Ministry of Climate Change
Government of Pakistan

REDD+
Pakistan

FINAL REPORT

REDD+PES DESIGN DOCUMENT FOR MANGROVE ECOSYSTEM

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Pakistan Forest Institute makes its best effort to provide accurate and complete information while developing this document.

FINAL REPORT

REDD+PES DESIGN DOCUMENT FOR MANGROVES ECOSYSTEM

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LIST OF ACRONYMS

AFOLU	Agriculture, Forestry and Other Landuse
A/R	Afforestation/Reforestation
BFD	Balochistan Forest Department
CBOs	Community Based Organizations
CDM	Clean Development Mechanism
CfRN	Coalition for Rainforest National
CAN	Country Needs Assessment
CSOs	Civil Society Organizations
CSR	Corporate Social Responsibility
CERs	Certified Emission Reductions
CIFOR	Center for International Forestry Research
CO_2	Carbon Dioxide
CoP	Conference of the Parties
CPEIR	Climate Public Expenditure and Institutional Review (CPEIR)
DHA	Defence Housing Authority
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
FD	Forest Department
FEG	Framework for Economic Growth
FGD	Focus Group Discussion
FCPF	Forest Carbon Partnership Facility
FPIC	Free, Prior and Informed Consent
FY	Financial Year
GCF	Green Climate Fund
GHG	Green House Gas
GPS	Global Positioning System
GoP	Government of Pakistan
Ha	Hectare
ICIMOD	International Centre for Integrated Mountain Development
IUCN	International Union for Conservation of Nature
KITE	Korangi Industrial Trade Estate
Km	Kilometer
KP	Khyber Pakhtunkhwa
KPT	Karachi Port Trust
LITE	Landhi Industrial Trade Estate
MFD	Marine Fisheries Department
MFF	Mangroves for Future
MGD	Million Gallon Daily
MEAs	Multilateral Environmental Agreements
MOCC	Ministry of Climate Change
MoU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
MUSD	Million United States Dollar
NCCP	National Climate Change Policy

NFMS	National Forest Monitoring System
NGO	Non-governmental Organization
NPV	Net Present Value
NTFP	Non Timber Forest Produce
PC	Participants Committee
PCMF	Pakistan Coastal Mangrove Forest
PDD	Project Design Document
PES	Payment for Ecosystem Services
PFDs	Provincial Forest Departments
PFI	Pakistan Forest Institute
PKRs	Pakistani Rupees
PLRs	Policy Laws and Regulations
PoAs	Programme of Activities
PQA	Port Qasim Authority
PRA	Participatory Rural Appraisal
REDD+	Reducing Emission from Deforestation and Forest Degradation, plus the role of enhancement of carbon stock, conservation of carbon stock and sustainable forest management
RPP	Readiness Preparation Proposal
SBOR	Sindh Board of Revenue
SFD	Sindh Forest Department
SITE	Sindh Industrial Trade Estate
SUPARCO	Space and Upper Atmosphere Research Commission
T	Tonnes
TAP	Technical Advisory Panel
TEV	Total Economic Value
ToR	Terms of Reference
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
USAID	United States Agency for International Development
VCS	Voluntary Carbon Standard
VCUs	Verified Carbon Units
WWF	World Wide Fund

PREFACE

Ministry of Climate Change, Government of Pakistan is implementing REDD+ Readiness Preparation Proposal (R-PP) with financial support of the Forest Carbon Partnership Facility (FCPF) of the World Bank. Under R-PP Pakistan is working on four main components i.e. (i) REDD+ Policy Analysis, (ii) REDD+ Technical Preparation, (iii) Readiness Management Arrangements and (iv) Designing and Testing REDD+ Payments for Environmental Services.

Payment for Environmental Services (PES) and Reducing Emissions from Deforestation and Forest Degradation (REDD+) programs represent economic instruments that are increasingly being used worldwide for for compensating forest owners for providing valuable environmental services. The underlying philosophy of these programs is market creation and enhancement, which aim at creating and strengthening the role of the market mechanism in guiding the allocation and use of resources, and providing economic incentives for forest conservation. The use of these instruments will not only create markets for ecosystem services but also ensure that markets reflect the full social costs and benefits of forests conservation and their sustainable use over time.

Reducing emissions from deforestation, degradation, sustainable forest management and conserving and enhancing carbon stocks in the forests known as REDD+ has emerged as a promising option for climate change mitigation in developing countries. The REDD+ idea simply means rewarding efforts aimed at stopping deforestation and forest degradation and thereby reducing the amount of CO_2 emissions into the atmosphere and increasing forest cover to sequester more CO_2 from the atmosphere. REDD+ aims to transfer economic resources from carbon offset buyers to sellers with payments being conditional to the delivery of emission reductions against national or project-based baselines.

Pakistan Forest Institute (PFI), being the prime public sector organization in forestry research and education, was awarded a study by the National REDD+ Office, Ministry of Climate Change for “Designing REDD+ Payment for Environmental Services” in January, 2018. Two ecosystems were selected for the study in consultation with stakeholders which included, Temperate Forests of Kaghan in Khyber Pakhtunkhwa and Mangove Forests in the coastal areas of Sindh and Balochistan. The main objective of the study was to design a pilot programme to test payment for ecosystem services that supports results for REDD+ in at least two forest ecosystems.

This report presents Design of REDD+ Payment for Environment Services in Mangrove Ecosystem of Sindh and Balochistan. The design included identification and quantification of ecosystem services, setting of prices for different ecosystem services, identification of buyers and sellers for ecosystem services, devising a benefit sharing mechanism and development of institutional arrangements for REDD+ PES implementation in the selected ecosystems.

National Project Director, REDD+
Ministry of Climate Change

EXECUTIVE SUMMARY

This report presents PES scheme for mangrove forests located in the coastal areas of Sindh province near Korangi Harbor Area (Korangi and Phitti Creeks) and Miani Hor in Lasbela District of Balochistan province. The report is divided into fifteen chapters. Each chapter addresses different aspect of the PES scheme for mangrove forests as described below.

Chapter-1 is the introduction which covers the contextual elements related to mangrove forests (physical context, natural resources, socio-economic conditions and institutional setup-organizations, laws and policies), ecosystem services of mangrove forests and threats to mangrove ecosystems.

Chapter-2 is about the process ddopted for development of this document. It describes how the different types of data, including the socio-economic, has been collected, how ecosystem services and resource inventory has been done in the field, how consultations have been held with the various stakeholder groups on different aspects of the REDD+PES Desing including various institutional parameters (policies, laws, regulations), how project boundaries have been laid out, how institutional mechanisms about the PES scheme have been designed in light of the discussions held with the provincial forest departments, and how benefit sharing mechanisms were discussed in workshops with communities and other key stakeholder groups.

Chapter-3 is the Project Design Document part of the report. It gives summary description of the project document, project sectoral scope and project type, project proponents, other project entities, project start date, project crediting period, project description (including project goal, objectives and project activities), project location, stakeholders' engagement as PES Services Providers, legal status and property rights.

Chapter-4 discusses the ecosystem services identified under the PES scheme. These include protection of fish and shrimp spawning sites, coastal zone and habitat protection, biodiversity conservation & promotion of ecotourism, carbon sequestration and climate change mitigation, shoreline stabilization & prevention of sea intrusion.

Chapter-5 describes the buyers and sellers for the above-mentioned ecosystem services. The potential sellers of the different PES services include the Provincial Forests and Wildlife Departments, Port Qasim Authority, and local coastal communities. Potential buyers for the various services are Karachi Sewage Company, All industrial companies of industrial sites and hospitals, tourists and tourism agencies, Karachi City Government, Provincial & National Government, education and research institutions in Karachi, Karachi Coal Power Company, Thar Coal Power Company, Karachi hotel industry, Sindh Province cement industry, Pakistani and international flight companies, and other buyers of carbon credits.

Chapter-6 gives the prices set for different ecosystem services as follows:

Fish spawning sites

- Huge polluting companies: Payment annually of USD 10,000;
- Medium size polluting industrial companies: Payment annually of USD 2000;
- Small polluting companies: Payment of USD 500-1000 depending on size and pollution amount discharged from the company.

Coastal zone and habitat protection

For provincial government the price should be above USD 50,000/year, but a reasonable price is best settled through negotiations.

Biodiversity conservation & promotion of ecotourism

The buyers of PES services from this category are mainly ordinary tourists and therefore the payments will be in the form of an entrance fee that cannot be too high. A fee of around Pak Rs. 1,000 per tourist vehicle is probably about maximum which can be received from most tourists.

For research institutions there could be a fee of Pak Rs. 2000 PKRs for each research project that has activities in the mangrove areas. For school classes and other education institution visits there could be a fee of Pak Rs. 1,000 for each visit so as to keep it affordable.

REDD+ related carbon trading payments

The current carbon dioxide (CO_2) price is around USD 5 per ton on the global market and it is advisable to try to keep the carbon price at this level.

Shoreline stabilization and prevention of sea intrusion

For this PES service category will the same prices and funding rules apply as for those proposed for coastal zone and habitat protection.

Chapter-7 discusses business as usual and project scenarios and their comparison. It also identifies the methodology to be applied under the project. Based on an analysis of the situation, it has been decided to use the Clean Development Mechanism (CDM) Methodology AR-AM 0014-Methodology for Afforestation and Reforestation of Degraded Mangrove Habitats Version 4.1. This project meets all the applicability conditions of the proposed methodology. The following tools go with this methodology:

- Tool 02: Combined Tool to Identify the Baseline Scenario and Demonstrate Additionality in A/R CDM Project Activities. [1]

[1] United Nations Framework Convention on Climate Change. 2017. CDM Methodology Booklet. November 2017.

- Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0)
- Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.1)

For identification of alternative land use scenarios to the proposed project activity, the following alternatives to the project activity will be evaluated:

- Continuation of the pre-project land use
- Natural mangrove regeneration of the land within the project boundary
- Mangrove afforestation of the land within the project boundary performed without being registered as a project activity intended for the carbon market.

For identification of barriers that would prevent the implementation of at least one alternative land use scenarios, the following barriers have been analyzed:

- Investment barriers, other than insufficient financial returns
- Institutional barriers,
- Technological barriers;
- Barriers related to local tradition;
- Barriers due to prevailing practice;
- Barriers due to local ecological conditions,
- Barriers due to social conditions and
- Barriers relating to land tenure, ownership, inheritance, and property rights.

Quantification of carbon credits has been done using existing mangrove area of 33, 646 ha (29,121 ha in Sindh and 4,525 ha in Balochistan), and new plantings of 16,552 ha (11,552 ha in Sindh and 5,000 ha in Balochistan). Using these area figures, it is estimated that the project will sequester/achieve emission reduction of 4.038 million tons of carbon dioxide equivalent over a project crediting period of 30 years, starting from the year 2020.

Chapter-8 is about the MRV system to be used in the PES scheme. Main features of the MRV system include boundary setting, sampling design, plot shape and size, measurement of above ground biomass, below ground biomass, shrubs and dwarf mangroves, litter, pneumatophores, deadwood, soil carbon, carbon sequestration rate and measurement of non-carbon ecosystem services.

Chapter-9 discusses forest and land tenure issues in the context of PES scheme. It gives the conceptual foundation of tenure and property rights. It describes existing tenure systems in mangrove forests. It describes tenure effect on PES rights, liabilities and benefits sharing. International principles of responsible governance of tenure system are also given. In the end it gives a host of strategies for tenure reform.

Chapter-10 deals with benefits sources, criteria for identification of beneficiaries, and discusses various elements of the benefits distribution system, such as mode of payments, frequency of payments, conditionalities associated with benefits, targeting of benefits, etc.

Chapter-11 covers the role of women in the PES scheme as a vulnerable group, as beneficiaries, as stakeholders, and as agents of change. It discusses the challenges and opportunities for women involvement in the PES scheme at various stages of the PES scheme-design stage, implementation stage, and consolidation stage.

Chapter-12 is about governance and institutional arrangements for REDD+PES schemes implementation at the national and provincial levels. At the national level, it is proposed to strengthen National REDD+ Office of the Ministry of Climate Change to deal with PES schemes processing, coordination and reporting issues in close collaboration with Provincial Forest Departments and other stakeholder groups. The National REDD+ Steering Committee will deal with strategic aspects of the PES projects. At the provincial level, PES infrastructure is to be established at the provincial level and forest division/district level. At the provincial level proposed bodies include Provincial REDD+ Board (headed by Additional Chief Secretary/Chairman Planning Board), Provincial REDD+ Management Committee (headed by Secretary Forests). At the Forest Division level it is proposed to have a Social and Environmental Safeguard and Grievance Redress Mechanism.

Chapter-13 discusses project risks and risks mitigation strategies. For risks mitigation, a structure process is proposed which include risks identification, risks qualification, risks evaluation, and risks mitigation. Risks have been categorized into external risks and internal risks. External risks include informational, funding and financial, spatial, temporal, institutional, political, governance/bureaucratic, economic and market, security, natural hazards, etc. Internal risks include technical risks, organizational and managerial risks, fiduciary risks, and risks related to UNFCCC Cancun and Other Social and Environmental Safeguards and stakeholders engagement related risks.Options with respect to risks mitigation include sharing the risk, enduring the risk, avoiding the risk, and lessening the risk. Depending on the type of risk, a host of risk mitigation strategies have been proposed.

Chapter-14 is about conflicts and conflicts resolution mechanism. It identifies the potential actors or parties in the PES related conflicts, the sources of conflicts, and mechanisms for dealing with conflicts. For out of the court feedback and grievance redress mechanism, it is proposed to establish a Provincial Feedback and Grievance Redress Mechanism (PFGRM) Unit in each province. This unit is to have a dedicated staff officer who deals with the conflicts in a structured manner. The proposed process comprises of four steps which include receipt and registration of the grievance, investigation of the grievance, resolution of the grievance and monitoring of grievance

resolution process through maintaining a proper database. An easy and accessible system for complaints lodging is suggested which includes sending complaints through a variety means which *inter alia* include email, website, feedback/complaint box, toll free number, SMS/WhatsApp, letter form, in person appearance, etc. For ease of access to various stakeholders, the provision and registration of complaints is to be permissible in local language, Urdu as well as English language. Time frames have been suggested for the different steps in the conflicts resolution process.

Chapter-15, which is the last chapter, gives a detailed roadmap for PES scheme implementation.

CHAPTER-1

1 INTRODUCTION

1.1 Physical Context of the Pakistan's Coast

Pakistan has a coastline of approximately 990 km in the provinces of Sindh and Balochistan with 22,820 square kilometers of territorial waters and an Exclusive Economic Zone of about 240,000 square kilometers. The Sindh coast is 230 km long while the Balochistan coast has a length of 760 km. The two coasts have different climatic and physical characteristics. The coastal areas along the Balochistan are characterized by oceanic waters and a rocky, and coral-reef with a thin & scattered mangrove stands. The Sindh coast has a shallower profile with a combination of mangrove forests, mudflats, and sandy beaches.The average annual rainfall in the coast is 10-20 cm. The Sindh coast receives the tail end of thesouthwest monsoon, while the Balochistan coast is semi-tropical and arid.

The coast has four distinct geographical areas- the Indus delta, the Karachi coast, the Lasbela Coast and the Makran Coast. The Indus delta has 17 creeks. It spreads over an area of 667,129 hectares with extensive mudflats and is one of the largest expanses of mangroves in the world. The system supports fisheries, provides mangroves wood and fodder, is nesting ground for wildlife such as green turtles, dolphins and migratory and resident birds and is a potential source of earning from tourism and recreation. The Karachi coast area, which is one of this pilot project area is the most polluted and contaminated part of the coast. Various pollutants originating from a city of about 20 million people, and contaminants from industries and hospital are directly released into the ocean. These pose health hazards for both coastal communities as well as marine life, especially around the Karachi area. The situation is further worsened by unmanaged shrimp and fisheries harvest and lack of appropriate investment and management plans for mangrove forests in both Karachi coast area and Balochistan coast. As a result, the coastal ecosystems of Sindh and Balochistan are under serious threats of irreversible destruction.

The coastal environment, which is extremely important both in terms of biodiversity and economic activity, is under pressure from development activities such as harbor dredging, land reclamation, disposal of solid waste and sewage. The ecosystem is also vulnerable to the impact of climate change.

There is a certain volume of gray literature about Pakistan's mangrove ecosystems. Most of this research and rehabilitation work has been done in the Indus Delta area. There is a need for work in the Karachi coast and Balochistan coast areas. Available data from research carried out in the Indus Delta area show that much of the original mangrove area have been degraded, primarily due to freshwater diversion, over exploitation (wood, fodder and grazing) as well as land-based pollution. In common with

other coastal areas, the Karachi and Balochistan coastal areas of Pakistan are threatened by over exploitation of natural resources particularly fisheries and shrimps, population growth, unchecked development and lack of awareness, education and capacities about sustainable management of coastal resources both on the part of the coastal communities who use them and the government and outside agencies that approve and implement development activities.

1.2 Natural Resources

Main natural resources found in the coast of Pakistan are the mangrove vegetation, fishes and shrimps, and various wildlife species. The mangrove vegetation comprises of four species. The wetlands, estuaries, lagoons, sandy beaches and mangrove forests along the coast are main habitats for migratory birds, waterfowl, turtles and mammals. More than 200 species of fish and about 20 cetaceans have been reported from the sea waters of Pakistan.

1.2.1 Fisheries

Commercially important marine fish fauna comprises of some 250 demersal fish, 50 small pelagic, 15 medium-sized pelagic and 20 large pelagic fish. In addition, there are 15 commercial species of shrimp, 12 of squid/cuttlefish/octopus, and 5 of lobster. Whereas freshwater fauna comprises of more than 200 fish species & 35 of shellfish including prawns & crabs. Around 20 fish species are commercially important.

Fisheries are the principal source of livelihoods for the dependent fishermen communities living along the coast and the sector plays an important role in the alleviation of poverty. Also, fisheries exports generate substantial foreign exchange for the country. Fisheries' share in GDP is 0.4 percent but has a greater value addition in export earnings.

During FY 2017-18 (July-February), total marine and inland fish production was estimated at 482,000 metric tons out of which 338,000 metric tons was from marine waters and the remaining catch came from inland waters. Whereas the fish production for the period FY 2016-17 (July-February), was estimated to be 477,000 metric tons in which 332,000 metric tons was from marine and the remaining was produced by inland fishery sector.

During FY 2017-18 (July-February), a total of 108,262 metric tons of fish and fishery productswere exported. Pakistan's major buyers are China, Thailand, Malaysia, Middle East, Sri Lanka and Japan etc. Pakistan earned US $ 264 million, while the export for FY 2016-17 (July-February) of fish and fishery products was 89,032 metric tons which earned US $ 239 million.

The export of fish and fishery products has increased by 21.6 percent in quantity and 10.5 percent in value during FY 2017-18 (July-February) comparing same period last year.

Fisheries sector provides direct employment to about 379,000 fishermen and around 400,000 people are employed in ancillary industries, mostly in coastal areas in both the categories.

Government of Pakistan is taking a number of steps to improve fisheries sector. Further a number of initiatives have been taken by federal and provincial fisheries departments whichinclude inter alia strengthening of extension services, introduction of new fishing methodologies, development of value added products, enhancement of per capita consumption of fish, and up-gradation of socioeconomic conditions of the fishermen's community.

1.2.2 Mangrove Forests

The mangrove ecosystems of Pakistan are an important natural resource, critical for fisheries, as natural barrier to various disastrous threats, and for coastal biodiversity conservation. Balochistan has a large coastal area and is exposed to tidal action with risk of Tsunami and hurricanes. The mangrove forests are present at only four geographic locations along the 990 kilometer coastline. Some 0.667 million hectares in the Indus delta area classified as "mangrove forests". Environmentally and economically these forests are of prime importance as breeding grounds for shrimps, fisheries and different bird's species. Four different species of mangrove- *Avicennia marina, Rhizophora mucronata, Ceriops tagal, and Aegicerus corniculatum*- have been recorded along the coast of Pakistan. Two species, *Avicennia marina* and *Rhizophora mucronata* dominate the mangrove flora in Pakistan.

This ecosystem possesses large variety of animal species and provides safe refuge for them. So far around 88,000 hectares have been replanted at various locations in Indus delta and Makran coast through innovative planting techniques, using *Avicennia marina* and *Rhizophora mucronata*.

Land cover statistics of Sindh and Balochistan coasts are given below:

Table 1. 1: Sindh Coast land cover statistics

S.No.	Class	Area in Ha.	Area in Sq.Km.	Percentage
1.	Dense Mangroves	30,216	302.16	4.53
2.	Medium and Sparse Mangroves	60,143	601.43	9.02
3.	Mud Flats and Sandy Area	414,236	4,142.36	62.09
4.	Creeks / Channels/ Sea Water	162,534	1,625.34	24.36
Total		667,129	6,671.29	100.00

Source: GIS Laboratory of Sindh Forest Department, 2018

Coastline of Sindh is 230 km long, which constitute 667,129 hectares of Indus Delta. The Indus Delta consists of a network of 17 major and several minor creeks mangrove islands in four districts of Sindh, namely Karachi, Thatta, Sujawal and Badin. Besides 667,129 ha of Indus delta (Korangi creek to Sircreek) there are additional 15,900 ha of Mangroves in Karachi coast (Cape Monze to Chinna creek).

Table 1. 2: Balochistan Coast land cover statistics:

S.No.	Class	Area in Ha.	Area in Sq.Km.	Percentage
1.	Miani Hor	4,525	45.25	87.83
2.	Kalmat Hor	194	1.94	3.77
3.	Gwater Bay	433	4.33	8.40
	Total	5,152	51.52	100.00

Source: SUPARCO, 2009

In Balochistan/Makran coast mangroves mainly exist in small patches at Somiani, Kalmat and Jiwani.

The mangrove ecosystem is of great economic and ecological significance. It is a pool of biodiversity and provides habitat for a diverse community of organisms, ranging from bacteria, fungi, fish, shrimps, birds and mammals. Mangroves are also source of fuel wood for local communities and provide fodder for camels and buffaloes. Mangroves play a crucial role in marine ecosystems as fish nursery and breeding ground, filtering systems and in shoreline stabilization. Mangroves also act as natural barriers against cyclone, tsunamis and hurricanes.

The coastline remains virtually undocumented and unmanaged, yet is an important nesting ground for the globally endangered green turtles (*Chelonia mydas*), Olive Ridley (*Lepidochelys olivacear*) and possibly logger headed turtle (*Caretta caretta*). A smaller natural and artificial mangrove pockets at ten geographic locations along the coast of Balochistan province are the stopover for migratory birds on the Central Asian – Indian Flyway. The biodiversity of Balochistan's diverse coastal features with its beaches, sand dunes, sea cliffs, rocky headlands, intertidal mudflats, deltas, estuaries, tidal lagoons, bays, islands and shelf areas remains undocumented. The Indus River is part of a major flyway for birds between Siberia and warmer lands to the south.

While the biodiversity of Pakistan terrestrial component is relatively well known, the flora and fauna of the marine and coastal water have been poorly documented. As a result, it remains very poorly understood. Policy makers, decision makers, politicians and public would all benefit from better information about the biodiversity of the coastal and marine areas.

1.3 Socio-economic Context

It is estimated that around 2.0 million of Pakistan's population live in the coastal areas. The coast of Sindh is sparsely populated with small fishing communities living along the

creeks. The Karachi coast, however, is densely populated with major infrastructure development. Similarly, there is the Korangi Fish Harbor and the Port Qasim near the Korangi and Phitti creeks. Along the Balochistan coast, the bays and headlands provide natural harbors, around which 35 fishing communities are residing. The population is about 500,000. Four small urban centers – Jiwani, Gwadar, Pasni and Ormara – account for more than half of the coastal population.

The coastal communities of Pakistan are mostly engaged with fishery, with a small percentage in agriculture and allied professions. In view of dwindling sources of livelihood in the region, due to a variety of factors, a vast majority (about 79%) live below the poverty line. A peculiar feature of the region is its wind potential for generation of electricity which, according to one estimate, is about 43000 MW. Then there is a potential of around 50,000 acres of land to be utilized for aquaculture and enterprises associated with it like fish grading, packaging and preservation (Sindh Fisheries Department). The picturesque beaches of the Makran coast offer opportunities for eco-tourism as well.

The government of Pakistan is committed to the development of this region with particular emphasis on poverty reduction.

1.4 Institutional Context

1.4.1 Organizational and Legal Context

Forestry is a provincial subject under the constitution of Pakistan, and mangroves are considered protected forests under Pakistani law. Therefore, mangroves are governed and managed by provincial forest departments and under provincial forest laws. Federal government's role in forestry is limited to policy development, research and training, and compliance with international agreements (FAO, 2005).

Forestland ownership and tenure arrangements in Pakistan are not dealt with by a single compendium of laws. While provincial governments are competent to pass forestry legislation, the key forest management legislation in majority of areas of Pakistan, however, remains the Forest Act 1927. The Land Revenue Act 1967 is the main legal instrument determining legal aspects of land ownership. There is no other umbrella national legislation to protect coastal and marine resources in general. Mangroves are notified as government owned Protected Forests in both Sindh and Balochistan Provinces.

The Federal Cabinet and Ministry of Climate Change (MoCC) are the key federal institutions for corrdinating forest policy issues at federal level. Decisions of the Federal Cabinet serve as policy directives to ensure sustainable forest management in the provinces. MoCC is the key national agency for environmental policy, and its Forestry Wing is responsible for national policy making, donor coordination, national forest surveys and assessments, and international agreements.

Provincial Forest Departments (PFDs) are responsible for forest protection, management and law enforcement, trade in forest products, and regulation of commercial forest harvesting (FAO, 2005). PFDs own all forest trees on state land, but not the land itself, which is owned by provincial Boards of Revenue. Each PFD is headed by an administrative secretary and the Chief Conservator of Forest (the technical head). Chief Conservators of Forest, Conservator of Forest, Divisional Forest Officer, Sub-Divisional Forest Officer, Range Forest Officer, Block Officer/Forester, and Forest Guards form the hierarchy of provincial departments and are responsible for forest management at the provincial, forest circle, forest divisions, forest sub-division, forest range, forest block and forest beat levels, respectively (FAO, 2005).

Provincial Boards of Revenue own all state land, and can issue land use rights to other public or private entities, including PFDs. They are also custodians of the rights of all private landowners, and maintain a land registry including all land titles (Hussain, 2016).

1.4.1.1 Mangrove Forestland Tenure

State ownership, private ownership and community ownership of forests are permitted under the Forest Act 1927, which lists five categories of forest land based on ownership:

1. State-owned reserve forests: These are state-owned forests reserved for protection. Explicitly prohibited activities include forest clearing, land conversion and grazing cattle. Local populations' rights are limited to collection of fuelwood from fallen trees, and rights of way and water (FAO, 2005). Before 'reserving' any forests, provincial government must resolve existing land claims.

2. State-owned protected forests: Provincial government can designate any forest outside reserve forests as protected forest, and determine associated access and usage rights. Unless specifically prohibited by separate orders, all activities are allowed, including grazing and timber harvesting. Provincial departments can also reserve specific tree species in protected forests (SFD, 2015).

3. Village forests: Provincial government may assign to any village community the rights to manage reserve forests, whilst stipulating therules for such management. Little use has been made of this provision (SFD, 2015).

4. Unclassed forests: Unclassed forests are uncultivated or uncultivable 'wasteland.' Provincial government reserves the right to make rules for management of unclassed forests (GoP, 2015). However, in most regions, forests that are not protected or reserved are considered common property of a village, tribe, or clan, and are known as shamilat (USAID, 2010).

5. Private-owned forests: If forest land happens to be on privately owned land, the owner can buy and sell the land, but only PFDs have the right to harvest trees; the land owner is not allowed to cut a single tree without the department's permission (FAO,

2005). PFDs may also prohibit certain activities in privately owned forest for public safety reasons, such as protection against storms (GoP, 2015).

1.4.1.2 Mangrove tenure in Sindh Province

Prior to 1958, all mangroves in Sindh Province were managed by the Sindh Board of Revenue (SBOR). In 1958, 364 000 hectares of mangrove forestland were transferred from SBOR to the Sindh Forest Department (SFD), and declared as protected forest (FAO, 2005). Simultaneously, a separate directive was issued by SFD, declaring all mangroves as 'reserved' species as per the Forest Act 1927(Hussain, 2016). The Board of Revenue retained management of the remaining 272,485 hectares of mangrove forests in the delta (Qamar, 2009).

In 1973, 64,400 hectares of mangroves were leased by SFD to the Port Qasim Authority (PQA) for port enlargement (IUCN, 2005). The lease contained a condition that mangroves would remain as protected forests and not be harmed (Qamar, 2009). In addition, the Karachi Port Trust (KPT) manages a 500 hectare mangrove area east of Karachi, as shown in the table below.

Table 1. 3: Jurisdiction over Mangrove Forestland in Sindh Province

S.No.	Organization	Area in hectares
1.	Sindh Forest Department (SFD)	280,470
2.	Sindh Board of Revenue (SBOR)	260,000
3.	Port Qasim Authority (PQA)	64,400
4.	Karachi Port Trust (KPT) and Defense Housing Authority (DHA)	500
	Total	605,370

Source: IUCN, 2005

In 2010, the Sindh Government issued a notification declaring all mangroves as protected forests (Hussain, 2016). Technically, this means that mangroves managed by SFD, SBOR, PQA and KPT are protected from harvesting and grazing, with human use limited to collection of deadwood for fuel. However, the ground reality has been different and people have been using these forests.

1.4.1.3 Mangrove tenure in Balochistan Province

Of the 5,152 hectares of mangroves in Balochistan Province, only 294 hectares are declared as protected forests and are under the control of Balochistan Forest Department. In these areas only dead, dying and moribund trees are permitted to be cut to meet subsistence requirements. Mangroves outside the protected forests remain the property of local communities or of the Board of Revenue (IUCN, 2005). Overall, data on tenure arrangements for forests and rangelands in Balochistan are scarce (FAO, 2005).

1.4.2 Mangrove policy

Mangrove policies comprise statements, directives, guidelines and plans at the federal and provincial levels. Key policy issues include 'lack of holistic visioning, inadequate coordination and disintegrated planning, in particular the approach of treating the coastal zone in isolation from the terrestrial activities having an impact on the coast' (MFF, 2014). An example of these limitations is provided by the negative impact of upland damming on mangrove health in the Indus Delta.

As mentioned above, the federal government is responsible for forest policy, whilst provincial governments are responsible for forest policy within the national framework and forest management (FAO, 2005; USAID, 2010). Following are the federal and provincial policies relevant to mangrove management:

- National Forest Policy, 2015.
- National Environment Policy, 2005.
- National Climate Change Policy, 2012.
- Provincial Government Forest Management Directives and Notifications

The National Forest Policy is intended to be an umbrella polic yguiding federal, provincial and district governments, with a stated objective o frestoration, development, conservation and sustainable management of forests. The policy called for halting of conversion of forestland tonon-forestry uses and promoted 'massive afforestation programs, especially on all denuded, degraded and unproductive lands' (MoCC, 2017). For mangrove forests, the policy states that 'proper arrangements shall be made for containing marine pollution, allowing sufficient water to flow down the Indus River and evolving an incentive-based system for sustainable management of these forests. To ensure implementation, the policy has prepared a plan for its operationalization. The policy also envisages the establishment of a Forest Development Fund to support proposed measures from domestic and international sources.

The National Climate Change Policy 2012 has prepared by the MoCC, and calls for restoration of degraded mangroves in the Indus Delta and prevention of further degradation 'by allowing minimum necessary environmental flows downstream of Kotri' (MoCC, 2012). The 2013 'Framework for Implementation of Climate Change Policy 2014-2030' emphasizes international funding (including UN-REDD and the World Bank) and, among others, commits the Government of Pakistan to the following priority action: 'Initiate campaigns to plant mangroves,coastal palm and other trees suitable for coastal areas to control sand and soil erosion' (GoP, 2013).

The SFD website states that SFD's primary goal is conservation and improvement of mangroves, including through mangrove planting on mud flats (SFD, 2015). It also has set three World Guinness Records in 2009, 2013 and 2018 of planting record number of mangrove saplings on a single day. It is supporting the distribution of saplings to

farmers at subsidized rates' and to undertake planting, conservation and protection measures in mangroveare as under its management, as well as those managed by SBOR, PQA and private owners.

In 2012, the Sindh government approved a project to plant 100,000 hectares of mangroves, to be implemented by SFD using the government's own resources over the 2013-2018 period.

SFD has prepared forest management plans in 1963-64, 1984-85 and 2006-07, providing information about resources, distribution of forest stands, plant and animal species (Qamar, 2009). It also developed two 20-year mangrove management plans and a 'Working Plan of Mangrove Forests from 1985-86 to2004-2005.'

Balochistan Forest Department (BFD) has also implemented mangrove rehabilitation works from its own sources as well as with assistance from other organizations like IUCN. It, however, has not prepared a specific Forest Management Plan for its mangrove forests so far.

Mangrove-related activities in both Sindh and Balochistan provinces have been largely project-based, with funding from domestic and outside sources.

1.5 Mangrove Ecosystem Services

Mangroves like other forest ecosystem provide a number of valuable ecosystem services that contribute to human wellbeing. These ecosystem services fall into four broad categories and are tabulated below:

Provisioning Services	Regulating Services	Informational and Cultural Services	Supporting Services
Timber/Wood	Air Quality	Aesthetic Values	Primary Production
Fuelwood	Buffering against Extremes	Effects on Social Interactions	Soil Formation
Fodder	Noise Abatement	Iconic Landscapes/Seascapes	Habitat –breeding, spawning and nursery habitat for numerous fish, shrimps and other species
Biochemical, Medicinal and Pharmaceutical Products	Carbon Sequestration and Climate Regulation	Inspiration	Biodiversity conservation
Food Products like Honey	Protection form floods and tsunami	Knowledge Systems	Nutrient Cycling
Genetic Resources	Storm and Erosion Control	Recreational Opportunities	

Ornamental Resources	Prevention of Salt Water Intrusion	Sense of Place	
Transport Infrastructure	Pollination	Spiritual and Religious Values	
Water	Reducing Pests and Diseases	Therapeutic Services	
Fishes, Shrimps and Other Marine Products Production	Water Purification	Non-use and Existence Values	

Many of these ecosystem services have the characteristics of 'public goods' such that the people who benefit cannot be excluded from receiving the service provided (e.g., habitat and nursery service supporting fisheries); and that the level of consumption by one beneficiary does not reduce the level of service received by another (e.g., coastal protection and storm buffering). Due to these characteristics, the potential for private incentives to sustainably manage mangrove ecosystem services is limited and markets for such services do not exist. In other words, there is a 'market failure' and by their inherent nature, mangrove ecosystem services are under supplied by the market system.

As a result, mangroves are generally undervalued in both private and public decision-making relating to their use, conservation and restoration. The lack of understanding of, and information on, the values of mangrove ecosystem services has generally led to their omission in public decision making. Without information on the economic value of mangrove ecosystem services that can be compared directly against the economic value of alternative public investments, the importance of mangroves as natural capital tends to be ignored (Brander et. al., 2012).

A number of studies have developed and applied methods to calculate the monetary value of mangroves (Ramdial, 1975; Ahmad, 1984; Barbier, 1994; Bann, 1998). Although these studies provide some insight in the range of values that may be assigned to the ecosystem services provided by mangroves, they are all context specific and do not provide a more generic insight in the values of mangroves.

