	LC
5	Burrowing Frog	*Sphaeroteca breviceps*	LC
6	Indian Cricket Frog	*Limnonectes limnocharis*	LC
7	Southern Cricket Frog	*Fejervarya sahyadrensis*	LC
Turtles and Tortoises			
8	Yellow-spotted mud turtle	*Geoclemys hamiltonii*	VU
9	Common mud turtle	*Hardella thurjii*	VU
10	Brown mud turtle	*Pangshura smithii*	LC
11	Sawback turtle	*Pangshura tectum*	NE
12	Indian soft-shell	*Nilssonia gangeticus*	VU
13	Peacock soft-shell	*Nilssonia hurum*	VU
14	Narrow-head soft-shell	*Chitra indica*	EN
15	Flap-shell turtle	*Lissemys punctate*	NE
Lizards and Geckos			
16	Garden lizard	*Calotes versicolor versicolor*	LC
17	Short-tail agama	*Brachysaura minor*	NE
18	Black Rock Agama	*Laudakia melanura melanura*	NE
19	Ceylonese chameleon	*Chamaeleo zeylanicus*	NE
20	Yellow-tail sand gecko	*Crossobamon orientalis*	NE
21	Tuberculate gecko	*Cyrtopodion scabrum*	NE
22	Yellow-belly gecko	*Hemidactylus flaviviridis*	NE
23	Common House Gecko	*Hemidactylus frenatus*	NE
24	Spotted barn gecko	*Hemidactylus brookii*	NE
25	Blue-tail Sand Lizard	*Hemidactylus persicus*	NE
26	Fat-tail spotted gecko	*Eublepharis macularius*	NE
27	Spotted Sand Lizard	*Mesalina watsonana*	NE
28	Short-snout Sand Lizard	*Mesalina brevirostris*	NE
29	Striped mole skink	*Novoeumeces indothalensis*	NE
30	Common mole skink	*Eurylepis taeniolatus taeniolatus*	NE
31	Striped grass skink	*Eutropis dissimilis*	NE
32	Bengal monitor	*Varanus bengalensis*	NE
Snakes			
33	Sindh sand-boa	*Eryx conicus*	NE
34	Red sand-boa	*Eryx johnii*	NE
35	Rock python	*Python molurus*	NT
36	Sindh thread snake	*Myriopholis blanfordi*	NE
37	Brahminy worm-snake	*Ramphotyphlops braminus*	NE
38	Striped keel-back	*Amphiesma stolatum*	NE

39	Banded racer	*Argyrogena fasciolata*	NE
40	Brown cat snake	*Boiga trigonata*	NE
41	Common wolf snake	*Lycodon aulicus aulicus*	NE
42	Sindh awl head snake	*Lytorhynchus paradoxus*	NE
43	Rat snake	*Ptyas mucosus mucosus*	NE
44	Diadem snake	*Spalerosophis diadema diadema*	NE
45	Checkered keelback	*Xenochrophis piscator piscator*	NE
46	Common krait	*Bungarus caeruleus caeruleus*	NE
47	Sindh Krait	*Bungarus sindanus sindanus*	NE
48	Black Cobra	*Naja naja*	NE
49	Russel Chain Viper	*Duboia russelii russelii*	NE
50	Saw Scale Viper	*Echis carinatus sochureki*	NE

Source: Tahir Mehmood, Herpetologist, (2018).

Appendix- H

Relative abundance of Avian Species Detected in Kot Dhingano-Lakhat Forest Landscape

Family	Scientific Name	Common Name	No of Detections	%
Columbidae	*Streptopelia decaocto*	Eurasian Collard Dove	1452	21.808
Phasianidae	*Francolinus pondicerianus*	Grey Francolin	910	13.668
Pycnonotidae	*Pycnonotus leucotis*	White-eared Bulbul	864	12.977
Leiothrichidae	*Turdoides striata*	Jungle Babbler	480	7.209
Phylloscopidae	*Phylloscopus fuscatus*	Dusky Warbler	320	4.806
Pellorneidae	*Graminicola bengalensis*	Indian Grassbird	260	3.905
Leiothrichidae	*Turdoides caudata*	Common Babbler	220	3.304
Ardeidae	*Ardeola bacchus*	Chinese Pond Heron	192	2.884
Rhipiduridae	*Rhipidura aureola*	White-browed Fantail	174	2.613
Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	168	2.523
Muscicapidae	*Phoenicurus ochruros*	Black Redstart	154	2.313
Muscicapidae	*Saxicoloides fulicatus*	Indian Robin	140	2.103
Corvidae	*Dendrocitta vagabunda*	Rufous Treepie	134	2.013
Anatidae	*Anas strepera*	Gadwall	127	1.907
Ardeidae	*Egretta garzetta*	Little Egret	123	1.847
Muscicapidae	*Saxicola caprata*	Pied Bush Chat	120	1.802
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	108	1.622
Muscicapidae	*Muscicapa dauurica*	Asian Brown Flycatcher	97	1.457
Hirundininae	*Riparia paludicola*	Brown-throated Sand Martin	84	1.262