1.6 Threats to Mangroves and Challenges in Sustainable Coastal Management

Following are the major threats to mangrove forests (Pakistan Mangrove National Strategy and Action Plan, 2014):

1.6.1 Industrial and Urban Pollution

About 70 % of the total industry of Pakistan is located in Karachi city and in the Port Qasim Industrial Area. Most of this industry is located in the Sindh Industrial Trade Estate (S.I.T.E), Landhi Industrial Trade Estate (L.I.T.E), Korangi Industrial Trading Estate (K.I.T.E), West Wharf Industrial Area of Sindh and Hub Industrial Trading Estate

(H.I.T.E) of Balochistan. L.I.T.E and K.I.T.E discharge their effluents in the mangrove populated areas as well as into the mudflats of Korangi Creek. The pollutants they discharge include heavy metals, organic matter, oils and greases and other toxic chemicals.

In addition to the industrial pollution, there is hospital waste coming into the sea as well. There are also six power plants on the Karachi Coast and one power plant on the mouth of the Hub Estuary. They utilize huge quantities of sea water for cooling and discharge heated effluents in the adjacent environment.

Along the Balochistan coast, the Gaddani ship breaking facility is a major source of pollution.

1.6.2 Dumping of Solid Waste

Due to the lack of adequate sanitation facilities inland, solid waste generated in the small coastal towns and villages, along with a significant portion of the urban waste of Karachi is dumped randomly along the coast which is flushed into the coastal ecosystem at high tides.

1.6.3 Pollutants Discharge via Terrestrial Streams

Along with fresh water, rivers also bring the run-off from agricultural fields. The agricultural pollutants such as pesticides, herbicides and fertilizers carried by the river have adverse impact on the coastal ecology. Coastal rivers like Malir, Lyari and Hub transport heavy loads of pollutants into the sea.

1.6.4 Over-exploitation of marine resources

There is reckless over-exploitation of marine resources as a result of which certain valuable marine fisheries resources stocks are declining rapidly. The fishing grounds in the coastal areas are under heavy fishing pressure from the mechanized boats and fixed nets. The trawlers add the harmful fine mesh nets fixed in the creeks areas catch large quantities of juvenile fish of larger fish species and small edible fishes as well as endangered, associated or dependent species without any consideration of target or non-target species. These harmful fishing practices and weak governance are leading to the depletion of some of the stocks and pose a serious threat to other stocks.

Mangrove Forests have been declared as Protected Forests and mangroves trees in both Sindh and Balochistan provinces are ‘reserved’ under the Forest Act 1927,meaning that clearance, harvesting, and animal grazing in mangroves are prohibited. However, grazing by camels, goats and buffaloes is widespread in both the provinces, and mangroves provide forage for around 8,000 camels, 5,000buffaloes and 1,000 goats (FAO, 2009). The biggest impact is from professional herders, each managing hundreds of camels. The herders come into conflict with villagers, but the vast mosaic nature of the coast complicates grazing control. On the positive side, there

is no commercial exploitation of mangroves and no serious attempt to convert mangroves to aquaculture.

1.6.5 Coastal land use change

There is haphazard development going on all around the coast areas, which is resulting in in-appropriate land use changes. These mushrooming and unauthorized fishing and other villages impact the coastal ecology as well as hydrology.

1.6.6 Lack of Freshwater Inflow from the Indus River

The construction of irrigation infrastructure upstream is diverting lots of water so that less water is finally reaching the Delta. The requirement for environmental flows of water has not been assessed for informed decision making and allocation of water for various used in the country.

1.6.7 Sea Level Rise and Saline Intrusion

It is estimated that there has been a sea level rise of 1.1 mm/year along the Karachi coast between1860 to 2000. Therefore, it can be assumed that there will be further sea level rise in the face of global warming. This means that the sea line will intrude up to 1-2 kilometers further inland from the existing Pakistan. Saltwater intrusion is the movement of saline water into freshwater aquifers, which can lead to contamination of drinking water sources and render fertile agricultural land unusable and barren. Sea intrusion and coastal erosion can also be aggravated by sea level rise due to climate change.

1.6.8 Natural Disasters

The coastal areas of Pakistan face threats of cyclones, storms and other climate change related risks. Their frequency and intensity has increased many folds.

In the Karachi area, industrial and urban development is leading to mangrove clearance and pollution. Whilst the mangrove area is not large, it is extremely important in mitigating the city's water and air pollution. Competition for land in and near Karachi is fierce, and two members of the Pakistan Fisherfolk Forum were allegedly killed in 2011 in a land dispute. Additionally, Port Qasim Authority (PQA) and KPT have been accused of clearing mangroves for port expansion, and residents of densely populated ghettos regularly harvest mangroves for fuelwood and charcoal production (Qamar, 2009). At times SFD officials are not permitted to enter areas managed by PQA, KPT and the Defence Housing Authority (DHA) for monitoring, the only deterrent is to apprehend those involved as they exit the area.

1.6.9 Dune Movements and Floods

In Balochistan, the biggest threats to mangroves are dune movements. They are also exposed to storms and extreme floods which put mangroves at risk.

CHAPTER-2

2 PROCESS FOR DESIGNING PROJECT DESIGN DOCUMENT

The main objectives of the study "Designing REDD+ Payment for Environmental Services" is to design a pilot programme to test payment for ecosystem services that supports results for REDD+ in at least two forest ecosystems. The main output of the study is two project design documents for REDD+ Payment for environmental services in two selected ecosystems.

The approach and methodology adopted for preparing Project Design Documents (PDDs) for the selected ecosystems were based on extensive review and analysis of the prevailing policies, laws and regulations governing environmental services in the country, international experiences about PES, intensive consultation with key stakeholders, socio-economic surveys and field inventories. This was further enriched by the knowledge and work experience of our key consultants, particularly the Team Leader, International Experts, NFMS Expert/Deputy Team Leader, Sociologist and the NRM Expert. Besides, the technical inputs provided by the National REDD+ Office and several renowned professionals working in Government departments and private sectors significantly improved the quality of the work.

The assignment was accomplished in three phases i.e. inception phase; field data collection, trainings, consultations and research phase; and data analysis, and report writing phase. The *Inception Phase* started with signing of the contract followed by the inception workshop held in second week of January 2017. During this phase sites were selected and methodologies were refined for field work.

2.1 Data Collection, Consultation and Research

The main component of the designing the PDD comprised *Field Data Collection, Consultations and Research*. This phase was started with a consultative and training workshop in Karachi on February 9-10 February. Before the workshop, the PES Team alongwith senior officers of Sindh Forest Department visited mangroves forests in Karachi and took stock of the ground situation. The workshop was attended by a wider group of stakeholders including officers of Sindh Forest Department, Wildlife Department, Fisheries Department, Agriculture Department, Livestock Department, EPA, PQA, Maritime Security Agency, Pakistan Navy, Balochistan Forest Department, members of local communities. The workshop was aimed at introducing the idea of payment for environmental services in mangroves forests, awareness raising and building the capacity of the stakeholders. During this workshop, the study methodology was presented which was refined in light of the inputs provided by the participants. PQA Mangroves area was selected as pilot site for PES in consultation with senior officers of Sindh Forest Department. After the workshop, the pilot site was visited by the PES Team and conducted a reconnaissance survey of the area. Discussions were also held with concerned field officers of Sindh Forest Department regarding field work and household surveys.

2.2 Socio-economic Surveys

A semi-structured questionnaire was developed for household surveys and focus Group Discussion in the pilot area. These tools were designed to collect primary data from the households regarding the dependence of local communities on mangroves forests, identification and quantification of environmental goods and services utilized by these communities, major constraints in the natural resource use and management. 73 and 23 household heads were interviewed during the survey in Sindh and Balochistan respectively. The following information was collected through household surveys.

- Household profile
- Energy sources
- Uses of mangroves forest
- Fish production and changes in fish catches
- Pollution
- Recreation and tourism
- Issues in accessing ecosystem services

Focus Group Discussions (FGDs) were held in six main villages in Sindh to cross check the data collected through household surveys. These villages included Lat Basti, Rehri Goth, Chashma Goth, Jumma Goth, Hundred Quarters and Ibrahim Hayderi. A central place was selected in each village where sitting arrangements were in place before holding the FGD. Around 15-20 household heads were invited to participate in the discussion. The field team put main questions and encouraged the participants to debate and analyze the questions. They were facilitated to reach consensus on the answers to these questions. Efforts were made to ensure participation of all group members. Individual meetings were also held with key informants and renowned professionals to get insight about natural resource use, ecosystem services and designing PES in the pilot area. Glimpses of FGD are given at Annex-3.

2.3 Analysis of Policies, Laws and Regulations

One of the main requirements for PES implementation is availability of enabling policy and legal framework. Relevant policies, laws and regulations were collected from different departments and offices. These documents were reviewed to identify relevant provisions and clauses affecting PES implementation in the selected sites, gaps were identified and recommendations were framed to amend these PLRs for REDD+PES implementation.

A workshop was held in Karachi on March 12-13, 2018 wherein the provincial Policies, Laws and Regulations (PLRS) were analyzed in a participatory manner and recommendations were made to amend these frameworks for smooth implementation of PES schemes in Sindh province. Similarly, the PLRs of Balochistan province were analyzed in a provincial level workshop held on April 17-18, 2018. Gaps were identified and recommendations were framed to amend these PLRs.

2.4 Benefit Sharing Mechanism

Benefit sharing mechanism was developed in consultation with stakeholders. The existing benefit sharing mechanism from the sale of timber was assessed and the new mechanism was based on the existing revenue distribution arrangements. Lessons

were also learned from the benefit distribution system implemented for trophy hunting of Markhor in Balochistan. The mechanism was presented in the workshops held in Karachi and Quetta and the inputs of the participants were incorporated to have an equitable and fair distribution mechanism for PES. The view point of the local communities and civil society organizations were given special consideration while designing Benefit Sharing Mechanism.

2.5 Institutional Arrangement

For proposing institutional arrangements for REDD+PES at federal, provincial and local level, the existing institutional arrangements were analyzed. Institutional and governance gaps/weaknesses with respect to REDD+PES were identified and measures were proposed to have an efficient and transparent institutional setup at multi levels for REDD+PES implementation. These proposed institutional arrangements were properly discussed in the consultative workshops and the proposals were duly endorsed by the representatives of the Forest Departments and other stakeholders.

2.6 International Experiences

International experiences on REDD+PES from around the world were reviewed and only the most relevant PES schemes were taken up for designing the current PES Schemes. The institutional arrangements, financing mechanisms, benefit distribution and values of different ecosystem services were of great importance for designing the PES Schemes in the pilot sites.

2.7 Forest Carbon Inventory

Forest Carbon Inventory was designed and implemented in the pilot sites to get latest and reliable data on the carbon stocks in mangroves forests. The method already used for Development of National Forest Reference Emission Level for this purpose was employed for data collection in mangroves forest. Cluster sampling was employed for data collection in the field. The cluster consisted of one plot in the center which was the primary sampling unit and four secondary sampling units on the corners 35 m apart from each other. A total of 79 sample plots were laid out in Sindh and 10 Plots were laid out in Balochistan PES area. The plots were randomly laid out on the map and their coordinates were uploaded onto GPS. The sample plots were navigated in the field with the help of GPS. Data was collected on aboveground biomass, dead wood, litter, and soil carbon. Details of allometric equations and methodologies employed for data collection from different carbon pool is presented in Chapter 8.

2.8 Boundary setting

Mangroves PES Pilot ecosystem includes two sites; Port Qasim Authority Mangroves Area and Miani Hor Mangroves forest. PQA area falls in Malir and Thatta Districts of Sindh province whereas Miani Hor is part of Lasbela district of Balochistan. Due to the lack of high resolution satellite imageries for the pilot area, it was decided to utilize Google Earth Pro for mapping the mangroves. As mangrove forests are found in intertidal areas along the coastal belts, most of the forest area occurs inside the creeks. For accurate estimation of area under mangroves and creation of good quality maps within short time, Google Earth Pro is the best option because Google Earth VHR satellite data is freely available. Forest cover, mudfalts and water bodies were mapped through visual interpretation and manual digitization of the Google Earth Images.

CHAPTER-3

3 PROJECT DESIGN DOCUMENT

3.1 Summary Description of the Project

The Pakistan Coastal Mangrove Forests (PCMF) PES Scheme is an initiative designed to promote climate change mitigation and adaptation, conserve and maintain biodiversity, improve livelihoods of local communities, ensure coastal areas protection and create alternative livelihoods through promotion of eco-tourism and other associated activities. The scheme is intended to be implemented under the United Nations scheme of Reducing Emissions from Deforestation and forest Degradation (REDD+). The following table gives statistics of the mangrove ecosystem at the two pilot sites:

Table 3. 1: Statiscs of Mangrove Ecosystem

S.No.	Cover Class	Area in Sindh Province (ha.)	Area in Balochistan Province (ha.)	Total Area (ha.)
1.	Water Bodies	22,321	13,263	35,584
2.	Mangrove Forests	29,121	4,525	33,646
3.	Mudflats	11,552	15,706	27,258
	Total	62,994	33,394	96,488

Total ecosystem area at the two sites is thus 96,488 ha. Area covered with mangrove forests is 33,646 ha. Mudflats at the two sites account for 27,258 ha in the ecosystem.

In Sindh, the project encompasses parts of Port Qasim Authority and Korangi Fish Harbor around Korangi and Phitti Creeks and adjoining areas. In Balochistan the project area is located in Miani Hor in Lasbela District. The project aims at protecting these critical mangrove forests as well as raising new plantations of mangroves over an area of 16,552 ha so as to have the following unique benefits:

- Climate change mitigation and adaption for local, national and global benefits through reduction of GHG emissions from the project area mangrove forests and enhancing their carbon sequestration potential;
- Biodiversity conservation of the coastal ecosystem and promotion of eco-tourism related opportunities in the area;
- Protection of coastal communities, adjoining Port Qasim Authority area and Korangi Fish Harbor area from damages in Sindh province and Miani Hor and surrounding areas in Balochistan province;
- Protection and enhancement of fishes and shrimps spawning areas, on which the livelihoods of many coastal communities depend;

- Pollution reduction into the sea from industrial estates, Karachi urban areas, hospitals and municipal areas waste, and agricultural wastes from coastal rivers flowing into the ocean; and
- Shoreline stabilization and prevention and control of sea intrusion into terrestrial ecosystems.

The project area is prone to climate change related damages resulting from sea level rise, temperature increases, greater frequency of extreme weather events, and increased vulnerabilities to tsunami damages.

The communities living in the coastal areas are extremely poor. Their livelihoods, food and nutrition are totally dependent on fisheries and income from fisheries resources. The mangrove forests protect and enhance the spawning sites of different types of these fishes and shrimps.

The project area supports unique fisheries and shrimps species biodiversity, turtles, migratory birds species, and coastal areas floral species.

Solid, liquid and air pollution from different sources is affecting the health of local communities, and marine life in the ocean including the mangrove forests.

As already highlighted, main threats to mangrove forests and other coastal ecosystems and their ecosystem services arise from the following:

- Pollution into the sea and mangrove forest areas from Port Qasim Authority Area, Korangi Fish Harbor Area, Miani Hor surrounding Areas, industrial estates, urban and municipal areas, hospital wastes, agricultural wastes and solid wastes that gets disposed to the coastal areas;
- Excessive and indiscriminate harvesting of fisheries and other coastal resources beyond their regenerative capacities;
- Inadequate engagement of key stakeholder groups to participate in resources conservation and development;
- Lack of awareness and capacities to sustainable manage various ecosystem services; and
- Lack of investment into coastal areas conservation and rehabilitation.

The different project interventions are designed to address the above issues which are contributing to degradation of coastal resources and their ecosystem services. Main outcomes of the project that are expected to contribute to the project development goal include:

- Reducing threats to existing mangrove forests in the project area and increasing area of mangrove forests thereby maintaining and enhancing the capacity of mangrove forests to provide ecosystem services;

- Models of public and private sector PES and related schemes developed and demonstrated within the project area, and the approach replicated in the wider coastal region of Pakistan;
- Enhanced technical capacity of key stakeholders to develop and implement PES schemes and recommendations made for improved policy, legal and institutional framework at the national and provincial levels so as to institutionalize PES concept in forest resources conservation and management;
- Increased availability of information on, and awareness of, PES concepts, schemes and opportunities increased in the provinces and at the national level.

3.2 Sectoral Scope and Project Type

As per IPCCC Guidelines 2006, it is an Agriculture, Forestry and Other Land Use (AFOLU) project and corresponds to VCS Sectoral Scope 14: Agriculture, forestry and Other Land Use. Within the framework of VCS, the project falls in the category degraded mangrove habitats and will use the ***Methodology AR-AM 0014: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, Version 04.1*** and its associated AR Methodological Tools:

Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01)

Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0)

Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.1)

3.3 Project Proponent

Sindh Province

Organization Name	Office of the Chief Conservator of Forests Coastal Areas Mangrove Forests and Range Lands Forest Region, Government of Sindh, Karachi.
Contact Person	Mr. Riaz Wagan, Chief Conservator of Forests
Address	Forest Offices, Model Colony, Malir Cantt. Karachi
Telephone No.	021-34110196
Fax No.	021-34510699

Balochistan Province

Organization Name	Office of the Chief Conservator of Forests Southern Forest Region, Government of Balochistan, Quetta.

Contact Person	Chief Conservator of Forests (South)
Address	Balochistan Forest Department, Joint Road, Quetta
Telephone No.	0819203744
Fax No.	
Email address	

3.4 Other Entities Involved in the Project

Organization Name	Office of the Inspector General of Forests Ministry of Climate Change, Government of Pakistan.
Contact Person	Syed Mahmood Nasir Hussain, Inspector General of Forests
Address	Local Government and Rural Development Complex, G5/2, Islamabad.
Telephone No.	+92 51-9245589
Fax No.	+92 51 9245590
Mobile No.	+92 300-2391663 and +92 301-2034054
Email address	igf@ccd.gov.pk

3.5 Project Start Date

January, 2020.

3.6 Project Crediting Period

Project crediting period is 30 years and 0 months. Start date of the crediting period is January 1, 2020 and the end date is December 31, 2049.

Work on project preparation has been started in January 2018. The first activity related to the project was the signing of agreement between the Ministry of Climate Change, Government of Pakistan and Pakistan Forest Institute for the preparation of first draft of Project Design Document.

Pakistan Forest Institute has since then started discussions and consultations with different stakeholders on design elements of the project.

Actual implementation of the project, however, is expected to start from January 1, 2020 after completion of all the codal formalities, including validation of the Project Description Document and its registration.

Supporting documentation for the start date can be found in the folder “Project start date”.

3.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	Yes
Large Project	

3.7.1 Estimated GHG Emission Reductions or Removals

Year	Estimated GHG emission reductions (ERs) or removals (tCO_2e)
1	0
2	27,300
3	81,900
4	163,800
5	273,000.0
6	423,623.2
7	574,246.4
8	724,869.6
9	875,492.8
10	1,026,116.0
11	1,176,739.2
12	1,327,362.4
13	1,477,985.6
14	1,628,608.8
15	1,779,232
16	1,929,855.2
17	2,080,478.4
18	2,231,101.6
19	2,381,724.8
20	2,532,348
21	2,682,971.2
22	2,833,594.4
23	2,984,217.6
24	3,134,840.8
25	3,285,464.0
26	3436087.2
27	3,586,710.4
28	3,737,333.6
29	3,887,956.8
30	4,038,580.0
Total estimated ERs	**4,038,580**
Total number of crediting years	30
Average annual ERs	134,619

3.8 Description of the Project Activity

3.8.1 Project Goal

To secure climate, community and biodiversity benefits in mangrove forest ecosystems through the demonstration and promotion of Payments for Environmental Services (PES) and related financing schemes.

3.8.2 Project Objectives

Project goal will be achieved through the following project objectives/outcomes:

Outcome 1:

Reducing threats to existing mangrove forests in the project area and increasing area of mangrove forests thereby maintaining and enhancing the capacity of mangrove forests to provide climate, community and biodiversity related ecosystem services.

Outcome 2:

Models of public and private sector PES and related schemes developed and demonstrated within the project area, and the approach replicated in the wider coastal region of Pakistan.

Outcome 3:

Enhanced technical capacity of key stakeholders to develop and implement PES schemes and recommendations made for improved policy, legal and institutional framework at the national and provincial levels so as to institutionalize PES concept in forest resources conservation and management.

Outcome 4:

Increased availability of information on and awareness of PES concepts, thereby enhancing opportunities for PES schemes in the provinces and at the national level.

3.8.3 Project Program of Activities (PoAs)

The project logical framework presented in this section is reflective of the theory of change behind the intervention approach chosen under this project. The theory of change is that reducing the existing and potential future threats to mangrove forests, making greater use of partnerships for mangroves conservation, and raising awareness about and enhancing the skills of relevant stakeholders will contribute to maintaining and expanding mangrove forests and thus the increased and sustained availability of their ecosystems services in support of climate change mitigation, improved living conditions of communities and better biodiversity conservation in the project area. Based on this chosen theory of change and intervention strategy, the project inputs and activities are designed to produce the outputs and outcomes required to eventually achieve the impact level results-climate change mitigation, biodiversity conservation and improved community livelihoods.

Based on international experiences, mainstreaming lessons learnt of projects that involve changes in policy and legislation are beyond the immediate control of the project, because policy and legal changes have to be approved by governments and involve debates and reviews that are beyond the control of the project. Therefore, wider geographical replication of the PES concept is proposed so as to deliver the project goal on institutionalizing it as an approach.

Important drivers towards project goal and impact include development of policy and legal frameworks at provincial and national levels, documentation, wider dissemination and distribution of best practices of this pilot PES scheme, and mapping and assessment of ecosystems and their services. The likelihood that the impact will be achieved depends on a number of assumptions including willingness of the Provincial and National Governments to mainstream PES schemes into policy and decision-making and overall forest resource management plans, collaboration among provinces and interest and motivation of the stakeholders to continue to apply PES schemes.

Logical framework of the project is given in Table 3.2 which also gives its Program of Activities (PoAs):

Table 3. 2: Logical Framework of Proposed PES Project

Expected Result	Objectively Verifiable Indicator (OVI)	Baseline	Target		Means of Verification (MoV)	Assumptions
			Mid-Term (when applicable)	Final		
Project Goal: Secure climate, community and biodiversity benefits in mangrove forest ecosystems through the demonstration and promotion of Payments for Environmental Services (PES) and related financing schemes.	A PES scheme for selected mangrove forests in Sindh and Balochistan coastal areas is developed for securing ecosystem services of mangrove forests.	Existing Forest Management Plans in Pakistan do not collect systematic data on various ecosystem services of different forest types. There is currently no PES scheme under implementation in forestry sector in Pakistan.	Work on the development of a Project Description Document for PES scheme in selected mangrove forests in coastal areas of Pakistan is initiated.	Mangrove Forests PES Schemes is designed, adopted and under implementation in selected coastal areas of Pakistan.	Project Description Document for Mangrove Forests PES scheme is developed and available. The PES Scheme is approved and under implementation.	Willingness of Governments to mainstream PES schemes into policy and decision-making and resource conservation and management tool. Collaboration between different provincial governments and with the federal government on PES related issues. Interest and willingness of stakeholders in continued implementation of PES schemes.
Project Outcomes						
Reduced threats to existing mangrove forests in the project area and increased area of mangrove forests thereby maintaining and enhancing the capacity of mangrove forests to provide ecosystem services.	Existing mangrove forests in the project area (total ~33,646 ha; 29,121 ha in Sindh and 4,525 ha in Balochistan) are protected and 16,552 ha additional area brought under mangrove forests.	Based on land cover statistics prepared from satellite imageries of 2017, total mangrove ecosystem area in the Korangi and Phitti creeks is 62,994 ha; out of which 29,121 ha are mangrove forests, 11,552 ha are mud flats	The 33,646 ha existing mangrove forest area is protected and plantation plan prepared for the 11,550 ha mudflats area in the Korangi and Phitti Creeks areas and 5,000 ha in the Miani Hor area. Mangrove forests areas to be assessed at the mid-term evaluation time.	The 33,646 ha existing mangrove forest area is protected and the 11,550 ha mudflats area in the Korangi and Phitti Creeks and 5,000 ha areas in Miani Hor is planted with suitable species using appropriate planting techniques and plant to plant spacing. Mangrove forests areas to be assessed	Land cover statistics and maps prepared from satellite imageries of the mangrove forests area at pilot project sites at project start time; mid—term evaluation time; and at post project terminal evaluation time.	High resolution satellite imageries are procured for the project, images are accurately interpreted and land cover maps prepared.

		and 22,321 ha are water bodies. In Balochistan Province, total ecosystem area is 33,394 ha. Of the total ecosystem area, 4,525 ha area is under mangrove forests in Miani Hor. There are mudflats over 15,706 ha and water bodies extend over 13,263 ha.		at the post project evaluation time.		
Models of public and private sector PES and related schemes developed and demonstrated within the project area, and the approach replicated in the wider coastal region of Pakistan.	MoUs developed and signed for public-private sector mangrove forests PES schemes. These PES schemes are meant to reward the maintenance, improvement or adoption of mangrove forests conservation and expansion-friendly measures.	No MoUs for public-private partnerships covering PES schemes currently existing in the said project area.	At least 2 MoUs developed.	At least 2 MoUs signed.	Copies of Project Design Documents and copies of signed MoUs between public-private partners for PES Schemes implementation. Copies of Plan for Mangrove Forests in Sindh and Balochistan Provinces at project start time; midterm evaluation reports of the project; and post- project independent evaluation time.	Societal changes in the coastal areas have opened a window of opportunity for developing and implementing PES schemes through public-private partnerships for resources protection, conservation and sustained production of environmental services to the society.
Enhanced technical capacity of key stakeholders to develop and implement PES	Number of key stakeholders in coastal areas with mangrove forests are aware of PES	Little or no awareness amongst key stakeholders in coastal areas with mangrove	Key stakeholders in the project areas are identified and their level of knowledge and needs related to PES and related	2 National level workshops and 6 provincial level workshops (3 in each province) are held with concerned staff	Reports of qualitative knowledge, skills and capacity assessment surveys among project participants and key stakeholders in pilot	Interest from key players in coastal areas. Lessons from and basic approaches developed in the pilot

schemes and recommendations made for improved policy, legal and institutional framework at the national and provincial levels so as to institutionalize PES concept in forest resources conservation and management.	and related sustainable financing mechanisms, and are considering adopting them for the conservation and sustainable management of mangroves forests in their areas. Concrete proposals for policy, legal and institutional reforms that are supportive of PES program are prepared at the national level as well as the provincial governments levels.	forests about PES and related sustainable financing mechanisms. Existing policies, legal and institutional frameworks at the national level and the provincial levels have gaps that need to be fulfilled through appropriate measures.	sustainable financing schemes are assessed. Specific gaps in existing policies, laws and institutional frameworks at the national and provincial levels are identified.	of relevant ministries and departments. Each workshop has at least 15 participants. Specific proposals for policies, legal and institutional reforms that are supportive of PES at the national and provincial levels are developed and are being considered for initiation of needed actions.	project sites to be conducted at project inception and as part of post-project evaluation. Concrete proposals for policies, legal and institutional reforms at the national and provincial levels are available.	project area are useful in other areas of the coast. Close cooperation is developed between the federal and provincial agencies and amongst the provincial agencies for bringing about needed policy, legal and institutional reforms that are supportive of and conducive for PES schemes implementation.
Increased availability of information on, and awareness of, PES concepts, schemes and opportunities increased in the provinces and at the national level.	Project experiences and lessons learned ('how-to' manuals, good practices guidelines, etc.) captured and available to key provincial, national and international conservation and development community through project website.	No documentation of best practices/ lessons in the project areas.	Draft lessons learned and best practices, and newsletter issues on interim results and lessons learnt.	Accurate documentation of processes and activities leading to best practices is systematically being documented at the project sites and the work is supported by the project.	Evidence provided in project survey reports, progress reports and final reports that the pilot PES project has made significant contributions to the concerned ministries, departments and conservation community's knowledge of how to scale-up PES and sustainable financing schemes as well as how to incorporate them in forest management so that they deliver significant	Interest from key players in other areas of different provinces and territories of Pakistan. Lessons from, and basic approaches developed in the pilot project are useful for and applicable for adoption other areas or can be applied after suitable adaptation. Interest in and PES and PES like schemes among Policy makers,

					conservation and livelihood improvements. Reports of qualitative information and knowledge assessment surveys and interviews among project participants of Ministry of Climate Change, Provincial Forest and Other Departments and other key stakeholders in local communities and conservation organizations, to be conducted at project inception and as part of post-project evaluation.	government departments, local communities and conservation and development organizations remains high.
Project Outputs						
Outputs contributing to Outcome 1						
Plan for reducing pollution into the sea from different industrial estates developed.	Consultations held and industrial pollution reduction plan developed.	No industrial pollution reduction plan existing.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Industrial Pollution Reduction Plan Document. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for reducing urban pollution discharges and hospital waste disposal into sea developed.	Consultations held and urban pollution and hospital waste reduction plan developed.	No urban pollution and hospital waste reduction plan existing.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Urban Pollution and Hospital Waste Reduction Plan Document. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for reducing municipal waste	Consultations held and	No municipal waste pollution	Consultations started and work on plan	Plan preparation finalized and MoU for	Municipal waste Pollution Reduction Plan	Sufficient level of interest in PES/SF of

discharge into the sea developed.	municipal waste pollution reduction plan developed.	reduction plan existing.	preparation initiated.	plan implementation drafted.	Document. MoU Document.	relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for reducing pollution from Port Qasim into the sea developed.	Consultations held and Port Qasim Area pollution reduction plan developed.	No Port Qasim Area pollution reduction plan existing.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Port Qasim Area Pollution Reduction Plan Document. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for reducing dumping of solid waste near the coast developed.	Consultations held and solid waste dumping pollution reduction plan developed.	No solid waste dumping pollution reduction plan existing.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Solid waste dumping pollution Reduction Plan Document. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for controlling discharges of agro-chemicals, agricultural waste and other pollutants via coastal rivers (Lyari, Malir and Hub) developed.	Consultations held and agro-chemicals and agricultural waste pollution via coastal rivers (Lyari, Malir and Hub) reduction plan developed.	No agro-chemicals and agricultural waste pollution into coastal rivers reduction plan existing.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Agro-chemicals and agricultural waste Pollution into coastal rivers Reduction Plan Document. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for controlling pollution into the mangrove areas from different shipping vessels and ships breaking facility developed.	Consultations held and shipping vessels and ships breaking facility pollution reduction plan developed.	No shipping vessels and ships breaking facility pollution reduction plan existing.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Shipping vessels and ships breaking facility Pollution Reduction Plan Document. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.

Plan for controlling cutting of mangrove trees for fuelwood purposed developed.	Consultations held and measures for controlling cutting of mangrove trees for fuelwood purposes agreed and codified.	No measures for controlling cutting of mangrove trees for fuelwood purposes existing in the project areas.	Consultations started and work on measures and their codification initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Document detailing agreed measures for controlling cutting of mangrove trees for fuelwood purposes. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for controlling of cutting of branches and lopping of mangrove trees for animal fodder purposes developed.	Consultations held and measures for controlling cutting of branches and lopping of mangrove trees for animal fodder purposes agreed and codified.	No measures for controlling cutting of branches and lopping of mangrove trees for animal fodder purposes existing in the project area.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Document detailing agreed measures for controlling cutting of branches and lopping of mangrove trees for animal fodder purposes. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plan for controlling unauthorized construction for habitation and business purposes developed in collaboration with concerned agencies.	Consultations held and plan for controlling unauthorized construction of habitation and business purposes developed.	No plan existing in project areas for controlling unauthorized construction of habitations and business complexes.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Document for controlling unauthorized construction of habitation and business complexes. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plans for controlling sea level intrusion into terrestrial coastal belts developed in collaboration with concerned authorities.	Consultations held and plan developed for controlling sea level intrusion into terrestrial coastal belts.	No plan existing in project areas for controlling sea level intrusion into terrestrial coastal belts.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Document for controlling sea level intrusion into terrestrial coastal belts. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation are available and can be mobilized.
Plans for controlling intrusion of saline water into fresh	Consultations held and plan developed for controlling	No plan existing in project areas for controlling intrusion of	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation drafted.	Document for controlling intrusion of saline water into fresh water.	Sufficient level of interest in PES/SF of relevant stakeholders exists.

water developed in collaboration with irrigation and drainage and other concerned authorities developed.	intrusion of saline water into fresh water.	saline water into fresh water.			MoU Document.	Financial resources for plan implementation are available and can be mobilized.
Plans for increase in mangrove forest areas through planting at suitable sites using suitable species, planting techniques and plant spacing in collaboration with concerned authorities.	Consultations held and plan developed for planting of mangroves over 16,552 ha mud flats in the project areas.	No plan existing for planting of mangroves over 16,500 ha mud flats in project sites.	Consultations started and work on plan preparation initiated.	Plan preparation finalized and MoU for plan implementation in collaboration with local communities drafted.	Project Document for planting of 11,550 ha mud flats. MoU Document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources for plan implementation available and can be mobilized.
Outputs contributing to Outcome 2						
Model public-private PES Programs developed by the Federal Ministry of Climate Change.	At least two project proposals for public-private PES program developed by the Ministry of Climate Change.	No proposal currently existing.	Work on proposal development initiated.	Work on proposal development completed and proposal ready for adoption.	Public-private PES Program Proposal Documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Technical capacity exists or can be procured for proposal development.
Model public-private PES Programs developed by the Sindh Provincial Forest Department.	At least one project proposal for public-private PES program developed by Sindh Forest Department.	No proposal currently existing.	Work on proposal development initiated.	Work on proposal development completed and proposal ready for adoption.	Public-private PES Program Proposal Documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Technical capacity exists or can be procured for proposal development.
Model public-private PES Programs developed by the Balochistan	At least one project proposal for public-private PES program developed by	No proposal currently existing.	Work on proposal development initiated.	Work on proposal development completed and proposal ready for adoption.	Public-private PES Program Proposal Documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists.

Provincial Forest Department.	Balochistan Forest Department.					Technical capacity exists or can be procured for proposal development.
Outputs contributing to Outcome 3						
Concrete proposals developed for initiating policy, legal and institutional reforms at the federal level that are conducive to and support implementation and large-scale adoption of PES programs in the forestry sector.	Proposals for policy, legal and institutional reforms at the national level that are supportive of PES programs are developed.	Currently concrete proposals for policy, legal and institutional reforms at the national level not existing.	Work on proposals development for policy, legal and institutional reforms at the national level initiated.	Work on proposals development for policy, legal and institutional reforms at the national level completed.	Documents of Concrete Proposals on Policy, Legal and Institutional Reforms. Project Progress Reports.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Technical capacity exists or can be procured for proposal development.
Concrete proposals for initiating policy, legal and institutional reforms at the provincial level that are conducive to and support implementation and large-scale adoption of PES programs in the forestry sector.	Proposals for policy, legal and institutional reforms at provincial levels that are supportive of PES programs are developed.	Currently concrete proposals for policy, legal and institutional reforms at provincial levels not existing.	Work on proposals development for policy, legal and institutional reforms at provincial levels initiated.	Work on proposals development for policy, legal and institutional reforms at provincial levels completed.	Documents of Concrete Proposals on Policy, Legal and Institutional Reforms. Project Progress Reports.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Technical capacity exists or can be procured for proposal development.
Outputs contributing to Outcome 4						
Awareness creation and training and capacity building program on PES	Increase in awareness scores of PES concepts, schemes and	Little or no awareness amongst staff of Provincial Forest	Targeted awareness raising activities carried out covering reaching key targets.	Increased awareness of PES concepts, schemes and opportunities among pilot sites Forest	Interviews with key set of stakeholders conducted during final project evaluation.	Sufficient level of interest in PES/SF of relevant stakeholders exists.

in the forestry sector for the staff of Provincial Forest Departments developed.	opportunities among pilot sites Forest Department staff.	Departments about PES concepts, schemes and opportunities.		Department staff.		
Awareness creation and training and capacity building program on PES in the forestry sector for relevant communities developed.	Increase in awareness scores of PES concepts, schemes and opportunities among pilot sites communities.	Little or no awareness amongst communities about PES concepts, schemes and opportunities.	Targeted awareness raising activities carried out covering reaching key targets.	Increased awareness of PES concepts, schemes and opportunities among pilot sites communities.	Interviews with key set of stakeholders conducted during final project evaluation.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Awareness creation and training and capacity building program on PES in the forestry sector for staff of other relevant departments developed.	Increase in awareness scores of PES concepts, schemes and opportunities among pilot sites staff of other relevant departments.	Little or no awareness amongst staff of other relevant departments about PES concepts, schemes and opportunities.	Targeted awareness raising activities carried out covering reaching key targets.	Increased awareness of PES concepts, schemes and opportunities among pilot sites staff of other relevant departments.	Interviews with key set of stakeholders conducted during final project evaluation.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Awareness creation and training and capacity building program on PES in the forestry sector for politicians, policy makers and other opinion makers developed.	Increase in awareness scores of PES concepts, schemes and opportunities among politicians, policy makers and other opinion makers.	Little or no awareness amongst politicians, policy makers and other opinion makers about PES concepts, schemes and opportunities.	Targeted awareness raising activities carried out covering reaching key targets.	Increased awareness of PES concepts, schemes and opportunities among politicians, policy makers and other opinion makers.	Interviews with key set of stakeholders conducted during final project evaluation.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Project Activities						
Interventions Related to Outcome 1:						
Reducing industrial	Hold consultations	Currently no consultations	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and	Sufficient level of interest in PES/SF of

pollution into the sea from Sindh Industrial Trading Estate (SITE), Landhi Industrial Trading Estate, Korangi Industrial Estate, and West Wharf Industrial Area (Sindh Province) and Hub Industrial Trading Estate (Balochistan Province) through dialogue with concerned industries and Environmental Protection Agencies.	with and prepare plan for industrial pollution reduction into the sea from various industrial estates.	are being held and no plans are available for controlling the industrial pollution into the sea.			plan document.	relevant stakeholders exists.
Reducing Karachi urban and hospital waste into the sea through dialogue with Karachi City and Hospital authorities and Sindh EPA.	Hold consultations with and prepare plan for urban and hospital waste pollution reduction into the sea from Karachi City and Hospitals.	Currently no consultations are being held and no plans are available for controlling the urban and hospital pollution into the sea.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Reducing municipal pollution into the sea from adjoining population centers through dialogue with concerned population centers and municipal authorities and Provincial EPAs.	Hold consultations with and prepare plan for municipal pollution reduction into the sea from various adjoining population centers.	Currently no consultations are being held and no plans are available for controlling the municipal pollution into the sea.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.

Reducing Port Qasim Area pollution into the sea through dialogue with Port Qasim Authorities and Sindh EPA.	Hold consultations with and prepare plan for Port Qasim Area pollution reduction into the sea.	Currently no consultations are being held and no plans are available for controlling the Port Qasim Area pollution into the sea.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Reducing dumping of solid waste near the coast which eventually finds its way into the sea due to high tides through dialogue with concerned authorities and provincial EPA.	Hold consultations with and prepare plan for pollution reduction into the sea from dumping of solid waste near the coast.	Currently no consultations are being held and no plans are available for controlling pollution resulting from the solid waste dumping into the sea.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Reducing agricultural and other terrestrial pollutants discharges via coastal rivers (Lyari, Malir and Hub) into the sea through dialogue with Sindh EPA.	Hold consultations with and prepare plan for agricultural and other terrestrial pollution reduction into the sea from different sources through coastal rivers.	Currently no consultations are being held and no plans are available for controlling the agricultural and terrestrial pollution into the sea coming through coastal rivers.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Controlling pollution from ships into the sea through dialogue with coast authorities and shipping companies.	Hold consultations with and prepare plan for pollution reduction into the sea from shipping vessels and ships breaking facility.	Currently no consultations are being held and no plans are available for controlling the shipping vessels and ship breaking facility pollution into the sea.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.

Controlling cutting of mangrove forests for fuelwood purposes through dialogue with concerned communities and effective implementation of forestry law.	Hold consultations with and prepare plan for controlling cutting of mangrove forests for fuelwood purposes.	Currently no consultations are being held and no effective plans are available for controlling the cutting of mangrove trees for fuelwood purposes.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Controlling damages to mangroves trees due to cutting of branches for animal fodder through dialogue with local communities and effective implementation of forestry law.	Hold consultations with and prepare plan for controlling damages to mangrove trees due to cutting of branches for animal fodder purposes.	Currently no consultations are being held and no plans are available for controlling the damages to mangrove trees due to cutting of branches for animal fodder purposes.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Controlling land use change along the coast and the construction of un-authorized human habitations and business complexes through dialogue with Karachi Development Authority and other relevant agencies.	Hold consultations with and prepare plan for controlling construction of un-authorized human habitations and business complexes.	Currently no consultations are being held and no plans are available for controlling the construction of un-authorized human habitations and business complexes.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Taking steps to tackle sea level rise and sea line intrusion into the coastal areas through dialogue	Hold consultations with and prepare plan for controlling sea level rise	Currently no consultations are being held and no plans are available for controlling the	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.

with city authorities and provincial disasters management authorities.	intrusion into the coastal areas.	sea level rise intrusion into the coastal areas.				
Taking steps to control intrusion of saline water into fresh water sources through dialogue with irrigation and drainage authorities.	Hold consultations with and prepare plan for controlling intrusion of saline water into fresh water sources.	Currently no consultations are being held and no plans are available for controlling the saline water intrusion into the fresh water sources.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.
Planting of different mangrove species plants at suitable sites using appropriate planting techniques and spacing through interaction with relevant agencies including Forest Departments, Pakistan Navy, Coastal Authorities, IUCN, WWF and other conservation organizations.	Hold consultations with relevant stakeholders and prepare plan for planting of mangrove plants over 26,550 ha mud flats existing at the project sites.	Currently no consultations are being held and no plans are available for planting of mangrove plants over 26,550 ha mud flats at the project sites.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources are available and can be mobilized for the purpose.
Interventions related to Outcome 2						
Initiation and promotion of public-private PES Model Programs by the	Federal Ministry of Climate Change initiates at least two public-private	Currently no financial resources are available for implementation	Work started on mobilization of needed financial resources.	Needed financial resources mobilized.	Minutes of the consultations held and financial resources mobilization plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists.

Federal Ministry of Climate Change.	PES Model Programs.	of Model PES Plans.				Financial resources are available and can be mobilized for the purpose.
Initiation and promotion of public-private PES Model Programs by the Sindh Provincial Forest Department.	Sindh Provincial Forest Department initiates at least one public-private PES Model Program.	Currently no financial resources are available for implementation of Model PES Plan.	Work started on mobilization of needed financial resources.	Needed financial resources mobilized.	Minutes of the consultations held and financial resources mobilization plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources are available and can be mobilized for the purpose.
Initiation and promotion of public-private PES Model Programs by Balochistan Provincial Forest Department.	Balochistan Provincial Forest Department initiates at least one public-private PES Model Program.	Currently no financial resources are available for implementation of Model PES Plan.	Work started on mobilization of needed financial resources.	Needed financial resources mobilized.	Minutes of the consultations held and financial resources mobilization plan document.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Financial resources are available and can be mobilized for the purpose.
Interventions related to Outcome 3						
Liaison and advocacy with concerned Federal Ministries to initiate policy, legal and institutional reforms that are conducive to and support implementation and large-scale adoption of PES	Liaise and advocate with concerned Federal Ministries to initiate policy, legal and institutional reforms that are conducive to and support implementation and large-scale	Currently only generic and not concrete work is on-going on the policy, legal and institutional reforms dimension.	Consultations held.	Consultations held and concrete proposals prepared.	Minutes of the consultations held and proposed documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Adequate technical capacity and resources are available or can be procured.

programs in the forestry sector.	adoption of PES programs in the forestry sector.					
Liaison and advocacy with concerned Provincial Ministries and Departments to initiate policy, legal and institutional reforms that are conducive to and support implementation and large-scale adoption of PES programs in the forestry sector.	Liaise and advocate with concerned Provincial Ministries and Departments to initiate policy, legal and institutional reforms that are conducive to and support implementation and large-scale adoption of PES programs in the forestry sector.	Currently only generic and not concrete work is on-going on the policy, legal and institutional reforms dimension.	Consultations held.	Consultations held and concrete proposals prepared.	Minutes of the consultations held and proposed documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Adequate technical capacity and resources are available or can be procured.
Interventions related to Outcome 4						
Designing, developing and implementing large-scale awareness creation and training and capacity building program on PES in the forestry sector for the staff of Provincial Forest Departments.	Design, develop and implement large-scale awareness creation and training and capacity building program on PES in the forestry sector for the staff of Provincial Forest Departments.	Currently no consultations are being held and no awareness creation and training and capacity building plans are available for the staff of Provincial Forest Departments.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plans documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Sufficient technical capacity and resources exist or can be procured to do the job.
Designing, developing and implementing large-scale awareness creation and training and	Design, develop and implement large-scale awareness creation and training and capacity building	Currently no consultations are being held and no awareness creation and training and	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plans documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Sufficient technical capacity and resources

capacity building program on PES in the forestry sector for relevant communities.	program on PES in the forestry sector for the relevant communities.	capacity building plans are available for the relevant communities.				exist or can be procured to do the job.
Designing, developing and implementing large-scale awareness creation and training and capacity building program on PES in the forestry sector for staff of other relevant departments.	Design, develop and implement large-scale awareness creation and training and capacity building program on PES in the forestry sector for the staff of other relevant departments.	Currently no consultations are being held and no awareness creation and training and capacity building plans are available for the staff of other relevant departments.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plans documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Sufficient technical capacity and resources exist or can be procured to do the job.
Designing, and implementing large-scale awareness and capacity building program on PES for politicians,policy makers and other opinion makers.	Design, develop and implement large-scale awareness creation and training and capacity building program on PES in the forestry sector for politicians, policy makers and other opinion makers.	Currently no consultations are being held and no awareness creation and training and capacity building plans are available for politicians, policy makers and other opinion makers.	Consultations held.	Consultations held and plans prepared.	Minutes of the consultations held and plans documents.	Sufficient level of interest in PES/SF of relevant stakeholders exists. Sufficient technical capacity and resources exist or can be procured to do the job.

3.9 Project Location

Project area of PCMF PES Project falls in the provinces of Sindh and Balochistan. In Sindh province, the Indus River Delta region is comprised of 17 major creeks, numerous sub-creeks, extensive mudflats and mangrove forests. This PES project will be implemented in two creeks, viz., Korangi and Phitti creeks and adjoining areas near Port Qasim Authority Area and Korangi Fish Harbor Area. Total estimated area of this ecosystem is 62,994 ha. Following is the distribution of the area of the ecosystem:

*Table 3. 3**: Landuse in Sindh Pilot Area***

Cover Type	Area in hectares
Mangrove Forests	29,121
Mudflats	11,552
Water Bodies	22,321
Total Ecosystem Area	62,994

In Balochistan province, mangrove forests are found in Miani Hor, Kalmat Hor and Jiwani Bay and Gawater Bay Areas. The distribution of mangrove forests in Balochistan is given in Table 3.4 and Landuse in the PES pilot area is given in Table 3.5.

Table 3. 4: Distribution of Mangrove Forests in Balochistan Pilot Area

Locality	Area in hectares	Percentage
Miani Hor	4,525	87.82
Kalmat Hor	194	3.76
Jiwani Bay and Gawater Bay	433	8.42
Total Mangroves Area	5,152	100.00

Table 3. 5: Landuse in Balochistan Pilot Area

Cover Type	Area in hectares
Mangrove Forests	4,525
Mudflats	15,706
Water Bodies	13,263
Total Ecosystem Area	33,394

In Balochistan, Miani Hor has the most mangrove forests and accounts for 84 % of the mangrove forests in the province. This PES scheme includes only Miani Hor Area mangroves. Kalmat Hor and Jiwani Bay and Gawater Bay Areas are not included in the PES scheme.

The project area receives minima rainfall, and mangroves in the coastal areas of Pakistan are the largest arid climate mangroves in the world. The mangroves in the Indus Delta area near Thatta district depend on fresh water flows from river Indus. Mangroves of Korangi and Phitti creeks receive their water from domestic and industrial estate discharges. The fresh water flow into the Miani Hor area comes from Hub River and other coastal rivers that drain into the sea around that area.

Maps of the Korangi and Phitti Creeks and adjoining areas, and Miani Hor and surrounding areas are given at Annex-1 and 2 respectively.

3.10 Business as Usual Scenario, Project Scenario and Comparison of Business as Usual and Project Scenarios

Please refer to Chapter-7

3.11 Stakeholder Engagement as PES Services Providers

The following table shows the major stakeholders in mangrove forests who are either directly or indirectly relevant in the context of this PES project, and who could potential be engaged as PES services providers. The table also highlights potential challenges associated with their involvement.

Table 3. 6: Stakeholders as PES Services Providers

Service Provider & Justification	Impacton Service Provision	Challenges
Subsistence Users: Long- term defacto use rights	Their use may be regulated to avoid over harvesting, but they would not have been expected to negatively impact forest. They may be among the most effective at monitoring status.	Identification of individual users is difficult, and changes overtime. Not a well-organized grouping and power to enforce is likely limited. Difficult to target payments.
Individual Households: Possible to provide household forest protection contracts that clearly define rights and responsibilities	Monitoring responsibilities can be clearly defined and targeted. Likely to be the most cost effective because targeting payments to few individuals.	Enforcement would have to rely on government. Concerns of elite capture in how protection rights are allocated.
Coastal Villages: Lac kexplicit rights, but proximity means they can influence management, likely overlap with subsistence users.	Best suited to enforce and make rules over resource use, if supported through co-managemen arrangement.	Not necessarily organized legally as a management unit with explicit rights to mangrove forests. Payment distribution likely to result in elite capture.
Coastal Authorities: Have land ownership rights in coastal area around Port Qasim in Korangi and Phitti creeks areas.	Decide on allocation of land for various purposes and therefore have management rights and responsibilities. Allocate contracts for coal, gas and oil pipelines. Have some monitoring ability.	Payment to government is less of a PES and more of a tax and regulating the system. More likely to take an administrative fee for PES transactions.
Full Surrounding Communities: Have rights over the area through de facto usages and tacit political support.	Limited impact beyond the coastal villages.	Too many people, with too little direct impact on the service.
Fishing Communities: Directly adjacent to mangrove areas and may have some fish harvesting and use certificates in and around mangrove areas	If fishermen have rights over fishing in neighboring mangrove forests, they could be paid to forego those rights to ensure sustainable fishing over time, as in a conservation easement. They maybe paid to forego their rights to restore fisheries and mangroves in the area.	Fishing rights have been assigned in recent years and it may not be socially appropriate or legal to pay them to change their fisheries and land use to forest.
Provincial Governments: Establish rules around mangrove protection and administer and finance enforcement.	Legal framework, but daily management is not possible or devolved.	Same as with Coastal Authorities.

3.12 Legal Status and Property Rights

Mangrove Forests in both Sindh and Balochistan provinces have been notified as Protected Forests under Pakistan Forest Act, 1927, and the trees found in the Protected Forests have been declared as reserved. The ownership of Protected Forests is vested in the state and the forests are therefore state property. Local communities have no rights in these forests. Furthermore, as per section 30 (1) (b) of Pakistan Forest Act 1927, government may by notification declare that any portion of such forests specified in the notification shall be closed for such term, not exceeding thirty years, as government considers fit and that the rights of private person, or village community, if any, over such portion shall be suspended during such term. Provided that when any portion of the forest is closed, it shall be ensured that the remainder of such forest is sufficient and is reasonably convenient for the due exercise of the rights suspended in the portion so closed.

Section 33 of the same legislation prohibits certain acts in Protected Forests.
Following are the major acts prohibited:

- Setting fire or abetting in setting fire;
- Construction of buildings and other structures;
- Grazing of livestock or cutting of grass;
- Pass through or trespassing any closed areas;
- Negligence and causing damage to forests or trees therein during harvesting operations;
- Cutting or causing any type of damage to trees, brushwood in these forests;
- Quarrying any stones or other forest produce;
- Polluting soil or water in the forests;
- Hunting or shooting wildlife;
- Fishing or poisoning any water; and
- Abetting in the commission or furtherance of any of the above acts.

Forest produce has been defined in the Act and includes both living and non-living things found in forest ecosystems. There, however, is no mention of forest carbon in the legislation as it is an old legislation and the concept of forest carbon did not exist at the time. However, it says that government through a notification may declare any other produce as forest produce from time to time.

Given the fact that communities have no de jure rights in these Protected Forests but are using the ecosystem under de facto arrangements, tensions can potentially arise when a PES project becomes operational. Tensions will arise because PES project will allocate certain incentives for improved behavior that contributes to resources conservation, as well as it will allocate certain responsibilities and obligations for protecting and enhancing the provision of their ecosystem services, including curtailing or altogether stopping some of their current usages under the de facto tenure system. Clarification of the property rights is therefore of crucial importance in the design of the PES scheme.

There are chances of tensions when deciding on tenure mechanisms, because a tension exists in all the following situations:

- approaches that individualize forest tenure into households that can clearly monitor and enforce rights (to the exclusion of others inthe community);
- approaches that are more community-based, but will also reduce the amount of payments that incentivize any given household; and,
- approaches that place all management authority in the hands of government.

It is therefore recommended that in order to provide incentives to local communities, fisher folks, individuals, or groups of individuals and users to conserve the mangrove forests, rights in ecosystem services of the services providers in the mangrove forests be defined and secured so that they become entitled to ecosystem services benefits, as well as can be held accountable for failing to comply with their assigned obligations and responsibilities. Accordingly, it is proposed that provisions be made in the forest, wildlife, fisheries and environmental laws with regard to the protection of ecosystem services rights of services providers under the PES scheme.

CHAPTER-4

4 ECOSYSTEM SERVICES IDENTIFIED FOR PES SCHEME

4.1 Overview

This chapter presents the major ecosystem services provided by the two framed PES areas in Sindh and Balochistan - especially by the areas' mangrove forests. Table 4.1 presents the identified main ecosystem services with the respective methods used in the economic valuation of these services.

Table 4. 1: The identified main ecosystem services with the respective methods of economic valuation

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Valuation technique	Data required
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	Calculation of actual fish /shrimp/lobster landing value as share of total national catches, market prices for each part of fishery sector. Share of PES area vis-a-vis all coastal mangrove forests.	Recent reports, official statistics, fish and shrimp market prices and extrapolation of long-term trends
	Fishery related other community wage labour	Other labour services in market prices that relate to fishing sector in nearby communities	Official labour statistics on monthly wages and community interviews
Coastal zone and habitat protection	Cleaning of waste water pollution with mangroves	Assessment of mangrove waste water cleaning potential & cost avoidance approach	Numerous Pakistani and international reports with pollution amounts, mangrove mitigation potential & official waste water treatment costs for Sindh/ Balochistan
	Cyclone & tsunami mitigation with mangroves	Assessment of mangrove cyclone and tsunami damage mitigation potential & cost avoidance approach	Assessment of recent historic cyclone and tsunami events & data on previous damage costs, inflation rates, population growth, and mangrove coverage
Biodiversity conservation & promotion of ecotourism	Ecotourism	Actual current numbers of ecotourists at market price & travel cost approach	Community survey and tour operator information from Karachi
	Education and research activities in mangroves	Actual current numbers of education & research activities at market prices	Community survey and previous valuation work
Carbon and other forest products	Community wood and NTFPs	Calculation of community wood and NTFP use of mangroves at market price	Community survey/interviews
	Mangrove carbon sequestration	Assessment of mangrove carbon sequestration potential and carbon market price	Measurement of mangrove growth in PES area & carbon sequestration calculations / carbon market

			price
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	Assessment of current mangrove land erosion prevention & opportunity cost	Recent report on subject using satellite images and GIS
	Land stabilization	Overlapping with previous	Same

The identified main ecosystem services will be further elaborated in Chapter 5 into relevant environmental and livelihood supporting activities to be financed by the payments provided by the PES buyers.

Several of the analyzed economic benefits have required a rather in-depth background assessment of the situation to come up with quantification amounts for mitigation potential of mangroves to up-keep an ecosystem service. These assessments have been included as annexes to this report to support the economic valuation exercises. In the following we will describe each of the identified ecosystem services in more detail.

4.2 Protection of fish and shrimp spawning sites

Fishery and fish/shrimp spawning site value: It turned out that it was better to analyze annual fish/shrimp/crab/lobster landings combined with the estimated value of the Pilot PES area's fish/shrimp/crab/lobster spawning site. The reason for this is that all coastal mangrove forests acts like the nursery sites for some 90 percent of all fish/shrimp/crab/lobster populations in Pakistani economic zone marine waters. There is therefore a strong link between the Pilot PES area and a percentage of all fish and other seafood landings from all Pakistani marine waters. Another issue is that the local community fishermen conduct their fishing both in the Pilot PES area and in many other locations in Pakistani waters, which means that the fish landings come from a rather large area. Thirdly, fishermen from many other communities along the Pakistani coast do also catch fish in the framed PES area if they can besides fishing elsewhere. Currently, the fishing effort pressure on the fish populations is about double what it should be to maintain sustainable fish populations. In fact, many fish populations are presently at 60-90% of their sustainable population size and some highly important fish species are completely over-fished at moment, which has led to their severe decline in Pakistani waters (Khan 2017).

The quantification of the annual fish/shrimp/crab/lobster landings is based on estimates reported by Marine Fishery Department (MFD) in Sindh (Khan, 2017) which concluded that the official fishery statistics reported to FAO is much lower than actual fish landings and economic value. According to Khan (2017) the actual annual figures are assessed to be on average 2.6 times larger. The official statistics comprise only the commercial fish industry's share of the fishery sector, while the whole artisanal fish landings (both commercial and subsistence) as well as wasted by-catches have been left unreported or even unregistered. The MFD conducted a major survey in 2010 along the coast in both Sindh and Balochistan to assess the actual landings. This data with supporting reports and interviews enabled a calculation of total fish landings for 1993, 2005 and 2010 from which statistical estimates were be prepared for 2015 by partial new statistics and extrapolation of

long-term trends. The 2010 and 2015 estimates could then further be divided into industrial and artisanal commercial, artisanal subsistence landings and by-catch waste as shown in Table 4.2.

Table 4. 2: The 2010 and 2015 estimates for industrial and artisanal commercial, artisanal subsistence fish landings and by-catch waste for the whole Pakistani coastal area (in tons)

Type of fishing	Total marine landings 2010 (t)	Total 2010 Sindh marine landings (t)	Total 2010 Balochistan marine landings (t)	Total marine landings 2015 (t)	Total 2015 Sindh marine landings (t)	Total 2015 Balochistan marine landings (t)
Industrial	**373913**	***258500***	***115413***	**350000**	***241968***	***108032***
Exported	214000	*147946*	*66054*	200314	*138485*	*61829*
Domestic human consumption	97594	*67470*	*30124*	91353	*63156*	*28197*
Chicken food	62319	*43083*	*19236*	58333	*40328*	*18005*
Waste	*Na.*	*Na.*	*Na.*	*Na.*	*Na.*	*Na.*
Artisanal (comm.)	**330435**	***228442***	***101993***	**210000**	***145181***	***64819***
Domestic human consumption	*165218*	*114221*	*50996*	105000	*72590*	*32410*
Chicken food	*148696*	*102799*	*45897*	94500	*65331*	*29169*
Waste	*16522*	*11422*	*5100*	10500	*7259*	*3241*
Subsistence	**156522**	***108209***	***48313***	**140000**	***96787***	***43213***
Domestic human consumption	54783	*37873*	*16909*	49000	*33876*	*15124*
Chicken food	86087	*59515*	*26572*	77000	*53233*	*23767*
Waste	15652	*10821*	*4831*	14000	*9679*	*4321*
Total	**860870**	***595152***	***265718***	**700000**	***483936***	***216064***

Table 4. 3: The 2010 and 2015 economic value estimates for industrial and artisanal commercial, artisanal subsistence fish landings and by-catch waste for the two PES areas (in PKRs).

Type of fishing	Total 2018 economic value from 2010 (PKRs)	Total 2018 econ. value of Sindh marine coast from 2010 (PKRs)	Total 2018 econ. value of Balochistan coast from 2010 (PKRs)	Total 2018 economic value from 2015 (PKRs)	Total 2018 econ. value of Sindh marine coast from 2015 (PKRs)	Total 2018 econ. value of Balochistan coast from 2015 (PKRs)
Industrial	**12855098**	**10388883**	**2466215**	**18651103**	**15072939**	**3578164**
Exported	20050249	5945817	14104432	10674520	8626661	2047859
Domestic human consumption	3355267	2711559	643708	4868106	3934184	933922
Chicken food	2142514	1731467	411046	3108506	2512157	596350
Waste	Na.	*Na.*	*Na.*	*Na.*	*Na.*	*Na.*
Artisanal (comm.)	**11360327**	**9180879**	**2179448**	**11190668**	**9043776**	**2146892**
Domestic human consumption	6885826	5796113	1089713	5595319	4521857	1073462
Chicken food	5112154	4131400	980755	5035787	4069671	966116
Waste	Na.	Na.	Na.	*Na.*	Na.	Na.
Subsistence	**5381204**	**4348823**	**1032381**	**7460436**	**6029163**	**1431272**
Domestic human consumption	1883404	1522082	361322	2611168	2110241	500927
Chicken food	2418426	2391854	26572	4103244	3316049	787195
Waste	Na.	Na.	Na.	*Na.*	Na.	Na.
Total in PKRs	**29596629**	***23918585***	***5678044***	**37302207**	***30145879***	***7156328***
Total in USD	**266636**	**215483**	**51154**	**336056**	**271584**	**64471**

The current commercial fish and fish-based chicken food market prices were turned into 2010 and 2015 prices by applying inflation rates. By combining this market price information with official fish catch statistics by fish species (Sindh Official Statistics from 2016) and thereby paring the respective fish species quantity with its weighted share, the total economic values for 2010 and 2015 were calculated, which are shown in Table 4.4and Table 4.5below.

Table 4. 4:Estimated fish catch quantities for the two PES areas in Sindh and Balochistan Provinces (in tons) for the years 2010 and 2015.

Type of fishing	Total catch for 2 PES areas 2010	Total catch (tons) for Sindh PES area 2010	Total catch (tons) for Balochistan PES area 2010	Total catch for 2 PES areas 2015	Total catch (tons) for Sindh PES area 2015	Total catch (tons) for Balochistan PES area 2015
Industrial	**24572**	**23989**	**583**	**23001**	**22455**	**546**
Exported	17066	13730	3336	13164	12852	313
Human consump-tion Pakistan	6414	6261	152	6003	5861	143
Chicken food	4095	3998	97	3833	3742	91
Waste	Na.	*Na.*	*Na.*	Na.	*Na.*	*Na.*
Artisanal (comm.)	**21715**	**21200**	**516**	**13801**	**13473**	**328**
Human consump-tion Pakistan	13642	13384	258	6900	6736	164
Chicken food	9772	9540	232	6210	6063	147
Waste	1086	1060	26	690	674	16
Subsistence	**10286**	**10042**	**244**	**9200**	**8982**	**218**
Human consump-tion Pakistan	3600	3515	85	3220	3144	76
Chicken food	5657	5523	134	5060	4940	120
Waste	Na.	*Na.*	*Na.*	Na.	*Na.*	*Na.*
Total	**56573**	***55231***	***1342***	**46002**	***44910***	***1092***

The percent shares of the two respective PES areas from the total mangrove area along the Pakistani coast were acquired by dividing the national economic values of 2010 and 2015 with these two PES areas respective percent shares. Table 4.3 shows the combined fishery and fish spawning site values of the PES area in Sindh and the Miani Hor PES area in Balochistan.

The above fishery figures are only related to the PES Pilot area, whereas the local fishermen not only catch fish from the PES area but also from other areas of the Pakistani economic zone waters. Thus fishery landings from other areas were not included in the PES area valuation.

Table 4. 5:The 2010 and 2015 economic value estimates for industrial and artisanal commercial, artisanal subsistence fish landings and by-catch waste for the two PES areas (in PKRs)

Type of fishing	Total 2018 economic value two PES areas 2010 (PKRs)	Total 2018 econ. value of Sindh PES area from 2010 (PKRs)	Total 2018 econ. value of Miani Hor PES area 2010 (PKRs)	Total 2018 economic value two PES areas 2015 (PKRs)	Total 2018 econ. value of Sindh PES area from 2015 (PKRs)	Total 2018 econ. value of Miani Hor PES area 2015 (PKRs)
Industrial	**13687587**	**13362833**	**324754**	**19859339**	**19387916**	**471423**
Exported	9506445	7648159	1858285	11365956	11096571	270248
Domestic human consumption	3572855	3487627	84670	5183062	5060458	123468
Chicken food	2281079	2227046	54033	3309458	3230888	78570
Waste	Na.	*Na.*	*Na.*	Na.	*Na.*	*Na.*
Artisanal (comm.)	**12096124**	**11809248**	**287433**	**11915949**	**11632750**	**283199**
Domestic human consumption	7599140	7455423	143716	5957543	5815943	141600
Chicken food	5443395	5314162	129233	5361789	5234867	126922
Waste						
Subsistence	**5729713**	**5593796**	**135918**	**7943390**	**7755167**	**188224**
Domestic human consumption	2005344	1957996	47348	2780187	2714567	65619
Chicken food	3151175	3076532	74643	4368865	4265255	103609
Waste						
Total PKRs in 2018 figures	**31513424**	***30765876***	***747548***	**39718679**	***38775833***	***942846***
Total USD in 2018 figures	**283905**	**277170**	**6735**	**357826**	**349332**	**8494**

Fishery related other community wage labor in the PES area vicinity

Based on household surveys of six communities in vicinity of the PES Pilot area who are stakeholders of this PES area it could be determined that how many households in the communities were laborers. IUCN (2013) and IUCN (2005) reports state that about 75% of all households have fishing incomes, which means that there are additional 3734 households that have part-time labor work related to the fishing

activities in their communities. From CPDI (2017) report it could be checked on relevant wage level for unskilled rural fishing sector laborers is currently around PKR 10000 per month. However, these community laborers hardly acquire such wages. IoBM (2016) state that lower bound income levels in these PQA areas is around PKR 7777 per month (i.e. wage laborers). The total combined annual wage income of these fishing industry related laborers in the five communities became thereby PKRs 4,569,516and USD 41,167, when scaled to the size of the PES area (i.e. these fishing wage laborers work that has been caught from much larger area than the PES area).

For Miani Hor PES area there are only 29 households that perform wage labor out of which 15% work in the fishery sector. The total monetized value for the fishing related wage labor is therefore PKRs 620,605 or USD 5,591.

4.3 Coastal zone and habitat protection

Cleaning of waste water pollution by mangroves

Mangrove forests in the PES Pilot areas play important roles in cleaning waste water pollution. The mangrove forests act like kidneys and clean efficiently all kinds of organic, nitrogen, phosphorus or heavy metal effluents. Even salinity can be reduced with mangroves. We have determined the mangrove role in waste water cleaning based on the in-depth assessment that is included in Annex 4of this report. The assessment covers all kinds of municipal and industrial waste water effluents. The mangroves forests in the Sindh PES area has an overall cleaning capacity of 50% or over. According to an estimate by the Karachi Water and Sewerage Board, a new waste water treatment plant for 100 million gallons daily (MGD) of waste water cleaning would cost around PKRs 5 Billion. The same report further stated that 456 MGD is daily discharged directly into the sea outside Karachi of which 363 MGD stems from municipal sources, 3 MGD from hospital and 94 MGD from industrial sites (Planning Commission, 2017).

Mangroves in the Sindh PES area have in fact for decades been acting like a large back-up waste water cleaning facility for Karachi city and its surroundings, which has not so far been recognized. One can only imagine how polluted the PQA coastal waters would have been without the mangroves, not to think about how unhealthy fish and seafood would have been to eat. Seafood with too high toxic or heavy metal values are a major human health risk, which we have omitted among the PES services not to make this PES scheme too complicated. Additionally, it is possible that fish and other seafood populations would have been heavily affected by the waste water effluents from Karachi area and thus adversely affected the entire fish population of Pakistan’s economic marine zone. Table 4.6 presents the monetized valuation of mangroves’ ability to clean waste water in Sindh PES area.

Table 4. 6: Monetized valuation of mangroves' ability to clean waste water in Sindh PES area

Type of discharge	Amount of daily waste water effluent in MGD	Cost of treatment in PKRs with constructed treatment plant	Value of mangrove mitigation of waste water discharges (50%) in PKRs
Karachi municipal	363	18,150,000,000	9,075,000,000
Hospitals	3	150,000,000	75,000,000
Industrial	94	4,700,000,000	2,350,000,000
TOTAL in PKRs			**11,500,000,000**
TOTAL in USD			**103,603,604**

(Source: Data taken from Planning Commission, 2017)

In the Miani Hor PES area in Balochistan there are no industries or towns in the surroundings which discharge their waste water into the Miani Hor PES area. Therefore, this cleaning of waste water treatment by mangroves is not applicable to the Balochistan PES area.

Cyclone and tsunami mitigation with mangroves

The Sindh coastline is a high risk area for cyclones in Pakistan, with a 20% annual risk of a landfall from a major cyclone. Annex 5gives the damage impacts of cyclones since 1940 and tsunamis over an even longer time span. This is combined with some observations on how mangroves appear to lessen the impact of the destructive power of cyclones, which is further supported by international scientific articles. Table 4.7 presents a calculation of economic benefit accrued from the mitigation of cyclones with extensive mangrove belts along the coastline.

The data for the calculations was derived from official insurance statistics over cost of damages from a cyclone that happened in 1999 in Badin and Thatta Districts. The coastal mangroves protect the whole inland from cyclones i.e. the two districts. This 1999 cyclone is the only cyclone for which a full overview of damages has been published. The 1999 economic damage information was then recalculated into 2018 economic figures and we also conducted a population growth assessment that further increased the recalculated damage costs as given in 2018 figures (i.e. a population growth multiplier of 1.238). The next step was to estimate the protection impact, which we found based on the Annex 5 conclusions to be 90% of the full 1999 economic damage.