Scolopacidae	*Tringa. hypoleucos*	Common Sandpiper	72	1.081
Corvidae	*Corvus splendens*	House Crow	68	1.021
Alcidinidae	*Ceryle rudis*	Pied Kingfisher	60	0.901
Motacillidae	*Motacilla alba*	White Wagtail	52	0.781
Laridae	*Sterna aurantia*	River Tern (NT)	43	0.645
Ardeidae	*Egretta albus*	Great Egret	36	0.541
Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	28	0.421
Alcidinidae	*Halcyon smyrnensis*	White-throated Kingfisher	23	0.345
Accipitridae	*Ictinaetus malaiensis*	Black Eagle	18	0.270
Columbidae	*Spiopelia senegalensis*	Laughing Dove	16	0.240
Picidae	*Dinopium javanense*	Common Flame back	14	0.210
Pycnnotidae	*Pycnonotus cafer*	Red-vented Bulbul	12	0.180
Laridae	*Sterna acuticauda*	Black-belled Tern (EN)	9	0.135
Alcidinidae	*Alcedo atthis*	Common Kingfisher	8	0.120
Meropidae	*Merops orientalis*	Green Bee-eater	8	0.120
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	7	0.105
Accipitridae	*Accipiter virgatus*	Besra	6	0.090
Passeridae	*Passer domesticus*	House Sparrow	5	0.075
Accipitridae	*Accipiter gularis*	Japanese Sparrow Hawk	5	0.075
Dicruridae	*Dicrurus macrocercus*	Black Drongo	4	0.060
Alaudidae	*Galerida cristata*	Crested Lark	4	0.060
Cuculidae	*Centropus sinensis*	Greater Coucal	4	0.060
Coraciidae	*Coracias bengalensis*	Indian Roller	3	0.045
Ardeidae	*Butriodes striata*	Little Heron	3	0.045
Phylloscopidae	*Phyllosocopus*	Yellow-brown Warbler	3	0.045

	inornatus			
Upupidae	*Upupa epops*	Common Hoopoe	2	0.030
Rallidae	*Gallinula chloropus*	Common Moorhen	2	0.030
Nectariniidae	*Nectarinia jugularis*	Olive-backed Sunbird	2	0.030
Phalacrocoracidae	*Microcarbo niger*	Little Cormorant	2	0.030
Podicipedidae	*Tachybaptus ruficollis*	Little Grebe	2	0.030
Accipitridae	*Haliaeetus leucoryphus*	Pallas Fish Eagle (EN)	2	0.030
Campephagidae	*Pericrocotus cinnamomeus*	Small Minivet	2	0.030
Nectriniidae	*Cinnyris jugularis*	Olive-backed Sunbird	1	0.015
Ardeidae	*Ardea insignis*	Great-billed Heron (CE)	1	0.015
Sylviidae	*Sylvia curruca*	Lesser Whitethroat	1	0.015
Cisticolidae	*Prinia inornata*	Plain Prinia	1	0.015
Alaudidae	*Ammomanes phoenicura*	Rufous-tailed Lark	1	0.015
Scolopacidae	*Tringa glareola*	Wood Sandpiper	1	0.015
		Total:	6658	

Source: Dr. Muhammad Nawaz Rajpar, Wildlife Consultant (2018).

Appendix- I

Images from Kot Dhingano-Lakhat Forest Landscape

Consultation with local community at Ottak.

Forest Nighaban with landscape Range Forest Officer

A view of forest regeneration

A view of Kot Dhingano forest along with Forest Hut.

INTERNATIONAL UNION FOR
CONSERVATION OF NATURE

Country Office

1 Bath Island Road
Karachi, Pakistan

Tel +92 (21)35861540/41/42
Fax +92 (21) 35861448
cro.pk@iucn.org
www.iucn.org/pakistan