Finally, we calculated the stretch of coastal area of the two districts (i.e. 210 km) for which the full damage occurred and compared this with the PES area coastal protection that covers a coastal stretch of only 30 km. The monetized value of cyclone and tsunami protection is thus 30km/210km times the full economic damage

costs of the 1999 cyclone in rectified 2018 figures. The acquired monetized value is then the full monetized protection value, but the annual protection value is 20% of this, that constitutes the end result of this valuation exercise.

Table 4. 7: Calculation of economic benefit for mitigation of cyclones with extensive mangrove belts along the coastline (In PKRs.)

District name	Popula-tion 1999	Popula-tion 2018	Damage cost 1999*	Inflation multiplier 1999-2018	Damage cost 2018	Final cost PKRs 2 districts	PES area length km	2 Dis-trict length km**	PES area cost PKRs
Badin	1,136,044	1,804,516		3.8					
Thatta	1,113,194	979,817	1,130,000,000		4,294,000,000				
TOTAL PKRs						5,315,545,043			
Mangrove impact 90% reduction = savings benefit						4,783,990,539	30	210	683,427,212
Incorporation of annual risk 20% of major cyclone landfall in Sindh (total in PKRs)									**136,685,444**
Annual total in USD									**1,231,400**

* Estimates taken from https://en.wikipedia.org/wiki/1999_Pakistan_cyclone

** Calculated from Sindh Province Map

In the Miani Hor PES area the actual cover of mangroves is insufficient to provide more than a modest protection against cyclones and tsunamis. It was, therefore, decided not to monetize this environmental benefit.

4.4 Biodiversity conservation & promotion of ecotourism

Valuation of current ecotourism

The socio-economic survey conducted by PFI in March 2018 for this PES project document preparation indicated that there are substantial numbers of outsider ecotourists visiting this PES area and they are paying customers of the local communities i.e. they pay the fishermen for using their own boats. Table 4.8 presents the number of annual ecotourists visiting the PES area.

Table 4. 8: Background information on current ecotourists in the PES area (PFI survey 2018)

Community name	HH nos	Fishing HH %	No. of fishHH	Ecotourists Qnty/mnth (during tot. 6 mnths/yr)	Price/unit PKRs	Tot income /year PKRs	Total cost /year USD
Rehri Got	7020	63	4413	50	50000	15,000,000	135,135
Lat Basti	900	55	495	30-100	50000	19,500,000	175,676
Chashma Goth	780	73	568	30-100	50000	19,500,000	175,676
Jumma Goth	9062	59	5310	30-100	50000	19,500,000	175,676
Ali Akbar Shah Goth	1835	64	1169	0	0	Na	Na
TOTAL	**19597**	**61**	**11954**	**1470 (as mean)**	**50000**	**73,500,000**	**662,163**

The international ecotourists coming to the PES Pilot area to experience fishing activities, watch birds and other sea life or enjoy the scenery in general during a boat trip in the archipelago have not decided on this ecotourism trip in advance in their home countries, which means that only local transportation costs can be added to their ecotourism expenditure besides the actual payments to the local fishermen

taking them out in the PES Pilot area. The same applies to the domestic ecotourists, who also start out on this trip from their home in Karachi or from a hotel in town.

To economically valuate the current ecotourism potential we checked the market prices given by ecotourism operators in Karachi and found that they offer their packages from PKRs 50,000 to PKRs 100,000. It seems that the higher price is for a package that contains other tourist attractions such as various watersports or tailor-made fishing for small groups only. These tour operators have well developed business models and their package seems to use the local fishermen communities to provide the actual ecotourism trips. The fishermen get perhaps some PKRs 20,000, but their service value should be worth around PKRs 30,000 inside the overall ecotourism package cost per tourist. The total monetized value for annual ecotourism operations in the PES area as calculated by the ecotourism agency price is then PKRs 73,500,000 or USD 110,360.

For the Miani Hor PES area in Balochistan there are also substantial ecotourism activities. All three communities stated in the community survey conducted by PFI that there would be 50-100 tourists every week during summer months **making a total of about 5400 tourists on annual basis**. The tourists are not only staying in the Miani Hor bay itself, but also travel out into the open sea and visit some islands where the tourists enjoy water sports and other activities. We have, therefore, valuated the ecotourism part of the trip separately from other activities. The total ecotourism value is around PKRs 270,000,000 or USD 2,432,432. Visits for education and research activities have been left out being negligible.

Education and research activities in mangroves:

There are also two other groups of people who visit the mangroves forests in the PES area quite frequently and these groups are school classes from Karachi and other nearby towns as well as researchers and professionals who use mangroves as suitable research subjects in their work. IUCN assessed the potential of these groups for the Keti Bundar, Kharo Chhan and Shah Bunder areas and came up with an economic value of PKRs 65/month for researchers in 2013 (or 83/month in 2018 economic value). The PES area is visited at least ten times the area reported by IUCN as it is closer to Karachi Ccity and has greater potential for education and research. The economic value of this activity becomes PKRs 830 per month and thus for the whole 2018 it would be PKRs 9,960. If we consider school classes visiting the PES area at similar costs we would get total economic value of PKRs. 20,000 per year. It is important that outsiders – particularly young people visit the mangroves and learn about their usefulness in biodiversity conservation.

4.5 Carbon and other forest products

Value of community wood and NTFPs

Table 4.9presents the total value of all mangrove wood and the NTFPs collected from the PES area. The information has been collected by PFI through a socio-economic survey in the area. The economic values for mangrove fuelwood and fodder have been monetized through their respective shadow prices in the local market (i.e. commercial fuelwood and commercial stall feeding fodder).

Table 4. 9: Total annual monetized value of all mangrove wood and the NTFPs collected from the Sindh PES area

Commu-nity name	HH nos	Man-grove % of wood	Non-mgr% of wood	Tree prod.	Quantity /Household /month	Man-grove quantity in Kg	Price/ Unit PKRs	Cost/ year per HH	Total cost /year PKRs	Total cost /year USD
Rehri Got	7020	60	40	Timber	0	0	Na	Na	Na	Na
				Fuelwood	300	180	275	14850	104247000	939162
				Fodder	as stallfed*				58686925	528711
				Tatching	1200/hut	mudflats	45/40 kg	675	4738500	42689
Lat Basti	900	60	40	Timber	0	0	0	0	Na	Na
				Fuelwood	200	120	125	4500	4050000	36486
				Fodder	stallfed**		45/HL		7515530	67707
				Tatching	1200kg/hut	mudflats	45/40 kg	675	607500	5473
Chashma Goth	780	100	0	Timber	0	0	0	0	Na	Na
				Fuelwood	200kg/mnth	200	25/40kg	16500	12870000	115946
				Fodder	stallfed***				315400	2841
				Tatching	1200kg/hut	mudflats	45/40 kg	675	526500	4743
Jumma Goth	9062	60	40	Timber	0	0	0	0	Na	Na
				Fuelwood	200kg/mnth	120	25/40kg	9900	89713800	808232
				Fodder	stallfed****				315400	2841
				Tatching	1200kg/hut	mudflats	45/40 kg	675	6116850	55107
Ali Akbar Shah Goth	1835	60		Timber	0	0	0	0	Na	Na
				Fuelwood	200kg/m	120	25/40kg	9900	18166500	163662
				Fodder	stallfed*****				784750	7070
				Tatching	1200kg/hut	mudflats	45/40 kg	675	1238625	11159
Total Timber value									Na.	Na.
Total Fuelwood value 1)									**229,047,300**	**2,063,489**
Total Mangrove fodder value commercial substitute									67,618,005	609,171
Total Tatching value 2)									13,227,975	119,171
Total in PKRs									**309,893,280**	
Total in USD										**2,791,831**

* calculated as stall-fed of commercial feed for 500 buffaloes, 150 cows, 1500 goats, 50 sheep and 25 donkeys;
** calculated as stall-fed of commercial feed for 50 buffaloes, 20 cows, and 70 goats;
*** calculated as stall-fed of commercial feed for 50 goats, 50 camels and 50 cows;
**** calculated as stall-fed of commercial feed for 50 goats, 50 camels and 50 cows;
***** calculated as stall-fed of commercial feed for 100 cows and 250 goats.

1) Total amount of annual mangrove fuelwood used in above mentioned communities is 2,835 tons
2) Total amount of PES area thatching materials used (1/2 of all huts change annually) is 10,657 tons

The households have their own ways of measuring quantities of mangrove wood and NTFPs, which sometimes makes it easier to just use their shadow price commercial substitute. This shadow price would be the alternative in use if the mangroves did not exist or where not accessible.

The wood and non-wood products harvested from the Miani Hor PES area in Balochistan was analyzed in the same manner through community group and household surveys, which are presented in Table 4.10.

Table 4. 10: The wood and non-wood products harvested from the Miani Hor PES area in Balochistan.

Community Name	Total HHs	Fishing HHS	Fishing HHs in %	Wood or NTFP use	Monetized value in PKRs	Monetized value in USD
Damp	498	353	0.71	Fuelwood*	697,200	6,281
				Fodder**	0	0
				Tatching***	336,150	3,028
Bhira	360	156	0.43	Fuelwood*	504,000	4,541
				Fodder**	0	0
				Tatching***	243,000	2,189
Washi	630	606	0.96	Fuelwood*	1,234,800	11,124
Baloch				Fodder**	538,825	4,854
				Tatching***	425,250	3,831
TOTAL	**1488**	**1115**	**0.75**	**All products**	**3,979,225**	**35,849**

*total quantity of annual fuelwood for the three communities was 283 tons;

**as stall-fed with commercial fodder for totally 1260 goats and 350 camels;

*** total amount of annual thatching material (1/2 of all community huts) was 893 tons.

The REDD+ monetized value of carbon sequestration

The PFI team analyzed together with the Sindh Forest Department data collected from 76 sample plots in the PES area mangrove forests and the results for 2018 were the following:

- Mean Aboveground Carbon Stock: 24.40 t/ha
- Carbon Stock in Pneumatophores and litter: 2.95 t/ha
- Mean Belowground Carbon Stock: 10.22 t/ha
- Soil Organic Carbon: 233.73 t/ha
- Carbon sequestration rate in Biomass: 9.10 tCO_2/ha/year
- Carbon sequestration rate in soil: 7.68 tCO_2/ha/year
- Total Carbon sequestration in Mangroves: 16.78 tCO_2/ha/year

As seen from the above estimates, the average total sequestration rate for mangroves is 16.78 t CO_2/ha/year for biomass and soil. These carbon sequestration figures can be reached simultaneously with the stakeholder communities' annual harvesting of fuelwood and NTFPs from these same forests.

According to Donato et al. 2011 the belowground carbon resources (both roots and soil organic carbon) have been found to be 71-98% of the total carbon stock in mangroves in the Indo-Pacific region. We can conservatively estimate it to be 80% of the total carbon pool in the system. At a carbon price of USD 5 per ton of CO_2 (current internationally common carbon price level) the income generated would be USD 83.9/ha/year. The total annual carbon increment economic value for Sindh PES area would thus be PKRs 271,200,961 or USD 2,443,252.

In 2016 the Miani Hor PES area had 283 ha of dense, 738 ha of medium and 2997 ha of sparsely growing mangroves. In 2018 there should therefore be approximately 1000 ha of dense mangroves, about 2000 ha of medium dense stands and the remaining still be sparse mangroves (including 507 ha of new mangrove plantations). One could thereby use the same carbon calculation also in the Miani Hor case (in fact, this can be seen as conservative), which means again a mean annual carbon increment of 16.78 tC/ha and thus the average carbon increment economic value would be USD 83.9/ha. The total for the whole PES area would then be USD 379,648 or PKRs 42,140,873.

4.6 Shoreline stabilization & prevention of sea intrusion

Shoreline stabilization and prevention of sea intrusion

To be able to assess the shoreline stabilization we will use the results of Hashmi and Ahmad (2018) who conducted a satellite and GIS-based modeling research study to assess annual erosion rate along Sindh south eastern coastline in Keti Bunder and Kharo Chhan areas. They used 7 km long transects that were applied from outer reaches of coastline almost perpendicular towards land. Totally they applied 189 transects along this coast as indicated in Table 4.11.

Table 4. 11: Land erosion by 7 km transects along Keti Bundar ans Kharo Chann coast line

Name of Talukas	Transect (7km long)			Maximum	Minimum	Mean	Comments
	Start No	End No	Total	Erosion (m/year)			Relat. erosion
Keti Bundar	1	89	89	89.99	-3.78	16.54	Low
Kharo Chhan	90	189	100	188.38	14.9	63.79	High

Source: Hashmi and Ahmad (2018)

The data given in the above table has been used for quantifying how much land erosion is occurring annually in the PES area. For this purpose we selected the Keti Bunder results which are close to the reality in the Sindh PES area. Thereafter, we set the transects as one hundred metres wide, which means that our transects will have 70 ha of PES area in a 7 km long line. To cover the whole Sindh PES area we estimated its front width against the open sea as 30 km and its depth towards land varying between 12km to 33 km, which means that the average is about 23 km. Consequently, we placed 300 transects next to each other (i.e. 30 km divided by 100 m wide transects). As each transect should be 23 km on average it means in practice that the Keti Bundar results should be multiplied by 3.29 (i.e. 23 km divided by 7 km) to get the transect length rectified. In Figure 4.1 we have coarsely outlined how the above described transects would look like as laid out over the Sindh PES area. In

Figure 4.1 we have just shown 12 red transects, as it was not possible to show all 300 transects on the map.

The next step was to get land value for the total PES area, the mangroves area only and the value for the combined mangrove and mudflat areas. These three monetized values were then used to get the monetized land erosion for each type of PES area (i.e. mangroves, mudflats and water) by seeing the value addition when shifting from the total PES area value per hectare to the value for mangroves and mudflats combined.

We got these monetized values by accumulating all the above calculated values for the Sindh PES area together and divide the monetized values by different number of hectares. The difference per hectare is the missing value of the lost land due to erosion. Table 4.12 presents the various calculations needed to acquire the final monetized value for land erosion in the PES area.

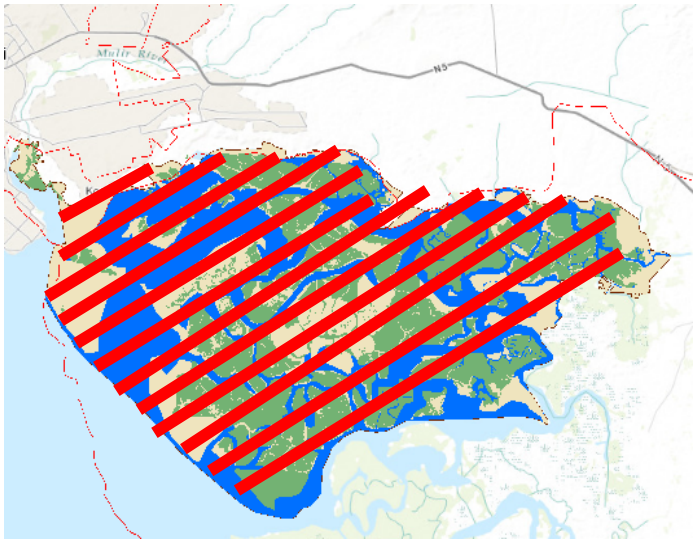


Figure 4. 1: *PES area with perpendicular transects 100 m wide to calculate the land erosion impact*

The Keti Bunder results of Hashmi and Ahmad (2018) given in Table 4.11 above can be used so that the minimum erosion value per transect represents the erosion situation with dense mangroves, the mean Keti Bunder erosion result represents medium and sparsely growing mangroves while the maximum Keti Bunder results represents erosion impact on mudflats devoid of vegetation. In this manner, we got the result that there will be 13.3 ha more land accumulation every year with dense mangroves, 58.4 ha of eroded away sparsely growing mangroves and finally 251.9 ha of lost mudflats each year. We got the economic land values of mangrove land, sparse mangrove land and mudflats by dividing the Total Economic Value of the PES area (with this land erosion monetized value excluded) by a) the mangrove area (29,121 ha), b) the combined mangrove and mudflat area (40,673 ha) and c) the total PES area in hectares (62,994 ha).

Table 4. 12: Sindh PES area monetized economic land values (without the shoreline stabilization values included)

SINDH PES area economic land types	Land area value in 2018 in PKR per hectares (Ha) excluding shoreline stabilization values	Land area value in 2018 in USD per hectares in (Ha) excluding shoreline stabilization values
Economic value of land accumulation around dense mangroves	423,576	3,816
Economic value of lost sparsely growing mangrove land due to erosion	303,252	2,732
Economic value of lost mudflats due to erosion	195,693	1,763
Monetized land transition values for land erosion sites		
Monetized value of land that accumulate around dense mangroves (13.3 ha addition)	4,033,252	36,336
Monetized value of lost sparsely growing mangrove land (58.4 ha)	-17,709,917	-159,549
Monetized value of lost mudflat lands (251.9 ha)	-49,295,067	-444,100
Total monetized value of annually lost land due to erosion in a mangrove scenario	**-62,971,732**	**-567,313**
Total monetized value of annually lost land due to erosion in a without mangrove scenario	**-173,518,752**	**-1,563,232**
Total net economic value of mangroves in protecting the coastal area from erosion	**110.55 million**	**995,919**

The final result of Table 4.12 gives the value of protecting coastal area with mangroves against erosion in the Sindh PES area by subtracting the without mangrove scenario from the mangrove scenario and thereby turning the overall monetized value of mangroves protecting the coastline into a positive ecosystem service. At the same time this ecosystem service value overlaps with a shoreline stabilization value.

For the Miani Hor PES area we calculated the land erosion and the shoreline stabilization monetized value in a similar fashion using the Keti Bundar mean land erosion value as the erosion factor with mangroves in the calculations (this was based on how the mangrove forests are located in the Miani Hor bay). In this manner we achieved the result that totally about 20.5 ha of mudflats would be eroded away annually. In a without scenario it can be expected that the maximum erosion result from the Keti Bundar case would happen (i.e. again based on how the mangroves are located) and therefore about 111.6 ha would erode away annually. When comparing the with and without scenarios in the same manner as for the Sindh PES area one can conclude that the monetized value of mangroves protecting the shoreline against land erosion is worth USD 6,756 or PKRs 749,916.

4.7 Conclusion for monetized valuation in the two PES areas

Now we have all identified PES benefits analyzed and monetized as far as these are relevant for the respective two PES areas. Table 4.13 presents the needed quantification of respective monetized ecosystem services, which is then building up to the summarized monetized values shown in Table 4.14 for the Sindh PES area monetized PES benefits.

Table 4. 13: Summarized quantification of the identified ecosystem services for the Sindh PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Overall quantification of Sindh PES area ecosystem services
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	Total annual fish/shrimp and crab catch assessed to be 44910 tons in 2015, which was monetized as described in sub-chapter 4.2.
	Fishery related other community wage labour	There are besides fishermen also some 14% or 3734 households with part-time labor work related to the fishing in their communities
Coastal zone and habitat protection	Cleaning of waste water pollution with mangroves	In Karachi area is daily 456 million gallons of waste water effluent discharged
	Cyclone & tsunami mitigation with mangroves	The damage costs of a cyclone from 1999 was recalculated into 2018 costs (i.e. 4,294,000,000) and analyzed in with and without mangroves scenarios.
Biodiversity conservation & promotion of ecotourism	Ecotourism	Annually some 1470 ecotourists visit the mangroves in the PES area.
	Education and research activities in mangroves	Travel expenses of researchers and students visiting the mangroves constitute the basis of valuation
Carbon and other forest products	Community wood and NTFPs	2835 tons of fuelwood, 10,657 tons of thatching grass, and stall-feeding commercial fodder for 550 buffaloes, 370 cows, 100 camels, 50 sheep, 1920 goats and 25 donkeys (as substitute for mangrove biomass fodder).
	Mangrove carbon sequestration	488,650 tCO_2
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	Land erosion with mangroves is annually 297 ha and without mangroves it would be 881.65 ha
	Land stabilization	Overlapping with the previous and thus not quantified nor monetized

Table 4. 14: The identified ecosystem services with the respective monetized values for Sindh PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Monetized value in PKRs	Monetized value in USD
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	38.78 million	349,332
	Fishery related other community wage labour	4.57 million	41,167
Coastal zone and habitat protection	Cleaning of waste water pollution with mangroves	11.5 billion	103.6 million
	Cyclone & tsunami mitigation with mangroves	136.69 million	1.23 million
Biodiversity conservation & promotion of ecotourism	Ecotourism	73.5 million	662,162
	Education and research activities in mangroves	20000	180
Carbon and other forest products	Community wood and NTFPs	309.9 million	2.79 million
	Mangrove carbon sequestration	271.2 million	2.44 million
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	110.55 million	995,919
	Land stabilization	overlapping with land erosion prevention	overlapping with land erosion prevention
Total PES area monetized value		**12.4 billion**	**112.1 million**
Total value per hectare of Sindh PES area		**197,544**	**1780**
Total value of mangrove forest per hectare		**427,323**	**3850**

Table 4.14 indicates that the most important monetized PES services are the mangroves ability to clean waste water effluents followed by the communities use of mangrove wood and NTFPs from the PES area. Shoreline stabilization and carbon sequestration are third and fourth important services of the mangroves. The overall value of this mangrove area is quite high - over 12.4 Billion PKRs or almost USD 112.1 million. On the basis of per hectare this monetized value is USD 1780 for whole PES area or USD 3850 for actual mangrove forests. The fact that this PES area is located immediately next to Karachi heightens its importance tremendously.

In similar manner we present for the Balochistan PES area in Table 4.15 the needed quantification of respective monetized ecosystem services, which is then building up to the summarized monetized values shown in Table 4.16.

Table 4. 15: Summarized quantification of the identified main ecosystem services for the Balochistan PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Overall quantification of Sindh PES area ecosystem services
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	Total annual fish/shrimp and crab catch assessed to be 1092 tons in 2015, which was monetized as described in sub-chapter 4.2.
	Fishery related other community wage labor	There are besides fishermen also some 29 households with part-time labor work related to the fishing in their communities
Coastal zone and habitat protection	Cleaning of waste water pollution with mangroves	No major polluters in Miani Hor area and thus this ecosystem service is not utilized.
	Cyclone & tsunami mitigation with mangroves	No major property around Miani Hor and mangroves are located so that this ecosystem service is negligible.
Biodiversity conservation & promotion of ecotourism	Ecotourism	Annually some 5400 ecotourists visit the mangroves in the PES area.
	Education and research activities in mangroves	Travel expenses of researchers and students visiting the mangroves constitute the basis of valuation – in this case negligible.
Carbon and other forest products	Community wood and NTFPs	Totally annually 283 tons of fuelwood, 893 tons of thatching grass, and stall-feeding commercial fodder for 350 camels and 1260 goats (as substitute for mangrove biomass fodder).
	Mangrove carbon sequestration	75,930 tCO_2
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	Land erosion with mangroves is annually 20.5 ha and without mangroves it would be 111.6 ha
	Land stabilization	Overlapping with the previous and thus not quantified nor monetized

Table 4. 16: The identified ecosystem services with the respective monetized values for Balochistan PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Monetized value in PKRs	Monetized value in USD
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	7.16 million	64,471
	Fishery related other community wage labor	620,605	5,591
Coastal zone and habitat protection	Cleaning of waste water pollution with mangroves	negligible	negligible
	Cyclone & tsunami mitigation with mangroves	negligible	negligible
Biodiversity conservation & promotion of ecotourism	Ecotourism	270.0 million	2,432,432
	Education and research activities in mangroves	negligible	negligible
Carbon and other forest products	Community wood and NTFPs	3,98 million	35,849
	Mangrove carbon sequestration	42.14 million	379,648
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	749,916	6,756
	Land stabilization	overlapping with previous	overlapping with previous
Total PES area monetized value		**324.65 million**	**2,917,991**
Total value per hectare of Miani Hor PES area		**9,693**	**87**
Total value of mangroveforest per hectare		**71,745**	**646**

Table 4.16 indicatesthat the Miani Hor PES area has got substantially less value as compared to Sindh PES Area. The total economic value of the main ecosystem services of the area is PKRs. 324.65 million or USD 2.92 million which is due to its low extent and absence of high value ecosystem services like cleaning of waste waterand coastal protection. It has only got poor fishing communities in its vicinity who catch fish from the area. The per hectare figures for the actual mangrove area is USD 646, while the total PES area monetized value is only USD 87/ha.

The above mentioned monetized PES area services have been analyzed and monetized on annual basis, which means that the total amount of PES services and payments over a time period of 20 or more years means 20 or more times the above given figures. Thus, there is a scope for numerous buyers in both PES areas.

CHAPTER-5

5 BUYERS AND SELLERS OF THE IDENTIFIED ECOSYSTEM SERVICES

5.1 Buyers and sellers identified for the Sindh PES area

Ten PES services have been identified and valuated for the potential PES scheme located in Sindh province. For these services we have identifiedthree main seller category parties, which are the following ones:

- Port Qasim Authority;
- Sindh Forest Department; and
- Local communities in vicinity of the PES area

Extensive consultations were held with the stakeholders to get their opinion about selling of the ecosystem services to the identified buyers. There was a general consensus among the stakeholders to sell these services under the proposed PES arrangements.

Table 5.2 presents how the realization of the identified ecosystem services can be made, which is then further elaborated in Chapter 7 particularly related to carbon trading.

The local fishermen communities are dependent on the PES area mangrove forests, mudflats and water bodies for their livelihood. These communities have also been heavily affected by waste water and water pollution from Karachi city, industries and harbor, and these communities will not be able to improve their livelihoods or switch to new livelihoods without the PES scheme payments. Additionally, such shift in livelihoods among the fishermen communities is the only way in which fish, shrimp and crab populations can be restored to sustainable levels once more. Without this there are many fish, shrimp or crab species that will become extinct in the near future.

The Port Qasim Authority is the owner of the land in the PES area, while the SFD is charged with the management of the mangrove forests and is entitled to revenue from the PES area. On the other hand, the PQA is also a polluter of the area, which means that it is almost obliged to support the PES scheme arrangements in other way. The PQA is also a substantial financial benefactor of the PES scheme, therefore, it will actively support the establishment of PES scheme.

The question about whether the PES scheme should be performance-based or input-based will be dealt with in chapter 6 where payments for different ecosystem service have been elaborated.

The Sindh Forest Department (SFD) has the capacity to act as the Coordinator of a PES fund into which all PES payments will be collected into as a financing basket from which funding will be distributed in defined percentages to the sellers in accordance with an agreement. The local offices of IUCN and WWF in Pakistan will act as outside facilitators to ensure that the funds are used efficiently and transparently.

The SFD will have to establish a dedicated managing/coordinating unit for the PES scheme arrangements in which local communities, IUCN, WWF and other stakeholders should have representation. The expenditures for these PES

arrangements will be met from the PES payments. The IUCN and WWF experts should have a technical and facilitation role in assessment of changes in the ecosystem services over time. Other research and academic institutions may also participate as technical facilitators in the PES Scheme. International NGOs may join later after the PES scheme has been established in case there can be a role and some financing commitments that these can carry with them into the PES scheme. This will improve trust between buyers and sellers and ensure acceptability of the PES results.

For the PES services we have identified 17 different local, provincial and national potential buyers of the PES services as well as one international buyer (an international flight company). The respective sellers and buyers for the Sindh PES area are presented in Table 5.1.

Table 5. 1: The potential buyers and sellers of PES services for the Sindh PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Potential Seller of PES	Potential Buyer of PES
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Karachi Sewage Company, All industrial companies of industrial sites and (Hospitals).
	Fishery related other community wage labour	Fishing communities	Fishing communities as in-kind (see table 5.2 below)
Coastal zone and habitat protection	Cleaning of waste water pollution with mangroves	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Karachi Sewage Company, All industrial companies of industrial sites and (Hospitals)
	Cyclone & tsunami mitigation with mangroves	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Karachi City Government; PQA Harbour, and Provincial Government
Biodiversity conservation & promotion of ecotourism	Ecotourism	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Ecotourists and agencies, Karachi City Government, Provincial & National Government
	Education and research activities in mangroves	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Education and research institutions in Karachi (as small entry fee) before starting up project or do excursion
REDD+ related	Community wood and NTFPs	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Fishing communities as in-kind (see table 5.2 below)
	Mangrove carbon sequestration	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Karachi Coal Power Company, Thar Coal Power Company, Karachi hotel industry, Sindh Province cement industry, Pakistani and international flight companies
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Karachi City Government; PQA Harbour, and Provincial Government
	Land stabilization	Same as above	same as above

The above large list of 17 potential buyers is sufficient to generate funding for the proposed PES Scheme. Some of the above mentioned buyers comprise numerous business entities (i.e. all industries and hotels in Karachi region as well as cement factories in Sindh province) who have large share in the environmental pollution in Karachi and thus it should be an opportunity for them offset their carbon foot-print and act under meet their social and environmental obligations.

Once the project design document is approved, the next step will be to hold negotiation with these buyers and show them the monetized values of the ecosystem services they are availing in the PES area. Thus, these buyers, who are actually polluters of the PES area, will have a chance to see and understand their own role in the PES scheme and environmental situation along Karachi coastline. It will be better to have both carrot and stick available when one approaches the potential buyers, so that if they don't agree with the proposed PES Scheme, there is backing of legislation to make them bound to contribute in the proposed PES Scheme.

We foresee that it is mainly the carbon trading market that is likely to become partner on voluntary basis, while the various payments for waste water pollution, shoreline protection, fishery sector support and others are likely to require a relevant specific law prepared and enforced to get a general acceptance of PES payments among the PES buyers.

Table 5. 2: The potential PES services provided by the sellers for the Sindh PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Potential Seller of PES	Potential PES derived activities to sell
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Planting of more mangroves, sustainable forest management practices among communities, compensation to fishing communities
	Fishery related other community wage labour	Fishing communities	combined with above: Fishing communities as in-kind by turning into other livelihoods (possible with compensation)
Coastal zone and habitat protection	Cleaning of waste water pollution with mangroves	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Planting of more mangroves, sustainable forest management practices among communities, compensation to PES sellers. Support for new livelihoods and infrastructure.
	Cyclone & tsunami mitigation with mangroves	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder	

		communities	
Biodiversity conservation & promotion of ecotourism	Ecotourism	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Support for building up ecotourism structures and capacity of local communities to better serve ecotourists and other visitors.
	Education and research activities in mangroves	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	
REDD+ related	Community wood and NTFPs	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Fishing communities as in-kind by being trained in sustainable forest management & other energy use
	Mangrove carbon sequestration	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Planting of more mangroves, sustainable forest management practices among communities, compensation to fishing communities. Also support to SF&WD for its capacity building
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	PQ Authority, Sindh Forest & Wildlife Department, and stakeholder communities	Planting of more mangroves, sustainable forest management practices among communities. Construction of some roads
	Land stabilization	Same as above	same as above

Regarding division of funding between the respective PES benefits it is not at this point clear exactly how this should be performed. This issue will be determined in various negotiations between buyers and sellers under the guidance of the facilitators. Some PES services can accumulate large amounts of payments, while other equally important PES services may have difficulty to catch sufficient funding, Therefore, this should be the task of the Sellers funding basket to figure out as result of the negotiation rounds that will have to take place. At least some important buyers should also be involved in these talks and negotiations to have high transparency in this process and reduce the risks of misallocation of money.

It is always best if both negotiations and agreements would be based on voluntary commitments, but we foresee that most polluting industries and other buyers will not give in to pay annually any PES payments despite the fact that they are very serious polluters of the Karachi city coastal waters. Without mangroves of the PES area the local costal water pollution would have completely been unbearable. Now the

mangroves have for years been carrying a huge waste water cleaning role in the PES area and its surroundings. To be on the safe side with getting all polluters on-board paying PES fees it is best to make the payments mandatory by preparing a special law for the PES area and to enforce it properly for the PES scheme implementation.

Regarding carbon trading, there are multiple opportunities to generate a variety of revenues streams that can provide payments for ecosystem services depending upon how mature the market for a particular ecosystem service is, and the regulatory environment at the location of the project intervention.

Forest carbon payments have had marketable value since the agreement of the Marrakesh Accords under the Kyoto Protocol in 2001. The Cancun Agreements agreed under the UNFCCC in 2010 outlined a three-phased approach to REDD+ for developing countries. The three phases essentiallyprovide boundary conditions for the appropriate types of financing to seek which are outlined in Figure 5.1 below.

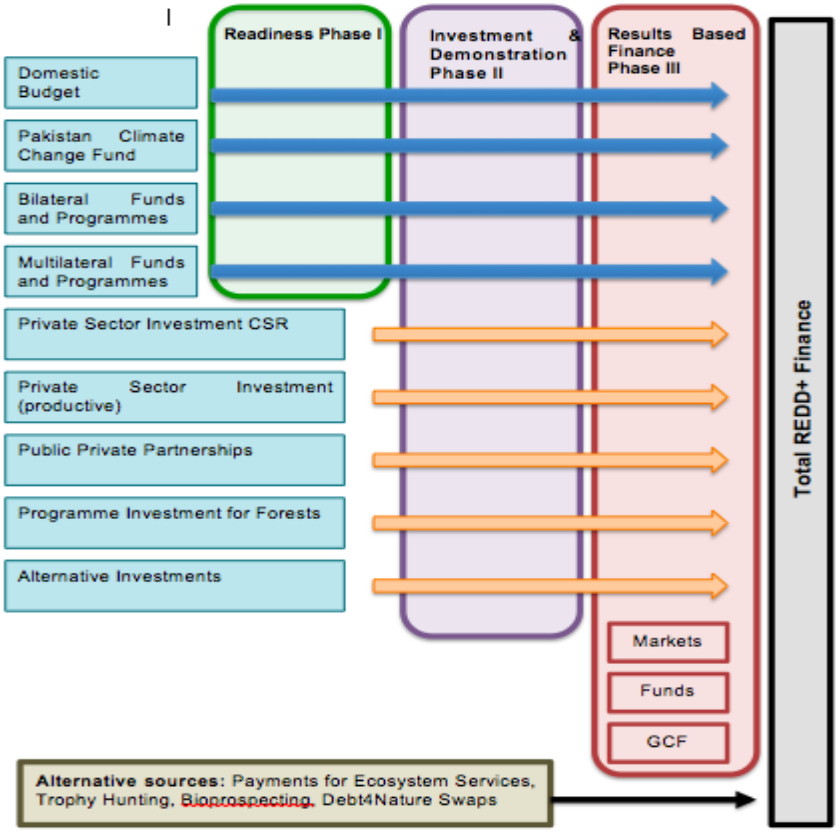


Figure 5. 1: Types of Financing Mechanisms for REDD+ and PES

One of the critical challenges Pakistan faces in implementing this REDD+ PES Pilot project is access to sustainable, predictable and adequate finance for its forest and community activities. Multiple reports in recent years have noted the challenge. Of particular relevance, a recent PROFOR publication-*Private Financing for Sustainable Forest Management and Forest Products in Developing Countries – Trends and Drivers*, noted, "Sustainable forest management needs between USD70 billion and USD160 billion each year (globally) to be implemented properly. But official

development assistance to forestry only covers about 1% of the estimated total financing need" (see Castren et al., 2014).

As part of the Warsaw REDD+ Framework, a work program on results-based finance to progress the full implementation of the REDD+ activities was agreed under COP decision 9/CP.19. The decision, among other things reaffirmed that results-based finance may come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources, and including the Green Climate Fund.

As part of continuing the work program in relation to the implementation of the Warsaw REDD+ Framework, and the paragraph 54 of the Paris Agreement, the issue of how to finance REDD+ continues, and hence there is a COP work programme on REDD+ finance. This section will briefly review the different mechanisms that can be used to support the pilot scheme for REDD+ PES in Pakistan and conclude with recommendations for the appropriate financing mechanisms. GHG removals generated by this project will not be used for compliance with binding limits to GHG emissions since such limits are not enforced in Pakistan.

Pakistan's domestic Climate Public Expenditure and Institutional Review (CPEIR) undertaken by the UNDP in 2015

The Government of Pakistan (GoP) ratified the National Climate Change Policy (NCCP) in 2012, which aims to ensure that climate change is mainstreamed in the economically and socially vulnerable sectors of the economy, and to steer Pakistan towards climate-resilient development.

In 2012, the Ministry of Climate Change (MoCC) expressed an interest in undertaking a Climate Public Expenditure and Institutional Review (CPEIR) to assess the level at which the GoP has so far been able to respond to the challenges of climate change, and to identify opportunities for further strengthening its response. The study includes an assessment at the federal level, as well as in one province, Khyber Pakhtunkhwa (KP).

The review found that climate change response in Pakistan requires major investment; climate change has been recognized in Pakistan as a core component of the economic growth model which is required for growth, poverty reduction and the wellbeing of the population. This is embedded in national economic policies such as the Framework for Economic Growth (FEG), 2011, Vision 2025 and the accompanying Medium-Term Development Plan (2010–2015).

The National Strategy for Sustainable Development (developed 2012) also positions climate change centrally in the sustainable development trajectory, although the strategy is so far un-ratified. For instance, Pakistan was ranked number three in the 2012 assessment of the Global Climate Risk Index 2014 with over 6 billion USD losses due to climate change. Investment requirements for mitigation to decouple economic growth from the corresponding GHG emissions increase have been estimated to be the order of USD 8 billion, annually for a 15 percent GHG reduction, to USD 17 billion for a 40 percent reduction. Naturally this has indirect implications for the REDD+ PES pilot scheme, because there could be actions taken on a public level that get financed, that can support a REDD+ PES pilot scheme.

The Federal Climate Budget

The total federal climate-related expenditure (development + current budget) was estimated to be between 5.8 and 7.6 percent of total federal expenditures in the four studied years. The relative proportion of the climate-relevant budget spent on adaptation and mitigation varied significantly across the studied years; adaptation varied between 25 and 60 percent and mitigation between 30 and 71 percent (combined adaptation and mitigation benefits were a maximum of 11 percent). While the fiscal headroom for climate-related development expenditures is tight, it is nonetheless growing. The CPEIR illustrated that the number of climate-relevant development projects and the proportion of climate-relevant projects within each government institution vary widely across the studied years, suggesting rather erratic resource allocation and policy delivery. The highest percentage of climate-relevant projects tended to be in the MoCC, the Water and Power Division and the Kashmir Affairs and Gilgit-Baltistan Division. The reality of erratic patterns of climate change-related expenditures highlight the need for an overarching climate change financing framework which can help streamline budget allocations and ensure a holistic response to climate change challenges in the country.

Pakistan Climate Change Fund: is managed by a board and will be used to finance suitable adaptation and mitigation projects and measures designed to combat the adverse effects of climate change. The fund could provide potential finance for the REDD+ PES pilot.

Multilateral Funds and Programs

Pakistan initially presented an expression of Interest to join the Forest Carbon Partnership Facility (FCPF) in 2011[2], and a follow up expression of interest was delivered on January 30th 2013[3]. The FCPF is designed to support REDD+ readiness and piloting demonstration activities, such as those presented in this document.

Pakistan submitted its initial R-PP on July 31st 2013, and then first revision on September 13th 2013, followed by a second revision on November 18th 2013. The document went through a review by the Technical Advisory Panel (TAP) and the Participants Committee (PC). Pakistan presented its intended final version of its R-PP to the PC in July 2014 with incorporation of the previous PC meeting decision comments, however further comments were received in the meeting and in September 2014, the final version of Pakistan's R-PP was submitted, and passed its completeness check in October 2014. In May/June 2015, Pakistan signed its grant agreement for Readiness Implementation with the World Bank.

Pakistan joined the Coalition for Rainforest National (CfRN) in 2010, and has maintained involvement in formulating and supporting its joint positions for REDD+ under the United Nations Framework Convention of Climate Change (UNFCCC) negotiations.

[2] https://www.forestcarbonpartnership.org/sites/forestcarbonpartnership.org/files/Documents/PDF/Jan2012/Pakistan%20FCPF%20-27-January-2012.pdf

[3] https://www.forestcarbonpartnership.org/sites/forestcarbonpartnership.org/files/Documents/PDF/Feb2013/Expression%20of%20interest%20FCPF%20update%20january%202013.pdf

In June 2011, Pakistan became a UN-REDD Partner Country to receive targeted support and support to the Country Needs Assessment (CNA). Under UN-REDD, Initial targeted support was provided to the preparation of the R-PP, completed in December 2013. Follow up support has assisted Pakistan with the development of a NFMS Action Plan and capacity development activities under the plan, preparedness for REDD+ through increased knowledge and capacity related to the legal and institutional framework at the national and provincial levels (legal preparedness).

In 2012, Pakistan developed its REDD+ Roadmap with the support from UN-REDD. In February 2013, over 70 forestry experts and stakeholders gathered for a national consultative workshop under the 'REDD+ Project: Preparedness Phase for Pakistan' to initiate a 'REDD+ Roadmap' process for improving forest protection and management in Pakistan. The workshop was organized by Pakistan's Ministry of Climate Change, ICIMOD, and WWF-Pakistan, with the support of One UN Joint Programme on Environment. The REDD+ Roadmap process launched at this workshop draws on the experience of several countries in Asia and the Pacific, backstopped by technical support from the United Nations Collaborative Programme on REDD+ (UN-REDD Programme), which also provides additional financial support.

Private Sector Corporate Social Responsibility: As part of this project, the international consultant reached out to a number of multinational corporations that have established corporate social responsibility programs, and requested expressions of interest in providing finance for the REDD+ PES pilot project. Discussions revealed there is certainly interest from an international airline and a hotel group that should be considered as the pilot project furthers its design process. Both CSR programs require social and environmental values to be considered in addition to transacting carbon from forests. The expected price of a bundled REDD+ PES credit is between USD 5-8 tCO_2e (bundled) based on initial consultations, depending on the extent of the social and environmental benefits compared to the baseline.

There are two additional related mechanisms that could be related to CSR that could be considered under the PES REDD+ scheme. These include **productive private sector investments**, for example, in native forest plantations; and a public private partnership. Balochistan has a good example of partnering with Merck pharmaceuticals to plant trees in arid degraded areas under the structure of a public private partnership.

There are mechanisms that are specific for results-based finance, however, this assignment focuses on PES and REDD+ applied in the context of a pilot scheme, and therefore, at this stage, results based finance should be considered for future potential financing through mechanisms such as the Green Climate Fund, or the Voluntary Carbon Market.

To conclude, potential PES and REDD+ buyers of credits for the pilot projects could consist of a range of different stakeholders summarized in the table below. The sellers of the REDD+ PES credits are likely to be the relevant authority from Government of Pakistan that will represent community interests. This is because there is already an institutional set-up, through the REDD+ Steering Committee and REDD+ cells in the provinces that can facilitate REDD+ activities with communities.

All PES transactions should best be managed by the same institution to ensure efficiency in communications and resource allocation.

5.2 Buyers and sellers identified for the Balochistan PES area

The Miani Hor PES scheme would have two main sellers of PES services, which in this case would be the following:

- The Balochistan Forest and Wildlife Department; and
- The stakeholder fishing communities in Miani Hor area.

We further recommend that the provincial offices of IUCN and WWF in Pakistan would be added as facilitators in the PES scheme for Miani Hor. In this manner can transparency and efficiency be better ensured when partners have to play with open cards. A funding basket for all the accumulating PES services from the Miani Hor PES area should be established under the Balochistan Forest and Wildlife Department, with the transparent overview of the other parties.

For the Miani Hor PES scheme there would at least be found some 14 different potential buyers of PES services of which several comprise of several entities (i.e. CPEC shipping and transport companies, and Balochistan hotels). The sellers and potential buyers are presented in Table 5.3 below.

Table 5. 3. The potential buyers and sellers of PES services for the Miani Hor PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Potential Seller of PES	Potential Buyer of PES
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	Balochistan Forest & Wildlife Department, and stakeholder fishing communities	Gawadar Port Authority and Ship & Transport industry (CPEC transport companies) in Gawadar harbour
	Fishery related other community wage labour	Fishing communities	Fishing communities as in-kind by turning into other livelihoods
Coastal zone and habitat protection	Cyclone & tsunami mitigation with mangroves	Balochistan Forest & Wildlife Department, and stakeholder fishing communities	Potentially by carbon buyers and Provincial Government
Biodiversity conservation & promotion of ecotourism	Ecotourism	Balochistan Forest & Wildlife Department, and stakeholder communities	Ecotourists and agencies, Provincial & National Government
	Education and research activities in mangroves	Balochistan Forest & Wildlife Department, and stakeholder communities	Education and research institutions in Karachi & neighboring Balochistan cities (as small entry fee) before starting up project or do excursion
Carbon and other forest products	Community wood and NTFPs	Balochistan Forest & Wildlife Department, and stakeholder communities	Fishing communities as in-kind by being trained in sustainable forest management & other energy use
	Mangrove carbon sequestration	Balochistan Forest & Wildlife Department, and	Karachi Coal Power Company, Thar Coal Power

		stakeholder communities	Company, Balochistan hotel industry, Pakistani and international flight companies
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	Balochistan Forest & Wildlife Department, and stakeholder communities	Provincial Government
	Land stabilization	Same as above	same as above

As some PES services may have easier to acquire payments than other services it may be good to collect the payments to the funding basket first and then distribute the funding in proper manner and in agreement between buyers and sellers in transparent way. Table 5.4 presents the type of PES activities which would be financed with the PES payments.

The Gawdar Port Authority and many ship and transport industries (i.e. CPEC transport companies) are severely polluting the Balochistan coastal waters though not specifically the Miani Hor bay where the PES scheme is located. However, their pollution affects the whole fishery sector along Balochistan marine waters in the same manner as Karachi city and industries affect the fishery sector of Sindh marine waters. So the basis for approaching these potential buyers be the same as is the case with buyers in Sindh Province.

Table 5. 4: The potential PES services provided by the sellers for the Miani Hor PES area

Identified main ecosystem services	Actual economic benefit analyzed and valuated	Potential Seller of PES	Potential PES derived activities to sell
Protection of fish and shrimp spawning sites	Fishery and fish/shrimp spawning site value	Balochistan Forest & Wildlife Department, and stakeholder fishing communities	Planting of more mangroves, sustainable forest management practices among communities, compensation to fishing communities
	Fishery related other community wage labour	Fishing communities	combined with above: Fishing communities as in-kind by turning into other livelihoods (possible with compensation)
Coastal zone and habitat protection	Cyclone & tsunami mitigation with mangroves	Balochistan Forest & Wildlife Department, and stakeholder fishing communities	Planting of more mangroves, sustainable forest management practices among communities, compensation to PES sellers. Support for new livelihoods and infrastructure.
Biodiversity conservation & promotion of ecotourism	Ecotourism	Balochistan Forest & Wildlife Department, and stakeholder communities	Support for building up ecotourism structures and capacity of local communities to better serve ecotourists and other visitors.
	Education and research activities in mangroves	Balochistan Forest & Wildlife Department, and stakeholder communities	
Carbon and	Community wood and	Balochistan Forest &	Fishing communities as in-

other forest products	NTFPs	Wildlife Department, and stakeholder communities	kind by being trained in sustainable forest management & other energy use
	Mangrove carbon sequestration	Balochistan Forest &Wildlife Department, and stakeholder communities	Planting of more mangroves, sustainable forest management practices among communities, compensation to fishing communities. Also support to BF&WD for its capacity building
Shoreline stabilization & prevention of sea intrusion	Land erosion prevention	Balochistan Forest & Wildlife Department, and stakeholder communities	Planting of more mangroves, sustainable forest management practices among communities. Construction of some roads
	Land stabilization	Same as above	same as above

CHAPTER-6

6 PRICES SET FOR DIFFERENT ECOSYSTEM SERVICES

6.1 Overview of price setting of the PES services

It is only the carbon trading mechanisms that already exist and these have already been described in detail in Chapter 5. For the other ecosystem services no proper market mechanism is in place in Pakistan or any other part of the world. These non-carbon services could be marketed with proper enabling policies, laws and regulations which are specifically tailor-made and enforced for the PES scheme. Most of the international PES schemes have such legal arrangements in place to enable PES funding accumulation.

It will be best if the PES payments are provided on annual basis and the first-year payment should be up-front to enable the PES scheme to start. The short term payments could be arranged by the government from its Annual Developmental Programme or through assistance from international donors like Global Environmental Facility (GEF) or Green Climate Fund (GCF). The long term expenditures will be met from the PES funding. The carbon trading mechanisms have already strict rules for payments based on performance and therefore no up-front payments are allowed. For second year and later annual PES payments (or fees) it will be decided through mutual agreements between buyers and sellers. However, from a performance viewpoint it is best that part of the funding would be up-front in-put based and another part performance-based, so that the sellers have got some funding to operate the PES scheme services to be performed each year. Without some up-front funding it is unlikely that the PES scheme will get commenced. It is proposed that the PES payment should be made on annual basis throughout the PES scheme duration depending upon the PES performance. For each year there should be set targets for the PES sellers to achieve. If one year's performance lags behind it should be possible to speed up performance later to reach the set annual targets and thus get paid later to full extent.

Except for carbon trading there is no set level for pricing of the PES services. This means that we will here analyze the needs of financing and back-track to propose price setting in accordance to the needs and a reasonable amount for PES payments. All of the identified PES services are in their own way important to finance, which means that there is good justification to include them. As the funding is proposed to be placed in a PES fund from where to distribute the payments there should be some flexibility allowed by the buyers to enable paying out money for a needed cause. Many of the response activities that balance the payments are anyway the same for different PES services as will be discussed below for each category of PES services.

6.2 Protection of fish and shrimp spawning sites

The payments under this PES service category has two noble and important aims:

a) To compensate fishing community households in such a manner that a substantial number of these households' family members are able to take up some other livelihood than fishing;

b) To plant thousands of hectares more mangroves to enlarge the waste water cleaning capacity of the mangroves to cope with current pollution better and to clean better waste water effluent;

Regarding the a) aim there is currently more than double fishing effort pressure on the existing fish populations, which means that the pressure needs to be reduced by more than 50% to reach a sustainable level of fishing. One way to achieve this target is to substatilly reduce the number of fishermen. This is also in the interest of the fishermen, who currently find themselves in a situation where income generation is dwindling fast, but they have no alternate financial resources to switch into another profession. A compensation would allow many of these farmers to educate themselves or aquire some skills, which would allow them to find another type of work. As there are thousands of these fishermen households, the total needed compensation amount will be millions of dollars or billions of Pakistani rupees.

The fishing community households will also contribute to the PES funding in an in-kind fashion. As these households receive PES compensation a substantial number of these households' fishermen should accept to educate themselves or upgrade their skills to take up another livelihood against the compensation. In this manner the fishermen contribute to the halving of the fishing pressure along the Pakistani marine coast and thereby to an enabling of fish populations to recover to sustainable levels.

Regarding the b) aim there is a substantial need to enlarge the mangrove areas, which act as nursery sites for fish, shrimps, crabs and lobsters and thereby increase the potential total fish and seafood species populations. In both PES areas there could be thousands of hectares of mudflats that could be turned into mangrove plantations and eventually into dense stands of mangroves that support the fish and seafood populations to become stronger. The financing for both these aims are mainly thought to be derived from polluting industrial companies in either Karachi or Gawadar cities.

As there will be thousands of buyer candidates for this PES scheme it will not be possible to have each polluting company or organization to pay their own fee directly based on their own pollution discharges. Instead these polluters should be grouped into waste water pollution discharge categories, which should be defined when these companies or rather their respective industrial associations are first approached. In this manner this can be handled with invoices sent to each industry twice a year. The size of the first annual payment can be the same each year, while the second annual invoice would be performance based adjusted in accordance with how the sellers have performed in any one year.Based on the expert opinion and consultation with stakeholders we would like to propose the following type of price setting:

- Karachi Sewage Company over USD 25,000/year;
- Huge polluting companies: Payment annually of USD 10,000;
- Medium size polluting industrial companies: Payment annually of USD 2000;
- Small polluting companies: Payment of USD 500-1000 depending on size and pollution amount discharged from the company.

At first one should aim for negotiations with all relevant industrial companies in Karachi and Gawadar, but based on the negotiation outcomes adjust the above initial payments in accordance with participating industrial companies and other reasons for adjustments. The annual payments could be collected as a fee directly to the PES fund. If the payment is not popular among industrial companies there may be a need to establish a law to support the payment collection and the fee then becomes a tax paid to a government body that will then re-divert the funding to the PES fund.

6.3 Coastal zone and habitat protection

The buyers of this category PES services are basically the same ones as for the previous PES service category and thereby the price setting should be the same for the same industrial companies. The funding from the industrial companies is merely first taken into the PES fund and then distributed among the PES services as optimally is best.

For provincial government the price should be above USD 50,000/year, but a reasonable price is best settled for via negotiations.

6.4 Biodiversity conservation & promotion of ecotourism

The buyers of PES services from this category are mainly ordinary tourists and therefore the payments will be in the form of an entrance fee that cannot be too high. An ecotourism fee has been worked out on the basis of expert opinion and inputs provided by the stakeholders. The fee should support the development of tourist facilities in the PES area and in the fishermen communities involved in providing of the ecotourism services to improve the overall ecotourism attraction. Therefore, the fee should be over PKRs. 1000 rupees per tourist vehicle or PKRs. 100 per tourist. From travel agencies involved in ecotourism tours in or via the mangrove PES areas there could be a fee of USD 500 per year.

For research institutions there could be a fee of 2000 PKRs for each research project that has activities in the mangrove areas. For school classes and other education institution group visits there could be a fee of 1000 PKRs per group for each visit. This fee should be paid up front in the harbor from where the boat with ecotourists starts out. The collected fees will then be turned over to the Sindh Forest and Wildlife Department for inclusion in the PES fund. A standard procedure needs to be worked out around these fee payments.

6.5 Carbon and other forest products

In Section 5.1 we have already presented substantial amount of information about various carbon trading options. As there are local carbon dioxide polluters in Karachi (i.e. Karachi Coal Power Company and major hotels and domestic flight companies) and in Sindh Province (Thar Coal Power Company and cement factories) it is advisable to start up negotiations with these first. For international carbon credit buyers there will also be several other PES projects in Pakistan, which means that they will also be needed in carbon trading in locations where there are no local substantial carbon polluters nearby.

The current carbon dioxide (CO_2) price is around USD 5 per ton on the global market and it is advisable to try to keep the carbon price at this level. The Sindh PES area mangroves are currently sequestrating carbon at a rate of 16.78 tCO_2/ha/year which means an annual total of 488 650 ton for the carbon market, while the Miani Hor PES area mangrove would offer another 65848 ton of CO_2/year. With planting of several thousand more hectares of mangroves can the above-mentioned amounts of annually sold carbon credits that are traded be increased considerably.

6.6 Shoreline stabilization and prevention of sea intrusion

For this PES service category will the same prices and funding rules apply as for those proposed for Coastal zone and habitat protection in Section 6.3 above.

6.7 Conclusions

The above proposed price settings are indicative and based on expert opinion and consultation with stakeholders. However, these could be adjusted through negotiations between sellers and buyers to set fair levels of PES payments to protect the PES area and stakeholder communities' interests in the first place and the whole Pakistani marine environment in second place. For the Sindh PES area the annual PES payments could be from USD 1.5 million to USD 2 million per year. For the Miani Hor PES area the annual payments may add to USD 0.5 million per year or more. With increasing mangrove forest coverage these annual payments can be raised further.

The main buyers will be different waste water discharging towns, industries, and others for whom the opportunity cost would be building of new proper waste water treatment plants to cover for the untreated waste water discharge. The current price in Karachi for this treatment plant is stated to be PKRs 5 billion for a 100 million gallon daily (MGD) capacity plant. However, as long as these waste water treatment facilities are non-existing the PES payments constitute a very cheap alternative to somehow clean the untreated waste water. It is likely that neither city sewage companies nor industries want to voluntarily pay these PES fees, which means that it has to become compulsory (i.e. through enactment of new specific PES law) on an annual basis at least until all waste water is cleaned through proper waste water treatment plant. Also, thereafter the sewage companies and industries have a social and moral duty to pay PES fees for all the years they have escaped cleaning of the waste water discharge.

For carbon trading there is already both international interest (e.g. flight companies) and local (at least hotels and cement factories) for voluntary carbon market. For ecotourism it will be for the benefit of everybody that ecotourism facilities are developed to improve the attraction of ecotourism sites. Other PES payments are in fact substituting investment expenses that would have to be made in shoreline stabilization or coastal protection anyway in some other more expensive manner (e.g. road construction or shoreline stabilization with cemented infrastructure).

CHAPTER-7

7 BUSINESS AS USUAL AND PROJECT SCENARIOS AND THEIR COMPARISON

7.1 Application of Methodology

7.1.1 Objective of Methodology Application

The objective of presenting this methodology is to present an initial baseline estimation for the amount of carbon stored in mangroves for the REDD+ PES pilot sites in Sindh and Balochistan. There are multiple methodologies to choose from under various international standards and frameworks. The methodology selected will need to comply with the financing mechanism, and as a result, the numbers and methods presented in this document should be viewed as preliminary and subject to change, pending area designation, community consultations, and the other various protocols required to be carried out when designing and implementing a REDD+ project aligned with best practices.

7.1.2 Title and Reference of Methodology

The following additional methodologies have been sourced to guide the development of the business as usual scenario. While this report is not a Project Design Document for submission for Verified Carbon Units (VCUs), it will employ the Verified Carbon Standard (VCS) guidance and methods as a form of applying best practice.

AR-AM0014: Afforestation and reforestation of degraded mangrove habitats (Version 3.02). ARR methodological tools:

Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01)

Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0)

Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.1)

7.1.3 Applicability of Methodology

Applicability conditions of the methodology AR-AM0014: Afforestation and reforestation of degraded mangrove habitats (Version 03.0)

a) The land subject to the project activity is degraded mangrove habitat

The selected approved afforestation and reforestation baseline and monitoring methodology AR- AM0014 "Afforestation and reforestation of degraded mangrove habitats"(Version 03.0) defines degraded mangrove habitat" as wetlands where, in their natural state, mangrove vegetation can grow and have soil or sediment that is usually water-logged with water that is saline or brackish, and that were subjected to impacts resulting in decrease of forest cover below that reported by the host Party to the CDM Executive Board according to paragraph 8 of annex to Decision 5/CMP.1 (A/R CDM modalities and procedures).

According to the 2003 IPCC GPG wetland category includes land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories. The fish ponds and mudflats which will be planted or restored with mangroves are all inundated twice per day, during high tide and are all influenced by ambient salinity; therefore all areas fall

under the wetland category. All project areas are assessed as part of the standardized site selection procedure (see section 1.8).

b) More than 90 per cent of the project area is planted with mangrove species. If less than 10 per cent of the project area is planted with non-mangrove species then the project activity does not lead to alteration of hydrology of the project area and hydrology of connected up-gradient and down-gradient wetland area;100% of the project area is planted with site specific, multi-species mangrove communities where the potential mangrove community in the project area is multi-species and/or zoned, and planting should, as far as possible, be designed to re-establish the multi-species composition and/or zonation, taking into account the ecological requirements of each species concerned.

Project activities will not lead to any changes in hydrology of land subjected to reforestation. The only project activity/measure is planting. Therefore, there will be no flooding, digging, drainage, ditch blocking or any other direct activity involving the alteration of the hydrology.

c) Soil disturbance attributable to the A/R clean development mechanism (CDM) project activity does not cover more than 10 per cent of area.

There will not be any aerial site preparation in this reforestation project activity. The plantation will be realized manually and will consist in preparing a small hole for the roots of the seedling, respecting the complete structure of the soil.

Applicability conditions of the tool: "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01)

a) Forestation of the land within the proposed project boundary performed with or without being registered as the ARR CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.

This grouped project is in compliance with applicable legal and regulatory requirements as outlined in Section 2.

Applicability conditions of the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0)

a) The tool is applicable to all occurrence of fire within the project boundary.

b) Non-CO2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥5% of the project area.

Burning biomass is very unlikely, all the areas are abandoned fish ponds or river/coastal mudflats and no fire occurs. Therefore this tool does not apply.

Applicability conditions of the tool: "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" (Version 03.1)

This tool has no internal applicability conditions.

Applicability conditions of the tool: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.2)

This tool has no internal applicability conditions.

7.2 Carbon Stocks Baseline

To identify the baseline scenario and demonstrate additionality of this project activity the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01) is applied.

7.2.1 Applicability

The afforestation project does not lead to violation of any applicable law even if the law is not enforced. The National REDD+ office will have to provid a letter or declaration that shows that the project has been approved by the Government of Pakistan.

7.2.2 Procedure

STEP 0. Preliminary screening based on the starting date of the A/R activity

A contractual agreement between Party 1 (Buyer) and Party 2 (Seller), became effective from the date of signing this agreement. As part of this agreement relevant funding mechanism or financier, is funding the planting and maintenance of the mangrove restoration activity. In return, the relevant Authority/Buyer is entitled to all VCUs/credits relating to the reduction in greenhouse gas emissions generated by the ARR activity.

Therefore, the incentive from the planned sale of VCUs/credits was seriously considered in the decision to proceed with the project activity. The project start date marks the starting point of mangrove afforestation and restoration activities in the field.

STEP 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity

Sub-step 1a. Identification of alternative land use scenarios to the proposed project activity.The following alternatives to the project activity will be evaluated:

- Continuation of the pre-project land use
- Natural mangrove regeneration of the land within the project boundary
- Mangrove afforestation of the land within the project boundary performed without being registered as a project activity intended for the carbon market.

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

To demonstrate that identified alternatives to the project activity are in compliance with all the applicable legal and regulatory requirements, the applicable laws and regulations which are implemented are listed below:

- The Pakistan Forest Act 1927 in its application to Balochistan Province
- The Pakistan Forest Act, 1927 in its application to Sindh Province

The above regulatory frameworks are taken into consideration while evaluating the alternatives to the project activity and the following alternatives listed are in compliance with the applicable laws and regulations.

STEP 2. Barrier analysis Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios The barriers included are:

- Investment barriers, other than insufficient financial returns
- Institutional barriers,
- Technological barriers;
- Barriers related to local tradition;
- Barriers due to prevailing practice;
- Barriers due to local ecological conditions,
- Barriers due to social conditions and
- Barriers relating to land tenure, ownership, inheritance, and property rights.

The table below displays the barrier analysis matrix, which identifies alternatives and barriers. A more complete discussion of the barriers follows.

Table 7. 1: **Barrier Analysis Matrix**

Alternative land use scenarios	Investment	Institutional	Technological	Ecological	Social	Land tenure
Baseline: Continuation of pre project land use						
Natural mangrove regeneration of land within the project boundaries				X		
Mangrove regeneration within the project boundaries without being registered as a VCS project	x	x	x			

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers

Scenario 1: Continuation of the pre-project land use

The land subject to the project activity is degraded mangrove habitat. The planting areas of this ARR project activity are sited in a coastal location where the population pressure and short-term economic incentive of aquaculture increased the degradation of the mangroves over several decades. In addition, upstream irrigation from the Indus River in Punjab and North Sindh have had a devastating impact on the tree cover along rivers and have created a degraded coastal shoreline.

Since the project is implemented as a grouped project stretching along a coastal

corridor of around 970 km, the "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities' was applied. This means that pre-project land use - further degradation of mangroves is classified at the regional level and the regional trend of this scenario is for degrading land quality.

According to Pakistan's Readiness Preparation Proposal (R-PP), Sindh reported 399,000 hectares of forest area, or about 9% of Pakistan's current forest area (FCPF, 2014). Sindh's forest resources are comprised mainly of mangrove forests and riverine forests. Sindh also has small areas of irrigated plantations and tree farms. Historically, Sindh has suffered from deforestation and forest degradation. However, recent planting efforts have reversed the trend. Sindh's forests have been affected both by natural and anthropogenic factors over the last century.

According to Pakistan's Readiness Preparation Proposal (R-PP), Balochistan reported 591,000 hectares of forest area, or about 13.5% of Pakistan's current forest area (FCPF, 2014). Balochistan is the largest province of Pakistan and hosts multiple forest ecosystems. The most studied are the Juniper forests and Mangrove forests. According to various literature sources, Balochistan has approximately 140,000 hectares (Ha) of *Juniperus excelsa* forests. Of this, some 86,000 ha are found in the Ziarat and Loralai districts (Achakzai et al, 2013). The dry temperate Juniper forest is the second largest Juniper forest in the world and contains trees as old as 2500-3500 years old (Marcoux, 2000). The Juniper forests provide important ecosystem services, especially for watershed management.

During the last few decades in Sindh, large-scale transfers of Government forest lands for non-forestry and commercial purpose have taken place. These forest lands have been transferred permanently or on lease to various departments including Defense, Education, Housing, Agriculture, Roads, Building, Ports and Tourism departments. Sindh has seen the largest provincial transfer of Government forest lands transferred for non-forest land uses – a total of 110,000 ha.

Forests in Sindh have both productive and protective functions. Riverine forests and irrigated plantations are forests with productive functions, while mangroves and rangelands primarily function as protective forests.

Table 7. 2: Forest Resources in Sindh Province 2013

Types of Forest	Area (ha)
Riverine Forests	241,198
Irrigation Plantations	82,277
Mangroves	344,845
Rangelands	457,546
Total	1,125,866

Source: Government of Sindh (2013) in Tagar and Shah (2015)

Abbasi et al (2011) used remote sensing techniques to study the changes in forest cover in the Sukkur and Shikarpur divisions between 1979 to 2009. Their results showed that in the study area the forest cover changed from 22.67% of the area in 1979, to 5.97% in 2009. The table below summarizes their results.

Table 7. 3:Results from the Spatial Temporal Analysis of Riverine Forest areas in Sindh Province 1979-2009

Year	Landsat MSS 1979 %	Landsat MSS 1992 %	Landsat MSS 1998 %	Landsat MSS 2000 %	Landsat MSS 2006 %	Landsat MSS 2009 %
Forest Cover	22.67	17.38	12.28	6.15	7.51	5.97
Water body	14.60	11.15	12.67	7.97	9.58	8.34
Grassland/Agriculture land	18.19	43.97	43.33	24.57	23.56	21.22
Dry/barren land	44.69	27.48	31.70	61.29	56.33	64.45

Source: Abbasi et al (2011)

Siddiqui et al (2004) concur with the results. They used remote sensing and GIS techniques to monitor and map changes in riverine forests in Sindh between 1977 and 1998. They found that the construction of dams/barrages on the upper reaches of the river Indus for hydroelectric power and irrigation, significantly reduced the discharge water into the lower Indus Basin and as a result 100,000 acres of forest disappeared during the study period.

Between 1960-1980, Sindh's riverine forests were reduced due to the Indus River embankment construction to divert river flow to irrigated agriculture. However, the riverine forests of Sindh are dependent on the Indus River water flow during the monsoon season to remain healthy. However, diversion of the river water for agricultural irrigation occurring during the drought has negatively affected the riverine forests reducing both ecological and productive function of forests, see Amanullah and Ahmed (2015).

Amanullah and Ahmed (2015) noted that population pressure has driven deforestation and forest degradation in Sindh citing domestic fuel wood needs, livelihoods, indiscriminate cutting, and conversion to agriculture. They noted that climate change has also had an impact on riverine forests in the province.

Tagar and Shah (2015) studied the causes of deforestation and environmental degradation in Sindh. Their study concluded that the mismanagement of wetlands, scarcity of water resources, rapid population growth, poor planning of urbanization and industrialization were the main causes of deforestation in Sindh.

Abbasi et al (2012) used an analytic hierarchy process model to study and determine the dominant cause of deforestation of riverine forests in Thatta, Shikarpur, Sukkur, Dadu, Larkana, Nawabshah and Hyderabad. They studied both natural and anthropogenic causes including droughts, unauthorized cutting, poverty, unemployment, low literacy ratio, government, utilization, land encroachment, bad law and order situation, and land use for cultivation. They found that droughts, unauthorized cutting and poverty were the three main factors causing deforestation.

Memon (2002) reviewed the literature on the impact and history of the water issue in Pakistan. The study noted that deforestation and desertification along the River Indus due to reduced flow of the Indus, as the water was the only source of regeneration and growth for these Riverine forests. Tree drying and mortality was noted and the reason given was agriculture.

Amjad et al (2007) studied the degradation of the Indus River and its impact on Mangroves. The study showed that between 1950-2000, there was a major loss of mangrove forest cover in Pakistan. They found that the factors responsible for the degradation of Indus delta mangroves were reduced flow of sweet water and silt from river Indus, inflow of pollutants from Industries, navigational activities and intermix of industrial effluents, browsing/ grazing by livestock, wood & fodder harvesting meandering and erosion of creek banks, over fishing and gradual rise in sea level. Other minor threats include lack of knowledge, mismanagement, over exploitation, browsing and less frequent and low tides over deltaic region.

Vistro and Wagan (2013) reported that Sindh Forests and Wildlife Department, Government of Sindh, realizing an alarming situation of depletion of mangrove vegetation, initiated nine mangrove rehabilitation/development projects from the year 1993 to 2012 with the assistance and partnership of "The World Bank, Asian Development Bank, Government of Pakistan and Government of Sindh" to mitigate the degradation process and loss of mangrove habitat. As per data compiled by the Office of Chief Conservator of Forests, Sindh, Pakistan, some 70,300 hectares have been rehabilitated/planted with local mangrove species during the last 20 years period from the year 1993 to 2012. The most fascinating aspect of these projects besides rehabilitating huge degraded areas is; setting of two new "Guinness World Records" during the year 2009 and 2013.

The drivers of deforestation and forest degradation in Sindh province are controversial. In Riverine forests, the construction of damns/embankments, and the diversion of river flow to irrigated agriculture has led to the reduction and loss of ecosystem and productivity function in riverine forests. To some extent, this has also affected coastal forests. Other direct drivers of deforestation and forest degradation include expansion of land for agriculture and fuelwood collection. Indirect drivers of deforestation and forest degradation in Riverine forests were noted to be population pressure, and poor planning for urbanization and industrialization. In mangrove forests, the trend of forest loss has recently been reversed and mangrove forest cover is increasing due to the efforts of Sindh Forest department, with the support of NGOs and donors. The key barrier to improving forest cover through conservation and regeneration efforts in Sindh province is the availability and access to fresh water. Multiple studies have noted this will probably remain the challenge of the next century for Sindh.

In the Balochistan province, mangroves are located at three sites, MianiHor, KalmatKhor and Jiwani. According to fairly recent image analysis, Balochistan hosted about 4,660 ha of mangroves occurring along the Makran coast in 3 isolated pockets at MianiHor (4,018 ha), KalmatKhor (407 ha) and Jiwani (235 ha), see Abbas et al (2011) and Abbas et al (2013).

Climate change is expected to have significant social implications in Balochistan and its impacts are expected to be multi-sector, multi-dimensional and disrupt livelihoods and economic development, see IUCN (2012). Droughts in Balochistan can cause forest loss and further degradation through forest and range fires, reduced forest productivity, and increased dependence by communities on forests for grazing, see Shafiq et al (2007).

Scenario 2: Natural Regeneration of Mangroves within the project boundary

In mangrove forests, the siltation is both a natural and a human-induced phenomenon which affects the ability of mangroves to regenerate. Siltation is caused by low discharge of the Porali River discharge into the lagoon due to human consumption of water, and low rainfall patterns and is exacerbated by human-induced deforestation and soil erosion (Saifullah, 2002). Natural regeneration of mangroves will only occur in Sindh and Balochistan if the natural hydrology in the region is restored.

Scenario 3: Mangrove regeneration within the project boundaries without being registered as a VCS project

Investment barriers, other than economic/financial barriers:

The basic rational behind the pilot project is twofold: wetland restoration of degraded wetlands and to provide an economic stimulus in a depressed area and to revitalize the important livelihood function fishery for local communities.

There is neither credit nor credit funding for non-profitable activities beyond the program Mangroves for the Future. The project is developed in consultation with local communities, which have already demonstrated a track record in environmental awareness and mobilizing local people to participate in mangrove regeneration, however, maintaining current efforts to continue the expansion of the program need funding. Local communities do not have the financial or technical capacity to implement the project without the Department of Forestry in Sindh and Balochistan.

Technological barriers:

The contribution of the technical assistance for mangrove restoration is necessary for the pilot project's success, and to also engage local enterprises to raise awareness of the impact of pollution and irrigation on coastal habitats.

Most of the population residing in the region comprises fishermen. To maintain these kinds of traditional fisheries, having a good mangrove habitat is essential which significantly supports the local livelihood. Capacity building and training is key to restore the region with a mangrove ecosystem providing multiple benefits, both economically as well as ecologically.

The reality is that if there is no organized program to involve communities and monitor efforts, these programs are unlikely to be developed by local communities themselves.

STEP 4: Common practice analysis

At a regional scale within the grouped project region, large scale systematic mangrove tree planting and restoration efforts are underway that will generate a mangrove forest. This is going to create a challenge for registering the regenerated sites for voluntary carbon market benefits and may limit the area which can be registered based on additionality rules. However, there are other mechanisms that can be potentially tapped into so that efforts to continue A/R efforts can expand. PES schemes financed through Corporate Social Responsibility Programs, and/or Public Private Partnerships could provide a sustainable source of financing to continue expanding A/R of mangrove areas.

7.2.3 Quantification of Carbon Stock Baseline

Under the applicability conditions of the applied methodology AR-AM0014 "Afforestation and reforestation of degraded mangrove habitats" (Version 03.0), it is expected that the baseline carbon stocks in litter and soil organic carbon pools will not show a permanent net increase.

The baseline net GHG removals by sinks are therefore calculated using Equation 1 of the methodology:

$$\Delta C_{BSL,t} = \Delta C_{TREE-BSL,t} + \Delta C_{SHRUB-BSL,t} + \Delta C_{DW-BSL,t}$$

Where:

$\Delta C_{BSL,t}$	= Baseline net GHG removals by sinks in year t; t CO_2-e
$\Delta C_{TREE\_BSL,t}$	= Change in carbon stock in baseline tree biomass within the project boundary in year t; t CO_2-e
$\Delta C_{SHRUB\_BSL,,t}$	= Change in carbon stock in baseline shrub biomass within the project boundary in year t; t CO_2-e
$\Delta C_{DW\_BSL,t}$	= Change in carbon stock in baseline dead wood biomass within the project boundary, in year t; t CO_2-e

Most of the afforestation activities are in abandoned coastal areas and some on coastal/river mudflats of the selected PES sites in Sindh and Balochistan. Many of the planting sites were bare land with very few trees and scattered existing mangrove vegetation.

The following table and maps present the areas for the REDD+ PES sites in Sindh and Balochistan, amounting to more than 90,000 ha of areas under management for the

Table 7. 4: Total Project Areas in Sindh and Balochistan

Classification	Sindh	Balochistan	Total
Water bodies	16,700	13,263	29,963
Mangroves	29,121	4,525	33,646
Mudflats	11,316	15,706	27,022
Total Area	57,137	33,494	90,631
Area to be restored under PES REDD+ Pilot	11,316	5,236	16,552

The total Project area for replanting consists of 16,552 ha falls in the provinces of Sindh (11,552 ha) and Balochistan (5,000 ha).

Based on land cover statistics prepared from satellite imageries of 2017, total mangrove ecosystem area in the Korangi and Phitti creeks is 62,994 ha; out of which 29,121 ha are mangrove forests, 11,552 ha are mud flats and 22,321 ha are water bodies.

In Balochistan Province, 4,525 ha area is under mangrove forests in Miani Hor. Mudflats and water bodies extend over 15,707 and 13,263 ha respectively.

The PES REDD+ pilot for mangroves is expected to result in 33,646 ha existing mangrove forest area is protected and plantation plan prepared for a total of 16,552 ha mudflats area at the two sites.Area to be planted in the Korangi and Phitti Creeks areas is 11,316 ha and that in Balochistan is 5,236 ha.

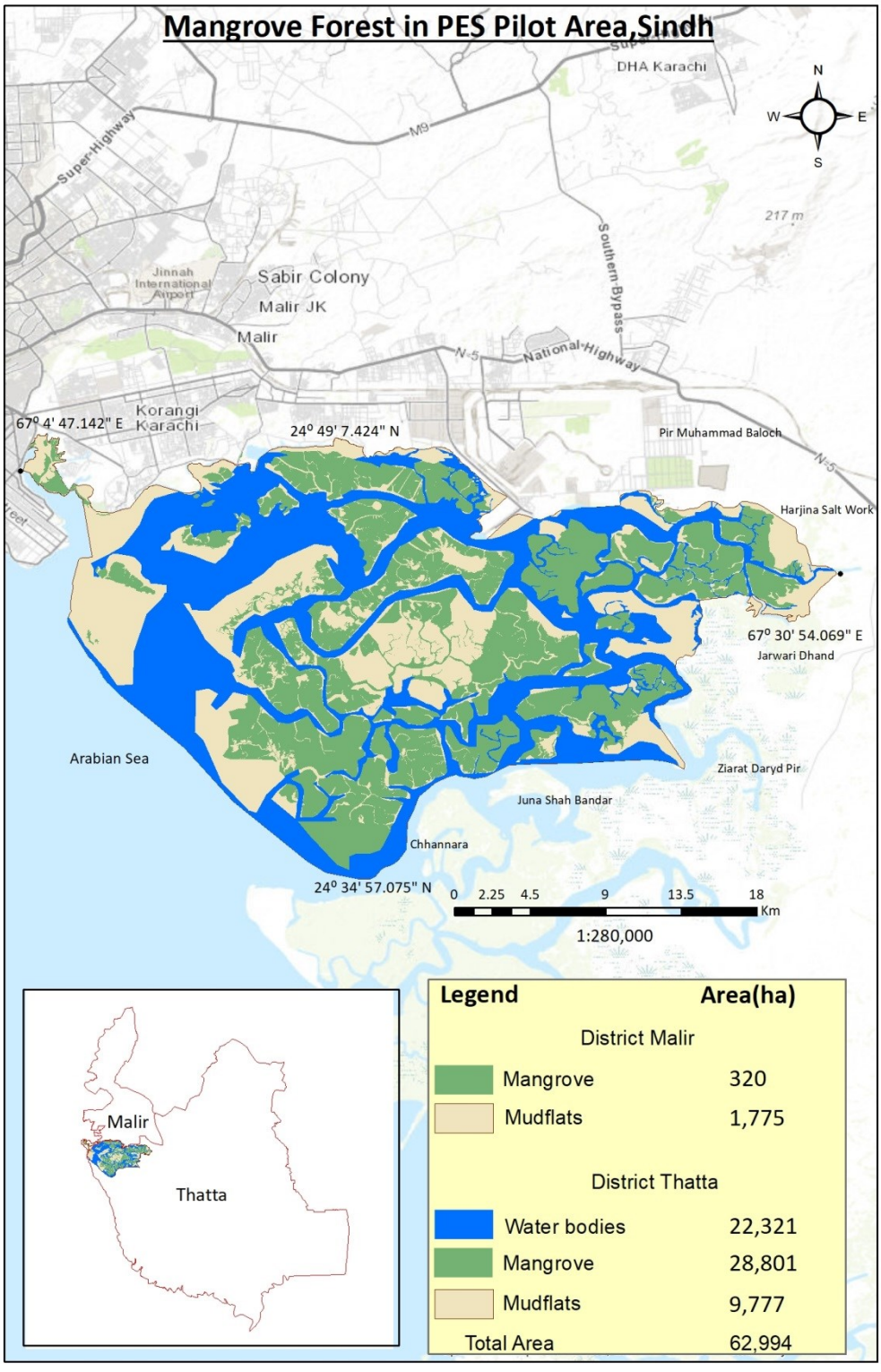


Figure 7. 1: Mangrove Forests in the PES Pilot Area, Sindh

Figure 7. 2: Mangrove Forests in the PES Pilot Area, Sonmiani

According to the methodology, the baseline emissions have to be calculated with the AR-Tool 14 A/R Methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.1).

Chapter 5 of this tool outlines the conditions that an ARR project has to fulfill in order to estimate the carbon stock and change in carbon stock in the baseline as zero. At this stage, the conditions that fulfill AR-Tool14 need to be validated, therefore, the following methodology will take assumptions that the mangrove restoration efforts through a PES REDD+ pilot project intervention will create a change in carbon stocks from the baseline of zero. According to the methodology:

1. Carbon stock in trees in the baseline can be accounted as zero if all of the following conditions are met:
   (a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the project activity;
   (b) The pre-project trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the project activity, at any time during the crediting period of the project activity;

   If any existing trees are available prior to project activity start, they form part of the overall restoration approach.
   (c) The pre-project trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity.

As a holistic mangrove restoration project, all trees are monitored as part of the carbon inventory permanent sampling system.

2. Changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero for those lands for which the project participants can demonstrate, through documentary evidence or through participatory rural appraisal (PRA), that the following indicators apply:
   (a) Observed reduction in topsoil depth (e.g. as shown by root exposure, presence of pedestals, exposed sub-soil horizons);
   (b) Presence of gully, sheet or rill erosion; or landslides, or other forms of mass-movement erosion;
   (c) Presence of plant species locally known to be indicators of infertile land;
   (d) Land comprises of bare sand dunes, or other bare lands;
   (e) Land contains contaminated soils, mine spoils, or highly alkaline or saline soils;
   (f) Land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;

As a mangrove restoration project in a heavily degraded mangrove ecosystem most of the typical degradation indicators in the baseline apply for the degraded fish ponds which have been abandoned due to declining fish production as a result of mangrove destruction, overuse of pesticides causing soil contamination etc. Therefore, changes in carbon stocks in baseline tree and shrub biomass including dead wood within the

project boundary can be estimated as zero. A shrub and tree baseline is calculated for this stratum in order to account for pre-project mangrove vegetation and pre-existing trees.

For the calculations of carbon stocks of the baseline the following equations are used:

Baseline carbon stocks in shrubs are calculated following the equation of the AR-TOOL14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 4.2):

$$C_{SHRUB;T} = \frac{44}{12} * CF_s * (1 + R_w \sum_i A_{SHRUB,} * b_{SHRUB,i}$$

$$b_{SHRUB,t} = BDR_{SF} * b_{forest} * cc_{SHRUB}$$

Where:

$C_{SHRUB,t}$ = Carbon stock in shrubs within the project boundary in the baseline; t CO_2e

CF_S = Carbon fraction of shrub biomass, tC (t.d.m.)$^{-1}$

R_s = Root-shot ratio for shrubs; dimensionless

$A_{SHRUB,i}$ =Area of shrub biomass estimation stratum I, ha

$b_{SHRUB,i}$ = Shrub biomass per hectare in shrub biomass estimation stratum I, t d.m.ha^{-1}

BDR_{SF} = Ration of shrub biomass per hectare in land having a shrub crown cover of 1.0 and the default above-ground biomass content per hectare in forest in the region where the project is located

b_{FOREST} = Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located, t d.m.ha^{-1}

CC_{SHRUB} = Crown cover of shrubs in shrub biomass estimation stratum I at the time of estimation, expressed as a fraction

Bforest: For the calculation of this first monitoring period, the default value for Pakistan presented IPCC table 3.A.1.4. is applied.

bFOREST = 27 t d.m. ha-1

Next, default values taken from the tool AR-TOOL14 are applied to trees and shrub biomass:

Parameter	Denotation	Value
Carbon fraction of shrub biomass	CF	0.47
Root to shoot ratio	R/S	0.4
Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0	BDR	0.1

Pre-existing tree baseline biomass

The estimation of carbon stock in pre-project tree biomass was done following equation 20 and 21 of the methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 04.2):

$$C_{TREE\_BSL} = \sum_{i=1} C_{TREE\_BSL,i},$$

$$C_{TREE\_BLSi} = \frac{44}{12} \times CF_{TREE} \times b_{FOREST} \times (1 + R_{TREE}) \times CC_{TREE\_BLSi} \times A_i$$

Where:

C_{TREE_BSL}	= Carbon stock in pre-project tree biomass; tCO_2e
$C_{TREE\_BSL,i}$	= Carbon stock in pre-project tree biomass in stratum i; tCO_2e
CF_{TREE}	= Carbon fraction of tree biomass (tC (t.d.m.)$^{-1}$
b_{forest}	= Mean above-ground biomass in forest in the region or country where the A/R CDM project is located; t d.m.ha^{-1}
R_{TREE}	= Root-shoot ratio for trees in the baseline; dimensionless
$CC_{TREE\_BSL,i}$	= Crown cover of trees in baseline stratum i, at the start of the A/R CDM project activity, expressed as a fraction; dimensionless
A_i	= Area of baseline stratum i, delineated on the basis of tree crown cover at the start of the A/R CDM project activity; ha

Crown cover (CC_{tree})

According to the crown cover analysis, the crown cover of pre-existing trees in the baseline represents 46% of the area in the project.

BFOREST: The same value as for the shrub baseline was applied (= 27 t d.m. ha-1)

For the following parameters, default values taken from the tool AR-TOOL14 are applied:

Parameter	Denotation	Value
Carbon fraction of tree biomass	CF_T	0.47
Root to shoot ratio for tree	R_T	0.25

Dead wood of pre-existing trees in the baseline

According to the methodological tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in AR CDM project activities (Version 03.1), when there are pre-existent trees in the baseline, dead wood carbon shall be account as baseline carbon.

The baseline carbon in dead wood is calculated using the conservative default-factor based method included in AR-TOOL12. The following equation is applied:

$C_{DW,i,t} = C_{TREE,i,t} * DF_{DW}$

Where:

$C_{DW,i,t}$ = Carbon stock in dead wood in stratum i at a given point of time in year t; t CO2-e;

$C_{TREE,i,t}$ = Carbon stock in trees biomass in stratum i at a point of time in year t; t CO2-e;

DF_{DW} = Conservative default factor expressing carbon stock in dead wood as a

percentage of carbon stock in tree biomass; per cent.

The conservative default factor for dead wood biomass for this project according to the corresponding biome (Tropical), elevation (<2000 meters) and annual precipitation (>1000 mm yr^{-1}) is 2% of carbon stock of pre-existing tree biomass. Hence, this value is applied.

The baseline approach used applies "the existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary", as stated in paragraph 22 of the A/R CDM modalities and procedures.

Compliant with the methodology, it is expected that the baseline carbon stocks in litter and SOC will not show a permanent net increase. It is therefore conservative to assume that the sum of the changes in the carbon stocks in these pools is zero for all strata in the baseline scenario.

The total Project area for replanting consists of 16,552 ha falls in the provinces of Sindh (62,994 ha) and Balochistan (33,394 ha).

Based on land cover statistics prepared from satellite imageries of 2017, total mangrove ecosystem area in the Korangi and Phitti creeks is 62,994 ha; out of which 29,121 ha are mangrove forests, 11,552 ha are mud flats and 22,321 ha are water bodies.

In Balochistan Province, 4,525 ha area is under mangrove forests in Miani Hor, while the total ecosystem area is 33,394 ha and mudflats are 15,706 ha.

The PES REDD+ pilot for mangroves is expected to result in 33,646 ha existing mangrove forest area is protected and plantation plan prepared for the 16,552 ha mudflats area in the Korangi and Phitti Creeks (11,316 ha) and Miani areas (5,236 ha).

The baseline carbon estimation for Sindh and Balochistan PES REDD+ pilot site is summarized in the table below:

Table 7. 5: Baseline Carbon Estimation for Sindh and Balochistan Provinces

	Start Year	Project Year	Mangrove Area per year (ha)	$C_{TREE,t1}$ Pre-existing biomass of trees (tCO2e)	C_{DW_BSL} Dead wood Pre-existing trees (tCO2e)	C_{SHRUB_BSL} Pre-existing shrub biomass (tCO2e)	C_{BSL} Total biomass baseline (tCO2e)
Sindh	2020	1	29,121	779,125	15,583	0	794,908
Balochistan	2020	1	4,525	121,065	2421	0	123,486
Total			33,646	900,190	18,004	0	918,394

Over the 30 year project period, there is an initial assumption that the baseline carbon stocks remain constant. These figures are expected to be adjusted after (every) 5 years when data becomes verifiable and reiterated into the baseline model. Literature review shows that Sindh lost considerable area of mangrove to deforestation prior to a targeted effort to improve the mangrove areas. As a result of recent successful efforts on mangrove restoration in Sindh and, to a smaller extent, Balochistan, mangrove areas in both provinces have increased. Mangrove areas outside of projects have not been monitored recently, and therefore data is

contradictory because it indicates on a very local scale that degradation is prevalent and driven my fuelwood consumption, pollution and industry expansion, but on the other hand, recent provincial level statistics using credible monitoring methods show an increase in the area of mangroves.

7.3 Project Emissions

Several local measured carbon sequestration factors were shared for the purpose of this initial calculation from Pakistan Forest Institute, to measure the project emissions from changes in carbon stocks in biomass and soil. These numbers are applied to the planting cycle for the project, and should be viewed as preliminary figures. This is because the results based financing has yet to be agreed, and communities have not yet been consulted. Therefore, the area estimates could change. Furthermore, extensive research is ongoing in the area of carbon estimation in Pakistan across institutes and universities, therefore emission and sequestration estimates are expected to continue to improve with accuracy.

7.3.1 Project Planting Schedule

Table 7. 6: ***Planting Schedule for Sindh and Balochistan Provinces***

Year	Area to be planted/regenerated in hectares in Sindh	Area to be planted/regenerated in hectares in Balochistan	Total
2020	2,000	1,000	3,000
2021	2,000	1,000	3,000
2022	2,000	1,000	3,000
2023	2,000	1,000	3,000
2024	3,316	1,236	4,552
Total	11,316	5,236	16,552

The sequestration rate of biomass (above and below ground) of 9.1 t CO2e /ha/yr calculated by PFI was applied to the above sequenced planting schedule. The year of planting is assumed to be zero emissions sequestered. The project emissions table that follows shows that if 16,552 ha are replanted in Sindh and Balochistan according to the planting schedule, and applying PFI's carbon sequestration calculation for biomass, a total of 4,038,580 tCO2e can be additionally mitigated over a 30 year period.

Table 7. 7: ***Project carbon sequestration from biomass 2020-2049***

Year	Net Annual Emissions Reductions tCO2	Accumulated Emissions Reductions tCO2e
2020	0	0
2021	27,300	27,300.0
2022	54,600	81,900.0
2023	81,900	163,800.0
2024	109,200	273,000.0
2025	150,623.2	423,623.2
2026	150,623.2	574,246.4

2027	150,623.2	724,869.6
2028	150,623.2	875,492.8
2029	150,623.2	1,026,116.0
2030	150,623.2	1,176,739.2
2031	150,623.2	1,327,362.4
2032	150,623.2	1,477,985.6
2033	150,623.2	1,628,608.8
2034	150,623.2	1,779,232.0
2035	150,623.2	1,929,855.2
2036	150,623.2	2,080,478.4
2037	150,623.2	2,231,101.6
2038	150,623.2	2,381,724.8
2039	150,623.2	2,532,348.0
2040	150,623.2	2,682,971.2
2041	150,623.2	2,833,594.4
2042	150,623.2	2,984,217.6
2043	150,623.2	3,134,840.8
2044	150,623.2	3,285,464.0
2045	150,623.2	3,436,087.2
2046	150,623.2	3,586,710.4
2047	150,623.2	3,737,333.6
2048	150,623.2	3,887,956.8
2049	150,623.2	4,038,580.0
Total	**4,038,580**	**4,038,580**

7.3.2 Additionality

Establishing additionality requires confirmation that emissions post-implementation of the project are lower than those that would have occurred under the most plausible alternative scenario. In section 7.2 above, we have already established that emissions from the existing mangrove forests are zero and that there will be additional planting of 16,500 ha of mangrove forests, which will sequester carbon from the atmosphere. The establishment of both these conditions imply and confirm that emission post implementation of the project are lower than business as usual scenario. Hence, additionality or net positive emissions reduction under the project is established beyond doubt.

7.3.3 Leakages Estimation

For leakages or displacement of emissions estimation, the ***AR Tool-15: A/R Methodological tool-Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity Version 02.0***has been used. This tool is available at the following link:

https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v2.0.pdf

According to the methodology, leakage emission is estimated under the following conditions:

1. Leakage emission attributable to the displacement of agricultural activities due to implementation of an A/R CDM project activity is estimated as the decrease

in carbon stocks in the affected carbon pools of the land receiving the displaced activity.

Note 1: Displacement of an agricultural activity by itself does not result in leakage emission. Leakage emission occurs when the displacement leads to an increase in GHG emissions relative to the GHG emissions attributable to the activity as it exists within the project boundary.

Note 2: Increase in GHG emission occurring outside the project boundary attributable to the secondary effects of the A/R CDM project activity (e.g. changes in demand, supply or price of goods) is considered insignificant for the purpose of this tool and hence accounted as zero.

2. Leakage emission attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero:
   i. Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;
   ii. Animals are displaced to existing non-grazing grassland and the total number of animals displaced does not exceed the carrying capacity of the receiving grassland;
   iii. Animals are displaced to cropland that has been abandoned within the last five years;
   iv. Animals are displaced to forested lands, and no clearance of trees, or decrease in crown cover of trees and shrubs, occurs due to the displaced animals;
   v. Animals are displaced to zero-grazing system.

We have first run a diagnostic test to see if the project site meets the condition 10, which it does as explained below.

(a) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land

There is very little in-situ grazing of animals in the project site and only an in-significant amount of fodder is collected in the project site. Most of the communities living close to the project site are fishermen and do not keep a lot of livestock. Hence, fodder demand from resident communities is small. During flood season in July and August, a small number of camels from Upper Sindh areas are brought to the project site because of flooding in Upper Sindh. The number of camels brought to the project site, however, is small and in no way will significantly affect the number of animals in the receiving grazing land (displaced and existing) and will not exceed the carrying capacity of the grazing land. Condition 10 (a) is therefore met and hence leakage on this count is insignificant.

(b*) Animals are displaced to existing non-grazing grassland and the total number of animals displaced does not exceed the carrying capacity of the receiving grassland*

As shown by land cover classes map of Korangi and Phitti creeks and surrounding areas, there are no non-grazing grasslands in the leakage belt. Therefore, condition 10 (b) is irrelevant and is assumed as insignificant.

(c) Animals are displaced to cropland that has been abandoned within the last five years

There is very little crop land in the vicinity of project site. Most of the surrounding area is occupied by fishermen towns/villages/settlements, Port Qasim Area, Korangi Fish Habor Area, or Industrial Estates of Korangi and Landhi. Hence, the question of animals displacing to cropland [condition 10 (c)] is trivial and irrelevant. Based on this, it is assumed that grazing leakage is insignificant.

(d) Animals are displaced to forested lands, and no clearance of trees, or decrease in crown cover of trees and shrubs, occurs due to the displaced animals

A very small number of animals (less than 100) may occasionally and only seasonally get displaced to forest lands. The number of displaced animals is very small which does not lead to any clearance of trees or decrease in crown cover of tree and shrubs. The increase in GHG emissions attributable to displacement of pre-project agricultural activities is thus small and insignificant given the quantum of forest area and the amount of mangrove biomass in those forest areas.

(e) Animals are displaced to zero-grazing system

Only an insignificant number of animals can potentially get displaced to zero-grazing system, where their impact on mangrove or other vegetation biomass is miniscule. Therefore, the increase in GHG emissions attributable to displacement of pre-project agricultural activities on this count is taken as zero and not estimated.

As explained above, the leakage emission attributable to the displacement of grazing activities meets the above conditions. Therefore, leakage emission is considered insignificant and hence is accounted as zero.

7.3.4 Addressing Non-permanence Issues

Concerns about the risk of reversals are important considerations in a REDD+ project. This issue will be addressed in two ways; first through setting the project period of 30 years and second through the establishment of “risk buffer pools”. Under the latter approach, a proportion—often corresponding to the reversal risk—of the credits generated by the project will be contributed to the risk buffer pool as a kind of insurance mechanism. Both these measures are meant to address the non-permanence issues.

7.4 Coastal Protection and Habitation Protection Baseline

The coastal ecology of Sindh and Balochistan are threatened from land based activities. However, updated and scientifically acquired data and updated information does not exist that is crucial in developing the appropriate policies, plans and conservation measures that can contribute to the sustained protection of the coastal habitat. In 2011, IUCN published the Intergrated Coastal Zone Management Plan for Pakistan, which has been used to set the baselines for Coastal and Habitation protection, as well as biodiversity conservation and ecotourism.

Continuing business as usual over the next twenty years is likely to result in declining human welfare throughout the coastal zone. By 2030 the main features of such development can be expected to include:

- Degradation of coastal and marine ecosystem and deforestation of 70% of the mangroves forests in Pakistan
- Coastal water that are so polluted they pose severe human health risks to surrounding populations.
- Coastal biological productivity decimated by the down stream impacts of poor

land use and unregulated industry.

- Important fisheries collapsing due to over exploitation and degradation of critical
- habitats.

A new model is needed to guide all stakeholders away from a sectoral approach toward a multiple use, systems-oriented mode of management in the coastal zone. To provide this direction, a plan for integrated coastal zone management is proposed – emphasizing the coordination of policies, management concerns, development objectives and stakeholders interest across the different landscapes of the coastal zone.

The Sindh coastline is a high risk area for cyclones in Pakistan, with a 20% annual risk of a landfall from a major cyclone.

The stretch of coastal area of the two PES sites is 30 km for which the full damage occurred and compared this with the PES area coastal protection that covers a coastal stretch of only 30 km.

7.5 Baseline of cleaning of waste water pollution by mangroves

Mangrove forests in the PES Pilot areas play important roles in cleaning waste water pollution. The mangrove forests act like kidneys and clean efficiently all kinds of organic, nitrogen, phosphorus or heavy metal effluents. Even salinity can be reduced with mangroves. We have determined the mangrove role in waste water cleaning based on the in-depth assessment that is included in Annex 4 of this report. The assessment covers all kinds of municipal and industrial waste water effluents. The mangroves forests in the Sindh PES area have an overall cleaning capacity of 50% or over. According to an estimate by the Karachi Water and Sewerage Board, a new waste water treatment plant for 100 million gallons daily (MGD) of waste water cleaning would cost around PKRs 5 Billion. The same report further stated that 456 MGD is daily discharged directly into the sea outside Karachi of which 363 MGD stems from municipal sources, 3 MGD from hospital and 94 MGD from industrial sites (Planning Commission, 2017).

Mangroves in the Sindh PES area have in fact for decades been acting like a large back-up waste water cleaning facility for Karachi city and its surroundings, which has not so far been recognized. One can only imagine how polluted the PQA coastal waters would have been without the mangroves, not to think about how unhealthy fish and seafood would have been to eat. Seafood with too high toxic or heavy metal values are a major human health risk, which we have omitted among the PES services not to make this PES scheme too complicated. Additionally, it is possible that fish and other seafood populations would have been heavily affected by the waste water effluents from Karachi area and thus adversely affected the entire fish population of Pakistan’s economic marine zone.

In the Miani Hor PES area in Balochistan there are no industries or towns in the surroundings which discharge their waste water into the Miani Hor PES area. Therefore, this cleaning of waste water treatment by mangroves is not applicable to the Balochistan PES area.

7.6 Fish and Shrimps Spawning Sites Baseline

Fisheries in Sindh are based on fish, shrimp and lobster only and other resources are hardly utilized. The resources of mullusca, crustacean and sea weed are well diversified in the coastal and offshore waters of Sindh. Commercially important species of mulusca include Oysters, Mussels, Clams Cookles, Windowpane Oyster, Blood calms, Fan shells, Pearl Oysters and Razor calms.

Like Sindh, fish, shrimp and lobster form the major part of the landings of non-conventional resources along the Balochistan coast. The coast of Balochistan lacks a major river and is predominantly rocky and rocky cum sandy whereas muddy shores and natural mangroves are restricted to few semi-enclosed bays. A well diversified mullascan and crustacean fauna is known from the Balochistan, sea weed is also represented by a number of species but so far these have not been exploited on commercial scale.

The baseline estimates of fish/shrimp/crab/lobster landings are based on data reported by Marine Fishery Department (MFD) in Sindh (Khan, 2017). The MFD conducted a major survey in 2010 along the coast in both Sindh and Balochistan to assess the actual landings. This data with supporting reports and interviews enabled a calculation of total fish landings for 2015 by partial new statistics and extrapolation of long-term trends which is given in the following table.

Table 7. 8: Baseline estimates for fish catch in the two PES areas in Sindh and Balochistan for 2015

(In tons)

Type of fishing	Total catch (tons) for Sindh PES area	Total catch (tons) for Balochistan PES area	Total catch for 2 PES areas
Industrial	**22455**	**546**	**23001**
Exported	12852	313	13164
Human consump-tion Pakistan	5861	143	6003
Chicken food	3742	91	3833
Waste	*Na.*	*Na.*	Na.
Artisanal (comm.)	**13473**	**328**	**13801**
Human consump-tion Pakistan	6736	164	6900
Chicken food	6063	147	6210
Waste	674	16	690
Subsistence	**8982**	**218**	**9200**
Human consump-tion Pakistan	3144	76	3220
Chicken food	4940	120	5060
Waste	*Na.*	*Na.*	Na.
Total	***44910***	***1092***	**46002**

7.7 Biodiversity Conservation and Ecotourism Baseline

In 1980, the Lasbela wildlife sanctuary was created and comprises an area of 1,687,579 hectares. Later it was reduced in size to 165,024 hectares and redesignated into as Hingol National Park. In late nineties, the estuarine area has also been included in the National Park. Today it is considered one of the largest national parks in the world. It stretches over three districts Uthal, Awaran and Gwader. The wildlife of the park which borders coast, includes Ibex, Urial, Leopard, Gazelle and marsh crocodiles.

Tourism in Pakistan has been declared as an industry in the late eighties. All that is being caused by way of tourism in substantial terms for revenue, promotion and management is without a well defined policy and therefore without results. This is evident from the accredited projections of the government of Pakistan and is reconfirmed by world statics which rate the tourism Industry in Pakistan as almost nonexistent.

Pakistan has a considerable large coastal zone in Sindh and Balochistan Provinces. Most of the coast line is beset with rocky and sandy beaches except the Indus deltaic coast which has numerous islands and harbours as well as one of the world largest mangroves forests. There are spectacular coastal cliffs, mountains, terrains with living mud volcano'sand archeological sites. There are offshore islands and innumerable small and large beautiful islands with network of creeks for great potential for holyday resorts and a variety of water sports, boating, sport fishing and developing Holiday resorts. The beautiful and clean beaches with brown sand and abundant along Pakistan coast and offer the potential of best secretion. The rocky beaches offers sites for jetties, marinas, and sport fishing. The deep sea fishing is possible almost all along the coastal belt. Therefore the coastal areas of Pakistan have tremendous ecotourism potential that is currently untapped, and could be developed if it was supported by the right policy environment and investment.

The impoverished, degraded, environment resulting from non-availability of surface and groundwater with discharge of untreated wastewater into the Lyari and Malir Rivers has irreversibly reduced the biodiversity of the native and non-native vegetation and hence it offers very little chance for the survival/growth of fauna in the macro-environment of the Karachi Division.

7.8 Shoreline Protection and Sea Intrusion Control Baseline

Coastal erosion is generally the result of natural processes and sea level change over the centuries. In recent years, however, the rate of erosion appears to have increased along the Sindh coast. The Bundal island at the approaches of Korangi-Phitti creek system has severely eroded. Indiscriminate cutting / felling of mangroves is the major cause of erosion. The island with dense growth hassoil stabiization and sedimentation. Plants are soil binders and as such mitigate the weathering effect of wave currents etc.

Occurrence of severe cyclones and storm surges coupled by south-western monsoon winds that are in excess of 30 knots add about 0.3 meter surge to the tides that further intensify the inundation processes. Creek entrances have also been eroded in the deltaic region as creeks have been receding inland. This has taken place due to recession of high water line, which has increased the tidal volume of the deltaic creeks. Sea level rise due to global climatic change also threatens to inundate low lying land and can intensify coastal erosion processes, in creek the salinity of

estuaries, coastal wetlands and aquifers, disrupt marine life and possibly threatens drinking water supplies.

There is therefore need for coastal protection in low-lying coastal areas to save the coastal communities, industries, agriculture lands and coastal amenities against erosion and inundation by sea water progressing inland. It is recommended that coastal defenses such as small retaining wall / large scale mangroves protective plantations be raised/planted to protect the coastal area.

7.9 Without Project Community Scenario

With the exception of the Karachi area, coastal communities in Balochistan and Sindh are scarcely populated, with an average density in 2011 of 87 persons/km^2.

The local inhabitants are mostly fishermen, professional grazers and agriculturists who cultivate rice during monsoon season, when the Indus is in floods, and sweeps over their land, make cultivable – During this period, mangroves timber and firewood demand is for house construction material and for cooking fuel respectively. Fishermen are mostly busy from October to May when many of them move out with their families from their villages and camp in temporary huts on suitable sites along coastal creeks to fish and catch prawn.

Women in the coastal areas are segregated from men outside the extended family or close relatives. They look after house, children and animals. They gather firewood and water, in cases where it does not mean going too far from their settlements or to areas inhabited by other tribes. Women have very little spare time to themselves and almost no social life or outing. Thus, the attitude towards women remain feudal in nature and a change for the better is a long way off, unless economic conditions can be improved.

In all, there are many challenges to developing a pathway to green growth in the coastal areas of Balochistan and Sindh. The main threats to the coastal ecosystem have been identified in the Intergated Coastal Zone Management Plan (2011), which include:

- Population growth
- Fresh water availability and salinity
- Over exploitation of natural resources by coastal communities
- Marine and industrial pollution due to urbanization and industrialization
- Lack of uniform legislation and coordination
- Use of destructive and unsustainable fishing practices
- Lack of education and awareness amoung people
- Unplanned development along the coast
- Port operations
- Enforcement capabilities
- Implementation of development programmes and policies
- Climate change

A project intervention that can be designed to address most of the above challenges could build momentum for transformational change and green growth. Therefore, the design of this pilot project goes beyond REDD+ and includes Payments for Ecosystem Services.

CHAPTER-8

8 MEASUREMENT, REPORTING AND VERIFICATION

Payments for Environmental Services and REDD+ are linked to performance or results agreed by the sellers. Therefore, there is a need to devise a transparent and effective mechanism to measure and monitor the results obtained from a REDD+PES Scheme. Different approaches and methods have been used to establish benchmarks for measurement of different ecosystem services and monitoring changes in these services over time. One of the key elements of these Measurement, Reporting and Verification (MRV) systems is the involvement of local communities, civil society organizations and other stakeholders to make these participatory and transparent.

8.1 Measurement and Monitoring of Carbon Stocks

For establishing the baselines of carbon stocks in the pilot area, a terrestrial carbon inventory was conducted.

8.1.1 Sampling Design

Cluster sampling was employed for data collection in the field. The cluster consisted of one plot in the center which was the primary sampling unit and four secondary sampling units on the corners 25 m apart from each other. Thus one cluster covered 0.25 ha area. Cluster sampling has already been used for carbon stock estimation in the country for development of emission factors. As there are multiple sample units in the cluster sampling, they are spread across a larger proportionof the sampled site than a single plot of the same area, cluster sampling design captures more microsite variation in vegetation and soils thereby reducing among-plot variation and increasing overall precision. Cluster sampling is also more suited for mangroves forests because movement in mangroves is difficult to the presence pneumatophores, mud, deep channels, standing water and extremely dense thickets composed of stilt roots and main stems.

8.1.2 Plot Shape and Size

Nested circular plot approach was used for data collection on different carbon pools. This approach consisted of a wider circular plot with radius 8.92 m for measuring trees with DBH more than 5 cm, and subplots with radius 5.64 m for shrubs and regeneration and 0.56 m radius plot for measuring pneumatophores and litter. A soil sample was also extracted from 1 m depth in the center of the plot to determine soil organic carbon in the ecosystem. Soil and vegetation samples were weighed on the spot and brought to PFI Laboratory for analysis. A total of 79 sample plots were randomly laid out on the map and their coordinates were uploaded onto GPS. The sample plots were navigated in the field with the help of GPS.

Figure 8. 1: A view of cluster sample laid out in Mangroves Forests

The sample plots were navigated in the field with the help of GPS and map. After identifying the exact location of the plot, the plot center was established by marking on a tree or a stone.After establishing the plot center, the boundary of the plot was marked by encircling the plot with a rope and marking on the trees on the border. Photographs of the sample plots were also taken from different angles.

The following general information were recorded for every sample plot.

- Plot Number : In case of cluster sampling also PSU Number and SSU Number
- Date
- Recorder Name
- Location: Name of Forest Area, District, Forest Division, Forest Range
- Landuse Class: Mangroves, Mudflats, water
- GPS Co-ordinates: Latitude, Longitude of the plot center and GPS precision
- Direction to the plot location
- Crown cover: crown cover was determined through visual interpretation by atleast three crew members and the average was recorded on the inventory form.
- Site category: forest, dwarf or scrub (<5 m height), or other (if other, describe)
- Ecological condition and land use: intact, degraded or deforested;
- Topography (microrelief): flat, depression, levee or hummock, etc.
- Geomorphic setting: river delta, coastal fringe, interior or basin, etc.
- Soil description: organic or mineral soil – sand, clay, silts, etc.
- Disturbance evidence:
  - Cyclone damage: not evident, light, moderate or severe;
  - Timber harvest: not evident, low (<30% basal area), medium (30–70%), or high (>70%).
  - Other disease or disturbance: not evident, light, moderate or severe. Also describe the other disease or disturbance.

8.1.3 Measurement of Aboveground Biomass

All trees falling within 8.92 m radius plots were measured in the field. Species name, diameter at base, diameter at breast height (DBH) and tree height were recorded on the inventory form. Diameter was measured with diameter tape and height was recorded with the help of Haglof Vertix. Trees on the border of the sample plot were included if more than 50% of their basal area was within the plot and excluded if less than 50% of their basal area was outside the plot. Trees having trunks outside and overhanging into the plot were excluded, but trees with trunks inside the plot and branches outside were included.Aboveground tree biomass was determined through the allometric equations given in Table 8.1.

Table 8. 1: Allomteric equations for biomass estimation

Species	Allometric Equation	Basic Wood Density	Source
Avicennia marina	$B = 0.1848 * D^{2.3524}$	0.65	Dharmawan and Siregar, 2008
Ceriops tagal	$B = 0.251 * p * D^{2.46}$	0.78	Komiyama et al., 2005
Rhizophora mucronate	$B = 0.043 * D^{2.63}$	0.74	Amira, 2008

Aboveground carbon stock ranged between0.96 t/ha and 77.17 t/ha with mean carbon stock of 24.40 t/ha.

Figure 8. 2: A view of Forest Carbon Inventory in Mangroves Forest in Sindh

8.1.4 Belowground Biomass

Belowground biomass refers to the biomass present in the roots of plants in the ecosystem below the soil surface. For belowground biomass, the following general equation was used (Komiyama et al., 2008).

$$BGM = 0.199*p^{0.899}*D^{2.22}$$

Where

BGM is belowground Biomass in Kg,

p is basic wood density, and

D is diameter at breast height

Belowground carbon stock ranged between0.47 t/ha and 30.69 t/ha with mean carbon stock of 10.22 t/ha.

8.1.5 Shrubs and Dwarf Mangroves

A great percentage of the mangroves havean aboveground structure of small trees less than a few meters in height, often referred to as dwarf mangrove or scrub or shrub. The bestpredictors of biomass for these smaller individuals arestem diameter at 30 cm aboveground level, crown area, height and/or crown volume.

Shrubs and dwarf mangroves were destructively sampled in 5.64 m radius plot and weighed on the spot. Samples were collected for drying in the oven. The oven-dried biomass was converted into carbon stock by multiplying with 0.47 as per IPCC Guidelines.

8.1.6 Litter

The litter layer is defined as the recently fallen non-woody,dead, organic material on the soil surface.Typically, it consists of dead leaves, flowers, fruits,seeds and bark fragments. In most mangroves, theamount of this materialis usually negligible due to the high efficiency of detritus-consuming crabs, as well as export throughtides and seasonal river flooding.

Litter was measured through collecting litter in 0.56 m radius plot. The material was weighed on the spot and a sample was taken for drying in the oven. The bagswerelabeled with the location, date, plot and samplenumber. Given the wet nature of mangroves, pre-labeledplastic bags were used for collection of littersamples.

It was found that litter is not a significant pool of carbon in mangroves ecosystem of the pilot area.It was estimated at 0.22 t/ha.

8.1.7 Pneumatophores

Pneumatophores of *Avicennia marina* have of significantbiomass in the pilot site. Pneumatophore density was determinedby counting their numbers and taking their fresh weight in the 1 m^2 plots established for the litter layer.

Carbon stock in pneumatophores ranged between 1.34 t/ha and 4.49 t/ha with average of 2.95 t/ha.

Figure 8. 3: Measurement of Pneumatophores in the field

8.1.8 Dead Wood

Dead and downed wood can be a significant component of aboveground biomass, particularly following natural disturbances such as cyclones and storms. It performs several important ecological functions in mangrove ecosystems. Landuse and/or land-cover change may also increase or decrease the quantity of downed wood on the mangrove forest floor. To accurately assess ecosystem carbon pools and influences of natural and human disturbances, dead and downed wood are important variables to measure. Downed wood is usually sampled either by plot-based sampling or by the line-intersect method (Baker and Chao, 2009).

Sample plot method was used in the pilot site for measurement of dead wood. Standing dead trees were measured in 8.92 m plot in the same way as live tree except that their decomposition classes were noted. The specific decomposition classes for standing dead trees are as follows:

1) Status 1 trees are recently dead and maintain many smaller branches and twigs.
2) Status 2 trees have lost small branches and twigs, and a portion of large branches.
3) Decay status 3 applies to standing 'snags', where most branches have been lost and only the main stem remains. The main stem is often broken.

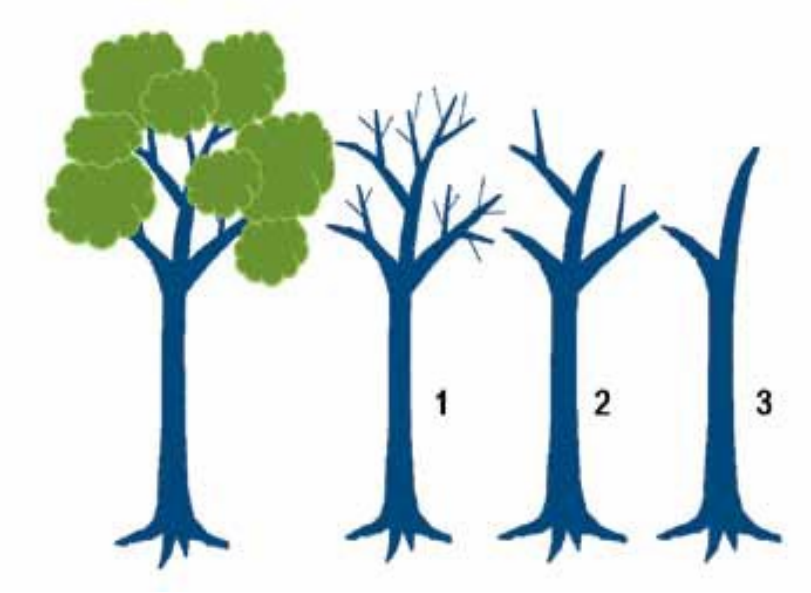


Figure 8. 4: *Decomposition classes of dead trees (Source: Kauffman and Donato, 2012)*

Fallen dead wood lying on the ground is measured in the 5.64 m radius plot. There are two methods for measurement of downed dead wood. Directly weigh the pieces of dead wood and take samples for drying in the oven. Alternately measure the volume of the dead wood by measuring the diameter at midpoint and length of the piece of the wood. Fallen branches and stems should be divided into sections of 2 meters and the exact length and diameter at the middle of each section should be measured.

It was found during the inventory in the mangroves forests in Sindh and Balochistan, that dead wood is not a significant pool in the ecosystem i.e. contributing less than 5% in the total carbon stock.

8.1.9 Soil Carbon

Soil samples were taken from 0-100 cm with the help of soil corer. Soil samples were put in the bags which were properly labeled. Soil and vegetation samples were oven dried in the lab and thus moisture percentage was determined. Dry biomass was converted into carbon stocks by multiplying with 0.47 as per IPCC Guidelines 2013. Soil samples were analyzed for determining soil organic carbon through loss on ignition method. This method involves the burning of organic matter by heating the sample at 440^{o}C for 8 hours in the Muffle Furnace.

Mean soil organic carbon in the pilot area was found to be 233.73 t/ha with a range between 76.99 t/ha and 635.83 t/ha.

Figure 8. 5: A view of soil sampling in Mangroves forests

8.1.10 Carbon Sequestration Rate

Mean carbon sequestration rate in mangroves forest in the pilot area was found to be 16.78 t CO_2/ha/year. In biomass the carbon sequestration rate is 9.10 tCO_2/ha/year whereas in soil carbon sequestration rate is: 7.68 tCO_2/ha/year.

8.2 Measurement of Non-Carbon Ecosystem Services

Unlike carbon sequestration, the non-carbon ecosystem services have no specific methodologies for measurement and monitoring. However, for measurement and monitoring of non-carbon environmental services, different indicators and proxies will be used to measure the performance of PES. For example in case of biodiversity conservation, key species will be identified as indicators of biodiversity status. For watershed protection and water regulation, sediment loads in the river and streams will be used to judge the performance of PES Scheme. Besides, change in extent of forest area itself is a good indicator for measurement of PES performance. If forest cover is increased with PES Scheme, then it is understood that environmental services are getting improved.

The design of MRV systems for PES and conservation incentive programs, including the use of particular indicators and technologies, has been largely directed by the criteria used to assess compliance and disburse compensation.

MRV system will use a combination of remote-sensing technology (high- and low-resolution satellite images and aerial photography) combined with ground inventories aimed at collecting data on different indicators. The monitoring indicators for non-carbon ecosystem services of Mangroves forests are listed in the Table 8.2.

Table 8. 2: Monitoring Indicators for Non-Carbon Ecosystem Services

Type of Ecosystem Service	Indicator	Measurement and Monitoring Methods
Protection of fish and shrimp spawning sites	Fish and shrimp stock population size Level of fish productivity Number of fish and shrimp species	Fish Resource Inventory Production Record
Pollution mitigation	Level of pollutants in sea water Fish mortality rate Ratio and number of sensitive plant and animal species	Laboratory analysis Field Surveys
Coastal Protection	Less incidents of damages to coastal habitations Less expenditures on protection infrastructure	Disaster Data Collection
Shoreline stabilization & prevention of sea intrusion	Reduction of wave energy by near shore and intertidal habitats Extent of shoreline and inland in the coast Change in beach profile (slope (gradient) and width (m) and stability) over time Extent (km2) and health of seagrass/saltmarsh/ oyster bed/biogenic reefs: density of living organisms, measures of growth and production, optimum ecophysiology	Remote Sensing photos, satellite, LiDAR, camera and models Field Surveys
Biodiversity conservation & promotion of ecotourism	Sea space available for recreation Number and quality of beaches Abundance and diversity of key species of recreational interest	Field Surveys Focus Group Discussion Tourists Surveys
NTFPs	Plant Species diversity Density by species Size-class structure by Species Biomass of herbs by Species Growth and yield of selected NTFP species	Resource Inventory Transact walk Monitoring Plot

8.2.1 Monitoring of Biodiversity

Biodiversity is a very broad and comprehensive concept that encompasses both flora and fauna and variations in all life forms from genes to kingdoms. Therefore, there is no single agreed methodology that can be used for measurement and monitoring of biodiversity. Different components of biodiversity can be measured by measuring different variables and proxies. However, any inventory and monitoring scheme at the community level will need to involve local communities multiple government agencies (Forests, Wildlife, Fisheries, Agriculture and Livestock). Forest Department has a key leadership role in this process, and any biodiversity assessment framework developed is to involve and consider agencies with different types of conservation responsibilities.

Biodiversity benchmarks will be established at the following three levels with specific indicators for measurement and monitoring of biodiversity:

Ecosystem level diversity

- Historical trends in land cover
- Area of forest land by forest type
- Extent of forest land by forest type and age class or successional stage
- Extent of areas by forest type in protected area categories as defined by IUCN
- Fragmentation of forest types

Species diversity

- Number of forest-dependent species
- Status of threatened and endangered species

Genetic diversity

- Number of forest-dependent species that occupy a small portion of their former range
- Population trends in wildlife species.

8.2.2 Watershed Protection

Soil erosion, landslides and land degradation are extremely important issues in Pakistan and therefore need to be factored into watershed related PES schemes. Version 2 of Revised Universal Soil Loss Equation (RUSLE-2), an empirically based model will be used for measurement and monitoring of erosion and landslides. The general Revised Universal Soil Loss Equation is as follows:

A = R x K x LS x C x P

Where:

A is average annual soil loss (tons per hectare per year;

R is the Rainfall and Runoff erosivity index (in MJ mm/ha/ hr/yr);

K is the soil Erodibility factor (in tons/MJ/mm);

LSis the Slope and Length of Slope Factor;

C is the Cropping Management Factor;

P is the supporting conservation practice factor.

From the above equation, it is clear that climate, soil, topography, and land use are the four major factors which determine rates of soil erosion and landslides. In the RUSLE-2 equation, erosion and landslides are directly related to the forces applied to the soil by erosive agents in relation to the soil's resisting forces regardless of the land use.

RUSLE-2 model can be applied to any type of land where soil erosion is occurring and land stabilization is important for ecosystem conservation. It can be used in the case of deforested or degraded forest lands, range lands, croplands, wetlands, abandoned mining sites, construction sites, reclaimed land, landfills, and any land where mineral soil is exposed to the direct forces of water erosion and surface runoff generated by heavy intensity rainfall events.

8.2.3 Coastal Protection and Shoreline Stabilization

Coastal protection and hazards management in the coastal areas of Pakistan is a serious issue of national importancedue to the high cost of developmental activities in the coastal areas and location of high value assets in these areas. The coastal protection is also becoming a significant issue due to increasingtrend for people to live at the coast, particularly fishermen folks, tourist infrastructure, and people working in coastal areas. Coastal areas are already facing high risks due to increase in the frequency of sea storms and other extreme events.Sea level rise and increase in the frequency and intensity of sea storms as a result of climate change are now adding to the existing risks.

The main objective of coastal and shoreline protection is to decrease the physical risk from coastal hazards. Establishment of the baseline will help identify Areas Sensitive to Coastal Hazards. For this purpose, based on international research and experience, a set of indicators is proposed for use that on coastal erosion risk. Three categories ofindicators are proposed for measurement and monitoring of coastal protection which are described below:

Foundation indicators

F1 –identification of coastal hazard zones on the planning maps

F2 – presence of rules to support the hazard zones and decrease physical risk of coastal hazards

F3 - policies to ensure that any building or community within the coastal hazard zones is subject to controls to mitigate risksuch as relocation and relocation plans

Baseline Indicators

B1 - Average building setback for residential dwellings in the “primary”hazard zone.

B2 - Number of residential dwellings in the “primary” or “secondary” hazard zones.

B3 - Number of residential lots in the “primary” or “secondary” hazard zones at a date close to the most recent survey of coastal areas.

Trend Indicators

The third level of coastal hazard indicators focus on measuring changes in the totalphysical risk based on consent approvals. These are:

T1 - Number of residential communities and populations living in the coastal hazardzones.

T2 - Number and area of residential building in coastal hazardzones

T3 - Number and area other buildings in the coastal hazard zones.

T4 - Number of population working in coastal hazard zones.

T5 - Number of existing coastal protection facilities in coastal hazard zones.

T6 –Number of new coastal protection facilities getting developed in the coastal hazard zones.

T7 – Number of existing coastal erosion monitoring facilities.

T8–Number of new coastal erosion monitoring facilities.

T-9 Number of awareness raising and capacity building sessions already held for people living in coastal hazard zones along with the number of participants in those awareness raising and training sessions.

T – 10- Number of new awareness raising and capacity building sessions proposed for people living in coastal hazard zones along with the number of participants in those awareness raising and training sessions.

8.2.4 Non-Timber Forest Products (NTFPs)

Non-timber forest products (NTFPs) constitute an important resource source of raw material for different pharmaceutical, herbal and culinary industries and as a source of livelihood for the local communities. These include medicinal and aromatic plants, mushrooms, honey, wild fruits, nuts, etc. Many rural people earn their livelihood or add to their income by collection and sale of these NTFPs.

The diversity, quality, and availability of many species of NTFPs in Pakistan are decreasing. This situation has serious consequences for the industries using these products, people dependent on these for their livelihoods or livelihoods supplementation and for the biodiversity of the forest and grassland ecosystems in the valley.

The PES project therefore proposes to take various measures so as to reverse this negative trend by working and interacting with the collectors, producers, traders, processors, manufacturers as well as with policy makers, implementers, promoters and researchers of NTFPs in the valley so as to ensure their protection and sustainable management.

The following indicators (condition indicators, pressure indicators, and human response indicators) will be used for measurement and monitoring of NTFPs.

Table 8. 3: Conditions Indicators used for measurement of NTFPs

Condition Indicator	Verifiers	Unit of Measurement	Methods
Diversity of plants species	No. of young/mature plants	No. of species	Field surveys, sample plots, transect walks
Density by species	No. of young/mature plants	Number per ha	Resource inventory
Size-class structure by species	No. of young/mature plants	Number per ha	Resource inventory
Biomass of herbs by species	Utilizable biomass	Kg per ha	Monitoring of Sample plots
Growth and yield of selected NTFP species	Tree diameter growth	mm per year	Monitoring of Sample plots
	Shrub height growth	cm per year	Monitoring of Sample plots
	Utilizable biomass growth	Kg/ha/year	Monitoring of Sample plots
	Product yield	Kg/ha/year	Monitoring of Sample plots
NTFP Regeneration by species	Young growth	4 point ordinal scale	Resource inventory
Seed production by species	Occurrence of seed	Qualitative	Focus group discussions, transect walk
		Quantitative	Experimental plot (mean kg/ha; % germination)

Table 8. 4: Pressure Indicators Relevant for NTFPs Measurement

Pressure Indicator	Verifiers	Unit of Measurement	Methods
Biomass Removal	Timber	Volume/ha/year	Records
	Fuelwood	Volume/ha/year	Records
	Poles and Posts	Volume/ha/year	Records
	NTFP Species	Weight/ha/yea	NTFP harvester & buyer records
Grazing	Area	Ha.	Records
	Livestock Units	No./ha/year	Records, Transect walks
	Period	Months per year	Focus Group Discussions
Land Conversion	Forest to Crop Land	Ha./year	Records
	Forest to Settlement	Ha./year	Records
	Forest to Roads	Ha./year	Records
	Forest to Other Non-forest land use	Ha./year	Records

NTFP Harvesting Practices	Season	Degree of Appropriateness	Focus Group Discussions
	Tools Used	Degree of Appropriateness	Focus Group Discussions
	Methods/Techniques	Degree of Appropriateness	Focus Group Discussions
Fire	Area	M^2/ha/year	Records, Transect Walks
	Frequency	No./year	Records, Transect Walks
	Type	Crown, ground, surface	Records, Transect Walks
	Cause	Natural, Prescribed, Incidental	Focus Group Discussions
Socio-economic Pressures	Price	Rs./unit	Records, Producers Surveys, Market Surveys, Focus Group Discussions
	Unemployment	Rate	Economic Surveys
	Out-migration	No. young people continuing extractive activities	Interviews, Focus Group Discussions

Table 8. 5: Human Response Indicators Relevant for NTFPs Measurement

Human Response Indicator	Verifiers	Unit of Measurement	Methods
Promotion of Natural Regeneration	Timber	Ha/year reseeded, planted or managed for natural regeneration	Records
	NTFP species	Describe various techniques	Interviews, Focus groups
Conflict	Stakeholders	List each group	Interviews Focus groups Ethnographic fieldwork
	Frequency	No. per year	
	Issue	Describe conflict	
	Resolution	Facilitation, negotiation, mediation, arbitration, litigation, coercion	
Perceptions	Of nature	Describe, categorize	Ethnographic fieldwork Participant observation Interviews Focus groups
	Of value of NTFPs to livelihood, quality of life		
	Of land management		
	Of conservation		

	Of I & M efforts Of regulations		
Resource Management Regulations	Forest Department NTFP related regulations	Describe, categorize	Records Interviews or focus groups with managers and policymakers
Law Enforcement	Frequency	No. of Incidences/year	Law enforcement records.
	Types	Describe Incidences	Law enforcement records Interviews

8.2.5 Ecotourism

Tourism is an untapped resource in Pakistan. Given the wide variety of touristic spots available in the country, the potential to develop this as a source of livelihood for the local communities and earning of foreign exchange for the country are vast. The key point, however, is to promote pro-poor and pro-environment eco-tourism that does not cause any cultural, social, economic or environmental problems.

The following Proposed eco-tourism related indicators will be used for assessing the performance of ecotourism in PES scheme.

Table 8. 6: Indicators for measurement and monitoring of ecotourism

Category of Indicator	Indicator
Socio-Cultural Scope Indicators	
Land Property	No. of tourism facilities of which property is owned by and title held by local people
Access Roads	No. of kilometers of paved roads
Trainings	No. of trainings conducted
	Types of trainings conducted
	No. of people trained
Loss of local identity and values	No. of local festivals held
	No. of complaints by local people about loss of local identity and values
Adhesion of the community to the tourism	No. of community people who adhere to tourism as an economic activity
Economic Scope Indicators	
Economic activities	No. of persons or families that carry out tourism
Visitation	No. of visitors monthly/annually
Travel agencies	No. of tour operators working in the industry
	No. of trips sold
	Types of activities offered
Accommodation	No. and square feet of properties currently existing
	No. and square feet of properties being developed

	annually
Gastronomy	No. of restaurants and kiosks opened
	No. of dishes including tradition food
	Sale levels measured in Pakistani Rupees
Household income	Increased household income measured in Pakistani Rupees
	Percentage of household income from tourism
Basic resources	No. of basic resources and facilities that are available
	Quality of available resources and facilities
Transportation	No. of modes of transport available
	Quality of transport facilities
Environmental Scope Indicators	
Solid waste generation	Kilograms of garbage generated per month in peak season
Energy used	Megawatts of energy used in high season
Water supply	Liters of water used per month in high season
	No. of water bodies getting contaminated
Biodiversity Impacts	No. of plant species getting affected
	No. of animal species getting affected
	Sighting species with conservation problems
Landscape/Seascape Impacts	No. of landscape/seascape impacts
	Type of landscape/seascape impacts

8.3 Boundary setting

Mangroves PES Pilot ecosystem includes two sites; Port Qasim Authority Mangroves Area and Somiani Mangroves forest. PQA area falls in Malir and Thatta Districts of Sindh province whereas Somiani is part of Lasbela district of Balochistan. Due to the lack of high resolution satellite imageries for the pilot area, it was decided to utilize Google Earth Pro for mapping the mangroves. As mangrove forests are found in intertidal areas along the coastal belts, most of the forest area occurs inside the creeks. For accurate estimation of area under mangroves and creation of good quality maps within short time, Google Earth Pro is the best option because Google Earth VHR satellite data is freely available.

Visual interpretation and manual digitization was employed for identification and delineation of the mangrove patches. Each and every creek, narrow strip of few meters to wide mangrove, water and mudflats covered areas were digitized from the high resolution images of January 2017. Each PES site was divided into three main landuse classes i.e. a) areas under water, b) mangrove cover and c) mudflats. Digitization of mangroves linear strips along creeks took much time than the wide areas. After completing the area delineation and categorization into different landuse classes in Google Earth Pro, the kml files were imported to ArcMap 10.3 and further area calculation and mapping was completed through Arc Map. GPS coordinates of the project area were also shown on the map.

CHAPTER-9

9 LAND AND FOREST TENURE ISSUES IN PES SCHEME

9.1 Conceptual Foundation of Tenure and Property Rights

The design and implementation of PES schemes need to consider and take into account land and resource tenure rights. Well defined tenure systems help in allocation and distribution of benefits as well as determine non-compliance and non-compliance liabilities, thereby increasing the legitimacy and effectiveness of PES schemes. Tenure systems also determine who need to be involved in the PES scheme and what are their rights and responsibilities.

Tenure for the purposes of this PES scheme is defined as the right, whether defined in customary or statutory terms, that determines who can hold and use land (including mangrove forests and other landscapes and wetlands), water and coastal resources (forests, fisheries, wildlife, grasses, non-timber forest products, etc.), for how long, and under what conditions. Tenure covers both formal property rights (social relationships containing enforceable claims to rights in something), and informal relations that govern access to, use of and exclusion from resources. Tenure entails multiple mechanisms and involves numerous authorities. The distinction between formal property rights and informal relations is important. Property rights enforcement requires the existence of socially legitimate institutions that sanction these rights. In addition to these formal property rights there are other forms of accessing and benefiting from natural resources. These mechanisms may rely on other forms of authority and legitimacy.

Property rights are in fact a differentiated “bundle of rights” that are mutable over time. This bundle of rights include the rights pertaining to access, withdrawal, usufruct, control, management and decision making, exclusion, and alienation. Access rights concern the right to enter a defined physical property. Withdrawal rights allow users to obtain the “products or services” of a resources (e.g., provisioning services, regulating services, etc. such as to catch fish, collect fuelwood, forest carbon). Users’ with management rights have the right to establish rules and conditions that sanction under which the resources can be managed. Users with exclusion rights can determine who has access and withdrawal rights. Finally, users with alienation rights have the right to transfer their acquired rights to other parties. Depending on the number of claims they can make over a particular resource, five different types of property rights holders can be identified as follows:

(1) the authorized entrant holding access rights only, e.g., the right to enter and walk through a mangrove forest;
(2) the authorized user with both access and withdrawal rights, e.g., the rights to collect fuelwood of other produce from a mangrove forest;
(3) the claimant, with access, withdrawal and management rights, e.g., the right to make decisions about who can have access to, withdraw from or be involved in the management of mangrove forests and their resources;

(4) the proprietor, with all but alienation rights, e.g., the right to prevent others from accessing, withdrawing from and participating in management of mangrove forests; and

(5) the owner, who holds all "bundles of rights", e.g., the right to exercise all the above rights and also have the alienation right of a mangrove forest (the right to rent out, lease out, sell out or otherwise dispose of a mangrove forest).

Tenure systems can in turn be grouped in four categories depending on the nature of underlying property rights (Corbera, et.al. 2011):

Open access systems: In the open access systems access to natural resources is unregulated and open to everyone (such as atmosphere, north pole, south pole and open oceans). In such systems it is difficult, costly, or almost impossible to establish rules of exclusion and regulations across resources users.

State and public property: Here the state is the only institution with the legitimacy to vest access rights and management quotas over the resource to other users and have also the coercive powers of enforcement. The government can and usually does establish regulations for sustainable resource use. Monitoring of such regulations is usually expensive, especially where there is vast geographical spread of the resource and governments have limited resources for enforcing these regulations. This makes enforcement of regulations by governments ineffective. Because of this, exclusion from such state property is unsuccessful and informal access to resource does occur. In some other instances, these state properties are in de facto use by individuals, organizations and/or communities. An example, is the open range grazing in state owned Protected and Reserve Forests.

Private property: Here individuals and families hold full rights over land. They, however, rely on state-based political and legal institutions to recognize as well as enforce their property claims. The private property holders have the right to exclude others from resources. The legitimacy of such rights determines the costs of exclusion. Furthermore, property, particularly in forests because of their importance for watershed and biodiversity conservation, is often subject to regulations that in practice constrain how owners can manage their resources. Also, the state can alienate private property under the eminent domain for public purposes.

Common property: In common property regime a group of resource owners and users share collective ownership over a particular geographical territory and the resources thereon. These owners and users share rights of access to and management of the resources. They rely on both community and state-based authorities to assert their claims, establish management rules and exclude outsiders. The state, however, retains alienation rights. The example of such common property regimes are the Village Common Forests. A number of communities manage their resources in common but their "bundle of rights" over such resources is quite often socially differentiated and regulated by customary practices and community institutions.

9.2 Existing Tenure System in Mangrove Forest Areas of Pakistan

Although, mangrove forests under the management responsibility of Provincial Forest Departments in both Sindh and Balochistan provinces have been notified as Protected Forests with ownership rights vested in the provincial government, and local communities have neither land and resource ownership rights nor access rights as per in-vogue forest law. Local communities, however, make de-facto use of these resources for collection of dead and fallen wood, cutting of branches for fodder collection, and open range grazing of livestock in these forests. They also collect various non-timber forest products in these forests. Local fishermen communities who reside near these mangrove forests depend on their services as protection of spawning sites of fishes and shrimps.

Thus the coastal resources (land, fisheries and forests) in the PES scheme area are subject to a variety of multiple, flexible bundles of tenure rights, which may be held permanently or temporarily by different rights holders. They may have fixed or fluid boundaries, which may be periodically renegotiated, modified, rescinded and agreed upon by the community. These coastal resources will remain as a viable source of livelihoods only if they are governed responsibly. Secure tenure rights to the coastal resources can provide incentives for the environmentally sustainable use of forests, fisheries and other coastal natural resources and for responsible investments in the productivity of the resource systems.

This suggests that the mangrove forests tenure systems in the coastal areas of Pakistan are shaped by history, geography, and the political context and that their configuration responds to the existence of customary claims, the way tenure reforms are implemented, and governments' policies and discourses on forest conservation and use in the area.

9.3 Tenure Effect on PES Rights, Liabilities and Benefits Sharing

Many ecosystem services of mangrove forests, including climate regulation and water quality improvement, are public goods available to everyone without charge. Therefore, owners and managers of these forests are often uncompensated for their contribution to ecosystem service production, and non-consideration of these ecosystem services in the management planning of mangrove forests and under provision of these services is a likely result. Incentive payments equal to the value of ecosystem services of these forests provide a potential solution to the under provision of ecosystem services. This PES scheme therefore has been designed to provide the needed incentives for their sustainable management and continuous provision of their ecosystem services.

Mangrove forests and other resources tenure issues have important effects on ecosystem services rights, PES liabilities and PES benefit sharing. They are therefore critical for PES schemes design for the following reasons (Sunderlin et al., 2017):

- The essence of PES scheme is to reward those who maintain or enhance the forests and their ecosystem services, and compensate them for lost opportunities; this includes direct payment schemes, which require not only clear rights to land but also the ability to demonstrate exclusion rights, which includes the right and means to prevent third parties from changing land cover.
- The right holders to ecosystem services and their providers must be held accountable in the event that they fail to fulfill their obligation – the 'conditional' part of conditional incentives.
- When tenure is unclear or not formalized, forest people may be excluded from forests and/or from participation in PES scheme benefits; also, if PES increases the value of standing forests, it may lead to a resource rush that places the rights of current residents at risk.
- PES scheme will inevitably prohibit certain uses of forest resources; this must be done with due process and compensation, and without increased hardship, for poor forest peoples.

9.4 International Principles for the responsible governance of tenure

The international community has provided ten human rights-based implementation principles for how state and non-state actors should set up processes for the responsible governance of tenure. These include: human dignity, non-discrimination, equity and justice, gender equality, a holistic and sustainable approach, consultation and participation, the rule of law, transparency, accountability and continuous improvement.

9.5 Tenure Strengthening and Reform Strategies

Keeping in view the international principles with regard to tenure management, and based on international experiences and best practices, a suite of strategies are generally used for tenure strengthening and reforms. These proposed strategies fall under the following three main headings:

- Strategies for legal recognition and protection of tenure
- Strategies for proper implementation of tenure by governments and right holders
- Strategies to support the enjoyment of rights given under the tenure

9.5.1 Strategies for legal recognition and protection of tenure

- Where appropriate and required, legally recognize legitimate tenure rights to forests, fisheries and other natural resources and their rights holders by devolving the authority and responsibility to govern these, conditioned by legal requirements for inclusive, accountable and sustainable governance.
- Strengthen or establish a legal framework focusing on procedural rules to accommodate the complexity, diversity and flexibility of tenure rights to forests, fisheries and other natural commons.
- Agree on rules for the utilization of these resources, map their boundaries and register them based on a negotiated and inclusive local process.

- Establish a transparent policy-making and law-making process that enables communities and civil society to participate.
- Carry out advocacy work to support agreed tenure rights to the resources.

9.5.2 Strategies for implementation of agreed tenure rights governments and rights holders

- Strengthen or progressively develop inclusive and accountable community governance structures.
- Support the empowerment of marginalized and vulnerable groups within communities to make effective use of community institutions.
- Strengthen or develop the implementation capacities of concerned government officials and devolve human and financial resources.

9.5.3 Strategies to support the enjoyment of tenure rights

- Ensure access to justice, recognize and integrate local-level mechanisms, and enable legal advocacy.
- Strengthen the environmentally sustainable and economically viable use of forests and fisheries resources to maintain and create long-lasting benefits for community members.
- Ensure that any partnerships or contracts with investors support local livelihoods and do not infringe on agreed tenure rights to forests and fisheries, or violate related human rights.
- Engage in the facilitation of multi-stakeholder processes for the review of legislation and monitoring of institutions, processes and the rule of law.

9.5.4 Summary

Defining rights to mangrove forests, wildlife, fisheries and other coastal resources are central elements of structuring effective PES scheme in mangrove forests, particularly as it relates to sellers/service providers. Service providers in the mangrove forests PES should, in theory, be focused narrowly on the people whose right (de facto or statutory) to use or convert a resource is being affected, or who are undertaking the effort to protect the resource; any other payments may be used to influence attitudes but are not resulting directly in service provision. Although Provincial Governments in Sindh and Balochistan province have declared mangrove forests as Protected with ownership rights vested in the provincial government, in the design of a PES scheme like this one for mangrove forests, it would not be enough that Forest Departments alone act as singleservice providers with full rights to make decisions on management, exclusion, and transfer. Instead, there are complex relationships between:

- Provincial governments that establish rules around the use of forest, wildlife and fisheries resources (which may or may not be followed, monitored, or enforced);
- Coastal authorities, other government bodies who nominally manage the resources; and,

- Community members and users of the coastal resources who use the resources on a daily basis.

Where a service provider has clear and enforceable rights, a positive incentive through a PES system may be an appropriate intervention. However, where providers do not have recognized rights (either statutory or de facto) , PES is not likely to be an appropriate option on its own, as paying a provider for not breaking the law is a morally questionable approach. Rather in these cases it may make sense to initially recognize the rights of stakeholders to coastal resources through an appropriate consultative process as suggested in the above tenure strengthening and reform strategies given above.

CHAPTER-10

10 BENEFITS ALLOCATION AND DISTRIBUTION MECHANISM

10.1 Sources of PES Benefits

REDD+ PES benefits can accrue at different levels, from a variety of sources and in a number of forms. These benefits accrue at individual, community and local levels as well as at sub-national and national levels. The benefits may accrue from a variety of sources such as sale of carbon credits, through provision of watershed services, biodiversity conservation, eco-tourism, sale of non-timber forest products, and protection of infrastructure and communities from various types of natural and human caused disasters. Further PES benefits may be in economic terms, in social terms or in environmental terms. The following table (adapted from Preskett, 2011) describes these benefits:

Table 10. 1: PES Benefits Levels and Description

Benefit type/level	Description/function
Local level	
Economic	• Employment in REDD+ PES schemes • Income from direct incentive payments • Income from sale of products linked to REDD+PES • Increased net income due to local infrastructure improvements • Increased land and forest assets linked to REDD+PES
Social	• Local institutions more inclusive of poorer community members and better represent their interests in decision making processes • Reduced conflict and acknowledgement of roles • Improved health
Environmental	• Improved local environmental quality
Sub-national/National Level	
Economic	• Contribution to REDD+ finance to sub-national/national GDP and profits from sale of REDD+ credits and other PES benefits sources • Multiplier effects of REDD+ PES investments, such as spending of income in local markets or creation of jobs elsewhere in the economy • Physical (e.g. roads; monitoring systems) and institutional (e.g. better resourced forest management institutions) infrastructure improvements • Reduced spending, for example on flood management due to improved forest environmental services
Social	• Accountable sub-national/national institutions
Environmental	• Improved sub-national/national environmental quality

10.2 Criteria for Identification of Beneficiaries

Desirable features of REDD+PES program are often characterized in terms of the "3E" criteria of effectiveness, efficiency, and equity outcomes. For example, in the REDD+ context, effectiveness is a measure of "the amount of emissions reduced or removals increased by REDD+ actions" and efficiency a measure of "the costs of these emissions reductions or removal increases" (Angelsen, 2009:5). The third characteristic equity relates to the distribution of socio-economic factors and goods in

a society according to an agreed set of principles or criteria, which often include principles such as fairness, justice, equity and need.

Luttrell et al. (2013) have identified a typology of six rationales for the distribution and targeting of benefits that cut across all three objectives of effectiveness, efficiency, and equity. These six rationales represent different justifications for the allocation of benefits, namely that:

- benefits should go to actors with legal rights ("legal rights" rationale);
- benefits should go to those actors achieving emission reductions ("emission reductions" rationale);
- benefits should go to low-emitting forest stewards ("stewardship" rationale);
- those actors incurring costs should be compensated ("cost compensation" rationale);
- benefits should go to effective facilitators of REDD+ implementation ("facilitation" rationale);
- benefits should go to the poorest ("pro-poor" rationale).

10.3 Benefits Distribution Mechanism for Sindh and Balochistan PES Sites

In the following we propose a Mechanism for Disbursement and Management of Benefits for Sindh and Balochistan PES sites. Main Design Features of the Benefits Distribution System are given below:

Table 10. 2: PES Benefits Distribution Mechanism

PES Design Element	Proposed Measures
PES Benefits Receipts Mechanism	All monetary PES benefits would be deposited in a Fund (called REDD+ PES Fund) to be established for the purpose within the Sindh and Balochistan Forest Departments. All monies received and realized under the REDD+ program will be deposited into this fund. This includes any seed money by government, donor grants and donations, loans and performance based payments from sale of different forest ecosystem services. The fund will be operated and managed by the respective provincial forest departments in accordance with the Fund Management Rules on the analogy of KP Forest Development Fund (FDF).
PES Benefits Distribution Mechanism	All community cash payments from PES benefits received on account of Mangroves Forests will be made by the concerned Divisional Forest Officer based on agreements reached with the communities on this count. Community infrastructure schemes related expenditures and monies to be spent on forest rehabilitation to be incurred from REDD+/PES Fund will be done as per in-vogue procedures of Forest Departments.
Beneficiaries share: government and local communities	Under existing benefits distribution system accruing from mangrove forests in Sindh and Balochistan provinces, all of the sale proceeds go to government as local communities do not have any concessions in the sale proceeds of Protected Forests in these two provinces. Mangrove Forests being protected forests are exclusively owned by the provincial governments and local communities have no legal rights in the sale proceeds from these forests. However, to promote community participation in the mangroves conservation it is proposed to provide them benefits from the REDD+PES Scheme. Based on discussions with stakeholders in the workshops held at Karachi and Quetta, it is proposed that under the PES scheme, 20 % of the net PES income be distributed to the eligible local communities, another 30 % spent on the rehabilitation of these Mangrove Forests. An additional 30 % income may be spent on infrastructure development activities for the benefit of the forest dependent communities. The remaining 20 % PES income may be deposited as government revenue.
Payment Amount	Payment amount should cover at least opportunity costs, transactions, validation and registration costs, as well as implementation costs.
Payment Mode	Payments in both cash and kind forms will be desirable. The community benefits for infrastructure development will be in kind form whereas government share and 20 % part of local communities benefits amount is proposed to be paid in cash.
Group vs.	Both group and individual payments are a possibility to the local

Individual Payment	beneficiaries of these Mangroves Forests. Group payments will be in kind form for various natural resources and infrastructure development initiatives.
Payment Differentiation	Payments need to be differentiated based on cost of provision and ecosystem services provision. Payment differential is desirable when opportunity costs or potential for ecosystem benefits per hectare/activity varies significantly across sites, and estimates on differentiation criterion are available.
PES Contract Length	Although long contract periods are desirable; however, given the fact that there may be some beneficiaries who would rather prefer medium to short term contract lengths. It has to be borne in mind though that in case of REDD+ projects, the contract length has to be at least 20 years long so as to avoid the pitfalls on non-permanence.
Payment Duration	Payment duration will vary with the ecosystem service being contracted out. For example, Carbon contracts, biodiversity conservation contractions and watershed services provisions contracts will have to be long term given the nature of the ecosystem service and the need for continuity. As against this, some contracts like the ones related to eco-tourism, NTFPs, etc. could be comparatively short term.
Upfront Payment	Although local communities do and would demand some upfront payments; however, such option be exercised after due consideration of local context.
Payment Frequency	Frequent and activity-based payments are desirable from the perspective of local communities.
Degree of Conditionalilities for PES Payments	Low degree of conditionalities for PES Payments are important from the perspective of local communities. However, PES is a conditional contractual arrangement wherein payments are performance linked; therefore, this has to be kept in mind.
Type of Conditionalities for PES Payments	Local communities have a preference for activities based payments.
Unit of Management or Control for PES Payments	Most of the payments will be linked to group/collective performance by the communities. Some local communities may perceive the payment based on group performanceas less fair and not reflective of their individual performance.
Establishing Additionality for PES Payments	Many current PES schemes do not compute baselines, but rather justpay on the basis of an activity being implemented. The additionality issue is given most attention in carbon sequestrationprojects.
Leakages Prevention	Leakages may happen on account of activities shifting by those local communities who shift their demand to other places. To prevent such leakages, communities will be made accountable for

	any such damages in the surrounding/reference region.
Ensuring Permanence for Ecosystem Services	Permanencein Ecosystem Services provision can be at risk due to a number of reasons, including both anthropogenic and natural such as increasing opportunitycosts and natural factors such sea storms, etc. Though increasing opportunitycosts would not be problematic if contracts were perfectly enforceable,in practice the temptation for ES providers to breach a PES contractbecomes high when opportunity costs rise significantly. PES contracts needs to be designed in a way that ensure permanence as well as differentiate between intentional non-compliances and those which are beyond reasonable human control.
Benefits Targeting	In general, targeting can be implemented at different levels. Areabasedtargeting criteria, for example identifying ecologically importantregions, are relatively inexpensive.
Cost Targeting	Cost targeting can be an issue in Mangrove Forests when different local communities will have different provision and opportunity costs.
Facilitating Conditions for Supporting Pro-Poor Ecosystem Services Provision	Transaction costs are the main barriersto participation of poor communities in PES. Further hurdles may include lack of access toinformation and credit and lack of trust in government programs. Whenthese issues are relevant, PES design needs to be adapted to reduce barriers toparticipation for poor ES providers, for example by keeping transactioncosts low (e.g., allowing group applications, lowering requirements onproof of formal title), supporting poor people through capacitybuilding, technical assistance, access to inputs and credit, and buildingtrust through transparency and credible intermediary organizations.
Reducing Negative Impacts on Poor	Some of the PES interventions are likely to impact selected poor communities and selected members of some communities who are users of Mangrove Forests. Given these negative impacts, special precautionary measures or compensation package may be needed to address these negative impacts on poor.
Reducing Negative Impacts on Women	Any increase in women work load as a result of the PES program needs to be avoided or duly compensated for their additional time and effort in PES activities. This is an important equity consideration and needs to be abided by.

CHAPTER-11

11 PROMOTING THE ROLE OF WOMEN IN PES SCHEME

11.1 Roles of Women in Forests and PES Project

Women are categorized and portrayed in different roles in forests and PES projects. These fall into the following four broad categories:

- Women as Vulnerable Group
- Women as Beneficiaries
- Women as Stakeholders
- Women as Agents of Change

Women as Vulnerable Group

Characterization of women as a vulnerable group has its roots in the recognition how inequalities of access to and control and power over forests and their ecosystem products and services make women more vulnerable. For example, women may not get the same share in landed property and income from forest resources.

Women as Beneficiaries

By specifically targeting women as beneficiaries, forestry and PES projects activities have the potential to contribute to gender equality and women's empowerment, as well as other sustainable development goals.

As forestry and PES activities can be quite encompassing, women along with their families and wider communities can benefit from diverse opportunities such as through increased economic opportunities; improved capacities, environment, health and safety; and stronger social outcomes and over-all better environmental results.

Women as Stakeholders

As producers, consumers and users of forests and their various ecosystem products and services, women lives and livelihoods are affected by decisions in forestry sector at all levels. They, however, are not part of the decisions that are taken in the forestry. When women are excluded from forestry governance, decision making processes are more likely to result in forestry projects and policies that ignore the unique needs, aspirations, knowledge and contributions of women.

Women as Agents of Change

Women can transform and change the forestry sector in their roles as forestry sector entrepreneurs, innovators and decision makers. Integrating women into all levels of forestry sector and its value chain can unlock greater productivity, returns on investment, biomass energy use efficiency, etc. However, women's knowledge and capacities often go unrecognized because of social, political and economic structures hindering their access to and contributions in developing forestry sector resources.

11.2 Women Consultations and Engagement in the Pilot PES Projects

To recognize and enhance their role in the Pilot PES projects, a workshop has been held with women at Karachi for Mangrove Forests Pilot Project in May, 2018. In this

workshop opportunities and challenges for women participation in the PES projects were discussed.

11.3 Challenges for Women Participation in PES Projects

Based on discussions held in the workshops, the following challenges have been identified for women participation in PES projects at various phases of PES projects.

Planning Phase Challenges

- Limited information dissemination to women
- Weak or non-existing forestry sector policy, legal and institutional reforms targeting women
- Cultural barriers limiting women participation and leadership roles
- Limited time to participate due to already too much workload, including house chores, water collection, fuelwood collection, etc.
- Lack of or inadequate alternative sources of energy and income generating activities
- Lack of comprehensive consultations with women at all levels
- Limited resources allocation for women related forestry sector activities
- Few pilot demonstrations targeting women due to fewer resources allocation in the sector
- Limited support to women's initiatives since forestry is low among government priorities
- Limited opportunities for women to serve in the forestry sector and PES projects
- Women in NGOs who are interacting with rural women have limited knowledge of PES initiatives
- Poor linkages between local, district, provincial and national levels due to which women issues which are mostly discussed at the local level do not get integrated into higher level decision making processes
- No deliberate effort by other stakeholder groups to involve women in consultations and ensure their participation in forestry sector and PES projects
- Only limited and at times inaccurate information may reach women about PES projects
- Poor targeting and hence elite capture of benefits to the detriment of women

Implementation Phase Challenges

Following are the major issues in implementation phase of PES project:

- Women may not be employed in key PES projects positions
- Women Organizations (WOs) may not information in all phases and aspects of PES implementation
- PES funds and benefits may not target women and women organizations
- Limited decision making at household level by women may limit their benefits
- Women may have limited time to participate in PES activities
- Men in some situations may not allow women to participate in PES activities

- Women lack knowledge and skills to use monitoring and evaluation tools that may be used in PES projects implementation
- Poor implementation of land tenure laws
- Majority of the women do not own land in their names and hence may not be entitled to carbon and other PES benefits which are tied to land ownership
- Women are not informed about over-all forest policies and laws and more specifically about PES related policies and laws.

Consolidation Phase Challenges

Major challenges anticipated in the consolidation phase of PES project are as follows:

- Weak capacity by women to negotiate
- Conflicts with regard to benefit sharing at household levels
- Likely frustration by women with PES and hence reverting to negative environmental practices
- If this frustration continues, women may de-campaign about PES among the younger population
- Limited land ownership by women affecting equitable sharing of PES benefits
- Threat to women's priority for food and energy security at the household level
- Limited understanding of the technical, social and economic aspects of PES hindering women's meaningful participation
- Traditional perception and viewpoint in selected areas that "property cannot own property", i.e., women do not own property

11.4 Opportunities for Women Participation in PES Projects

Following have been identified as potential opportunities for women participation in PES projects at various stages.

Planning Phase Opportunities

Following are opportunities for women in planning phase of PES Projects:

- Women networks and platforms created for knowledge sharing, advocacy and lobbying on use of forest resources and PES
- Breaking of myths about women uses of the forest
- Capacity building leading to women's involvement in decision making and participation in forestry and PES projects
- Career opportunities for women in forestry, surveying information and communication technology, etc.
- The requirements of UNFCCC and other social environmental safeguards to involve all stakeholder, particularly the vulnerable groups
- Existence of supporters who promote recognition of women as key players in PES projects
- The opening of government to involve all stakeholders in PES projects
- The on-going policy, legal and institutional reforms in forestry sector
- Consulting women at community level

- The existence of women organizations in some localities
- Brining women organizations on board to fully participate on policy and laws related to PES
- Exploring venues for bringing about different tenure reforms as part of the PES project
- Building capacity of CBOs, CSOs and NGOs to address gender in forestry sector and PES projects
- Identifying context issues on how women can contribute to forestry and PES projects as agents of change
- Identify and recognizing women as stakeholders and beneficiaries in forestry sector and PES projects

Opportunities for Women in Implementation Phase

Implementation phase opportunities include the following:

- Improve women's livelihood and poverty reduction: women will and can obtain benefits such as income from the sale of NTFPs, etc.
- Empowerment of women, as women come together to share knowledge through networks, they also build their self-confidence, which enhances their participation in programs, including PES
- Increase participation in forest management as women become aware of their rights in community based forest management practices
- Training and capacity building of women so that they are equipped with good management skills as they come to learn more about forest management and the need to conserve forests for next generations
- Existence of women organization and civil society organizations that are gender-sensitive
- Existence of partners who are supportive of women involvement
- Proposed forestry sector reforms as part of the PES project
- Environmental and social safeguards
- Social and environmental impact assessment studies which highlight the vulnerabilities of women to climate and environmental issues
- Increasing entrepreneurial skills of women
- Greater involvement in decision making

Consolidation Phase Opportunities

Following are some of the opportunities in the consolidation phase"

- Training and knowledge sharing on forest management for communities and particularly women
- Access to formal and informal education for women
- Capacity building for educated women in technical, social, business and management skills and aspects of PES projects
- Skills development in vocational skills development for higher employment and income earning opportunities

- Elimination of stereotype role for men and women in forestry sector
- Increased dialogues with women on forest planning, management and uses
- Increased access to and use of various forest ecosystem goods and services and their benefits
- Involvement of women in MRV
- Creation of Women MRV Committees
- Legal protection of rights of women through contracts and other instruments
- Increased incomes for women from PES activities
- Use of alternative and other forms of energy to save women time from fuelwood collection
- Provision of water facilities as part of PES project to save their time from water fetching
- Forest conservation and women development fund as part of PES revenues
- Improved nutrition and health opportunities
- Improved and diversified income opportunities
- Improved opportunities for getting access to credit and start of businesses
- Increased opportunities for women to demand transparency, accountability and good governance with regard to women involvement in forestry sector and PES projects
- Increased access to information and hence enhanced chances to contribution in the forestry sector

CHAPTER-12

12 GOVERNANCE AND INSTITUTIONAL ARRANGEMENTS FOR PES AND REDD+

PES and REDD+ program management in Pakistan as well as at the Provincial level is a multi-objective, multi-functional, multi-actor and multi-scale phenomenon. It is multi-objective because the person at the helm of affairs has to ensure that the multiple program objectives (carbon sequestration, biodiversity conservation, community development) are achieved in an effective, efficient and equitable manner. There also has to be an effective participation of all the relevant groups. Moreover, different principles and elements of good governance such as access to information, transparency, accountability and results-based orientation will have to be paid attention too.

REDD+ program is multi-functional because in involves numerous functions such as program design and planning, program implementation and coordination, program monitoring and oversight, program evaluation, networking and public relations management, motivation and communication etc. It is multi-actor as it involves different roles and functions like putting in place and strengthening policy, legal and governance frameworks; carrying on planning and decisions making processes and functions; and implementing, compliance and enforcement. Finally the program is multi-scale as it can be implemented as a project, at the provincial level as well as at the national level

Having so many dimensions means it requires very meticulous design and planning. Therefore, the governance and institutional arrangements for REDD+ must ensure that all these dimensions of REDD+ are implemented with due diligence and care too.

12.1 Institutional Arrangements

Institutional arrangements for the institutionalization and promotion of REDD+PES at federal and provincial level will be established as proposed below:

Federal Level Institutional Arrangements

At the federal level, there is a National REDD+ Steering Committee, which will also look after and steer the PES projects. Similarly, National REDD+ Office has already been established under the Ministry of Climate Change which is coordinating REDD+ activities in the countries. This office needs to be streghtned to carry out different functions associated with the processing, coordination, and reporting of REDD+PES activities in close coordination with provinces.

Provincial Level Institutional Arrangements

Provincial level institutional arrangements are currently being established in the provinces for REDD+. Provincial REDD+ Focal Points have already been notified and Provincial REDD+ Management Committees have been established in Sindh and Balochistan provinces, where the two pilot PES sites are located. In the following we propose institutional set-ups at provincial and district/forest division

levels. Sindh and Balochistan Forest Departments hav agreed to these proposals in principles and there is no significant financial implications of these setups as these draw their strength from the existing departmental setup.

Provincial Level Set-Ups

- Provincial REDD+ Board
- Provincial REDD+ Management Committee

Forest Division Level Set-Ups

- Forest Division Level REDD+ Social and Environmental Safeguards and Grievance Redress Mechanism

I. Provincial REDD+ Board

Provincial REDD+ Board will be the REDD+ Apex Body at the province level.

Composition of the Provincial REDD+ Board

The Provincial REDD+ Board will have members from government departments, international organizations, community groups, civil society organizations, industry, women and relevant academic institutions. It will be chaired by the Additional Chief Secretary/Chairman Planning Board of the province. Its members will include:

- Secretary Forestry, Environment and Wildlife Department.
- Secretary, Finance Department.
- Secretary, Planning and Development Department.
- Secretary, Agriculture and Livestock Department.
- Secretary, Fisheries Department.
- Senior Member Board of Revenue.
- Secretary Mines and Minerals Department.
- Secretary Local Government and Rural Development Department.
- Secretary, Law Department.
- Representative of IUCN Pakistan
- Representative of WWF Pakistan
- Representative of Civil Society
- Representative of Industry
- Representative of Academic Institutions
- Representative of Women

Secretary Forestry, Environment and Wildlife Department shall act as Secretary of the Provincial REDD+ Board.

Roles and Functions of the Provincial REDD+Board

The REDD+ Board will carry out steering and liaison function involving the approval of REDD+ policies, plans, laws and programs. Detailed functions of the Provincial REDD+ Board with respect to the above role include:

- Act as a Think Tank and Strategic Resource for Sustainable Forest Management and REDD+ related matters by giving vision and framework;
- Review, develop and advocate for policies, laws and institutions for Sustainable Forest Management and REDD+;
- Review and approve the State of Forestry and REDD+ Report of the Province;
- Brief and Inform the Chief Minister and Minister-Incharge about the State of Forestry and REDD+ Report of the Province;
- Appraise the performance of the Department with regard to Sustainable Forest Management and REDD+;
- Coordinate with Federal Government on REDD+related matters;
- Coordinate with United Nations Framework Convention on Climate Change (UNFCCC) and Other International Forums on REDD+ matters;
- Identify and resolve basic issues hampering the implementation of REDD+ in the province;
- Identify and study the impact of various incentive measures for promoting Sustainable Forest Management and REDD+in the province;
- Increase transparency and accountability in the working of the REDD+program; and
- Any other relevant function as may contribute to effective REDD+ implementation in the province.

II. Provincial REDD+Management Committee

Composition of the Provincial REDD+ Management Committee

The Provincial REDD+ Management Committee shall be headed by the Secretary of Forest Department. Its members shall include the following:

Chief Conservators of Forests in the province

Conservator Wildlife

Director General, EPA

Director General, Tourism Department

Director General, Industries Department

Conservator of Forests, Planning/Working Plans

Provincial REDD+ Focal Person

One Representative of Forest Owners/Forest Concessionists

One Representative of Forest Users Groups

Head of Environment/Forestry Department from a public sector university

Representative of Chamber of Commerce and Industries

The Provincial REDD+ Focal Person shall be the Secretary of this Committee.

Functions of the Provincial Management Committee

The Provincial REDD+Management Committee shall have different, yet mutually reinforcing functions, which include:

- Supportive Function: involving preparation of REDD+ policies, plans, laws and institutional mechanisms, searching funding opportunities.
- Implementation Function: carrying out the previously determined mandate.
- Supervisory Function: involving progress review and monitoring the implementation of REDD+ programs.

III. Forest Divisions/District Level REDD+ Committees

Forest Division/District Level REDD+ Committees shall be established at each District Level where REDD+ Program is implemented. The Committee shall be chaired by the Divisional Forest Officer of the Forest Division of the concerned district headquarter. Its members shall include:

- DFO Wildlife
- District Officer of Agriculture Extension Department
- District Officer of Livestock and Dairy Development
- District Officer of Fisheries Department
- Assistant Commissioner Revenue Department
- A representative of Forest Owners/Forest Concessionists
- A representative of Forest Users Groups
- A representative of Civil Society Organization
- A representative of Women;
- Any other co-opted member.

The District Advisory Committees shall perform the following functions:

- Work as Think Tank and Resource Pool for the Provincial REDD+ Management Committee;
- Serve as platform for discussions on and resolution of REDD+ related issues at the district level;
- Provide information and data on REDD+ implementation at the district level to the Provincial REDD+ Management Committee.

CHAPTER-13

13 PROJECT RISKS AND RISKS MITIGATION STRATEGIES

Despite PES schemes strategic importance and Pakistan's commitment for its success, the implementation of PES schemes across the country may face certain risks. These risks can be external (e.g., finance) or internal (organizational weaknesses). Both types of risks need to be constantly monitored and relevant mitigation measures taken for their proper management. According to Roberts (2005) and based on discussions with stakeholders, effective risk management consists of the following steps:

- Risks Identification
- Risks Qualification
- Risks Evaluation
- Risks Mitigation

Risks Identification

In the identification stage, all potential risks and issues specific and inherent to the project are identified. Both the external and internal risks can be categorized in a number of ways. In the following table, we show the external or internal risks and the potential challenges these risks pose.

Table 13. 1 Risks and the challenges posed by the risk

Risk Category	Challenges Posed by the Risk
External Risks	
Informational	▪ Lack of awareness among beneficiaries and services providers.
Funding and Financial	▪ Non-availability of funds for project implementation. ▪ Perceived risks. ▪ High start-up costs. ▪ High transaction costs.
Spatial	▪ Spatial variability.
Temporal	▪ Non-permanence. ▪ Long time lags. ▪ Different time horizons of buyers and services providers. ▪ Different time horizons of different ecosystem services.
Institutional	▪ Multi-institutions involvement. ▪ Collective action problems. ▪ Weak community organizations and partners. ▪ Coordination and linkages problems.
Political, Governance and Bureaucratic	▪ Political instability. ▪ Changes in and reversal of government policies and priorities. ▪ Changes in bureaucracy and government failures to adopt and implement supportive policies, legislation and governance arrangements.
Economic and Market	▪ Low prices for carbon and other ecosystem services. ▪ Low economic returns and insufficient revenues from ecosystem services to pay for opportunity costs, transactions costs and implementation costs visa-a-vis high risks. ▪ Inflation and rising costs for project activities implementation. ▪ Extreme fluctuations in country currency exchange rates.
Security	▪ Insurgency.
External	▪ Wars.
Natural	▪ Tsunamis. ▪ Earthquakes.

	▪ Floods. ▪ Droughts. ▪ Forest Fires ▪ Diseases and Insects Pests Outbreaks ▪ Extreme weather events.
Internal Risks	
Technical	▪ Scientific uncertainty. ▪ Establishing baselines. ▪ Diffuseness. ▪ Appropriate program size. ▪ Avoiding leakages. ▪ Accuracy in ecosystems services valuation. ▪ Non-excludability and free-riding ▪ Shortages of skills and experience. ▪ Complicated measurement, monitoring, reporting and verification methods.
Organizational and Managerial	▪ Lack of capacities at organization level for project and program management. ▪ Organizational inertia.
Fiduciary	▪ Weak financial management and over-sight capacities.
UNFCCC Cancun and Other Social and Environmental Safeguards	▪ Lack of or inadequate capacities for proper understanding of the safeguards. ▪ Inadequate capacities to address safeguards in policies, laws and planning mechanisms. ▪ Inadequate capacities to respect safeguards in the field. ▪ Lack of or inadequate capacities to report on the safeguards system.
Stakeholders Engagement	▪ Inadequate engagement of key stakeholders.

Risks Qualification

The qualifications of the identified risks need to be rated and ranked and according to their likelihood and their impact on the project. Roberts (2005) proposes to create a risk matrix with scores from 0 to 11 for impact, and scores 0 to 10 for likelihood. For both, the value of zero stands for the least impact or least likelihood, and 11 or 10 respectively stand for the highest impact or likelihood. At the end each identified risk has two scores: one for likelihood and one for impact.

Risks Evaluation

In the evaluation stage, both scores are multiplied in order to assess the relative value of the risk or issue. These can also be categorized as low, medium and high. Low risk category has scores of 0 to 3 on the likelihood and impact scales). Medium risk category has scores of 4 to 6 on the likelihood and impact scales. High risk category has scores of 7 to 10 on likelihood scale and scores of 7 to 11 on impact scale.

Those elements that carry the highest risk factors need to paid special attention and prioritized for mitigation.

Using the evaluation criteria, the different risks are categorized as follows:

Table 13. 2: PES Risks Categorization, Challenges, Likelihood and Impact Scores

Risk Category	Challenges Posed by the Risk	Likelihood Score	Impact Score	Over-all Score
External Risks				
Informational	▪ Lack of awareness among beneficiaries and services providers.	▪ Medium	▪ Medium	▪ Medium
Funding and Financial	▪ Non-availability of funds for project implementation. ▪ Perceived risks. ▪ High start-up costs. ▪ High transaction costs.	▪ Low	▪ High	▪ Medium
Spatial	▪ Spatial variability.	▪ Low	▪ Medium	▪ Low
Temporal	▪ Non-permanence. ▪ Long time lags. ▪ Different time horizons of buyers and services providers. ▪ Different time horizons of different ecosystem services.	▪ Medium	▪ Medium	▪ Medium
Institutional	▪ Multi-institutions involvement. ▪ Collective action problems. ▪ Weak community organizations and partners. ▪ Coordination and linkages problems.	▪ Medium	▪ Medium	▪ Medium
Political, Governance and Bureaucratic	▪ Political instability. ▪ Changes in and reversal of government policies and priorities. ▪ Changes in bureaucracy and government failures to adopt and implement supportive policies, legislation and governance arrangements.	▪ Low	▪ High	▪ Medium
Economic and Market	▪ Low prices for carbon and other ecosystem services. ▪ Low economic returns and insufficient revenues from ecosystem services to pay for opportunity costs, transactions costs and implementation costs visa-a-vis high risks. ▪ Inflation and rising costs for project activities implementation. ▪ Extreme fluctuations in country currency exchange rates.	▪ Medium	▪ Medium	▪ Medium
Security	▪ Insurgency.	▪ Low	▪ High	▪ Medium
External	▪ Wars.	▪ Low	▪ High	▪ Medium
Natural	▪ Tsunamis.	▪ Low	▪ High	▪ Medium

	▪ Earthquakes. ▪ Floods. ▪ Droughts. ▪ Forest Fires ▪ Diseases and Insects Pests Outbreaks ▪ Extreme weather events.			
Internal Risks				
Technical	▪ Scientific uncertainty. ▪ Establishing baselines. ▪ Diffuseness. ▪ Appropriate program size. ▪ Avoiding leakages. ▪ Accuracy in ecosystems services valuation. ▪ Non-excludability and free-riding ▪ Shortages of skills and experience. ▪ Complicated measurement, monitoring, reporting and verification methods.	▪ Medium	▪ Medium	▪ Medium
Organizational and Managerial	▪ Lack of capacities at organization level for project and program management. ▪ Organizational inertia.	▪ Low	▪ Low	▪ Low
Fiduciary	▪ Weak financial management and over-sight capacities.	▪ Low	▪ Low	▪ Low
UNFCCC Cancun and Other Social and Environmental Safeguards	▪ Lack of or inadequate capacities for proper understanding of the safeguards. ▪ Inadequate capacities to address safeguards in policies, laws and planning mechanisms. ▪ Inadequate capacities to respect safeguards in the field. ▪ Lack of or inadequate capacities to report on the safeguards system.	▪ Low	▪ Low	▪ Low
Stakeholders Engagement	▪ Inadequate engagement of key stakeholders.	▪ Low	▪ Medium	▪ Medium

Risks Mitigation

In the mitigation stage, prominent risks need to be mitigated. Depending on the type of risk, a different combination of mitigation options can be used. Roberts (2005) has identified some options, which include:

- Sharing the risk
- Enduring the risk
- Avoiding the risk
- Lessening the risk

A risk can be reduced by sharing it with, for example, an insurance company, a project partner, or a public or financial institution.

The enduring option is only selected in those cases where the project can live with the risk. Only those risks are chosen for enduring in which the risks of harming the project are not too high so as to kill the project.

Certain risks can be avoided by being proactive and preparing alternative solutions, so that when the risks arise, an alternative is ready for implementation.

The last option, lessening the risk, focuses on reducing either the likelihood of the risk arising or the impact it will have if it arises.

Risks Mitigation Strategies

Following are the proposed risks mitigation strategies for the different types of risks:

Table 13. 3: Risks Mitigation Strategies

Risk Category	Challenges Posed by the Risk	Over-all Risk Score	Risk Mitigation Strategy
External Risks			
Informational	▪ Lack of awareness among beneficiaries and services providers.	▪ Medium	▪ Establish close cooperation with key partners and ensure pro-active engagement. ▪ Create awareness through making effective use of different information dissemination mechanisms, including print, electronic, social and theater media. ▪ Carry out advocacy work. ▪ Promote champions of PES amongst high political figures, policy makers, and other opinion makers.
Funding and Financial	▪ Non-availability of funds for project implementation. ▪ Perceived risks. ▪ High start-up costs. ▪ High transaction costs.	▪ Medium	▪ Diversify the PES funding sources and mechanisms. ▪ Explore options for the establishment of domestic financing mechanism such as from public sources, public-private partnerships, etc. aiming at funding a greater share of projects with in-country capacity. ▪ Explore other PES opportunities such as pollution control, water purification, bio-prospecting, etc. in addition to carbon finance initiatives only. ▪ Negotiate to reduce start-up costs and mobilize resources from different sources. ▪ Negotiate to reduce transactions costs through different measures. ▪ Reduce risks through adoption of a suite of risk mitigation strategies. ▪ Negotiate better contractual deals for service providers so as to increase the returns from PES services provisions.
Spatial	▪ Spatial variability.	▪ Low	▪ Adopt landscape approach to the extent possible.

Temporal	▪ Non-permanence. ▪ Long time lags. ▪ Different time horizons of buyers and services providers. ▪ Different time horizons of different ecosystem services.	▪ Medium	▪ Initiate and implement projects with long time spans to address non-permanence issues. ▪ Try to bring alignment in the time horizons of buyers and services provides through adoption of innovative financing and payments mechanisms which cater to the needs of both parties. ▪ Design PES schemes keeping in view the different time horizons of various ecosystem services.
Institutional	▪ Multi-institutions involvement. ▪ Collective action problems. ▪ Weak community organizations and partners. ▪ Coordination and linkages problems.	▪ Medium	▪ Making effective use of multi-sector and multi-stakeholders/institutions forums like the Mangroves Coordination Committee to make PES schemes a priority and as a standing agenda. ▪ Establish similar replica at other levels to ensure coordination at various level. ▪ Advocacy work so that appropriate resources are sanctioned for working of these fora. ▪ Capacitate PES institutions across all tiers of government, local communities and other stakeholder groups.
Political, Governance and Bureaucratic	▪ Political instability. ▪ Changes in and reversal of government policies and priorities. ▪ Changes in bureaucracy and government failures to adopt and implement supportive policies, legislation and governance arrangements.	▪ Medium	▪ Develop and implement an effective communication and information strategy for creating ownership for the project. ▪ Establish networks. ▪ Establish economic viability, and social and environmental desirability of the PES initiative. ▪ Establish close cooperation with key partners and ensure pro-active engagement. ▪ Create awareness through making effective use of different information dissemination mechanisms, including print, electronic, social and theater media. ▪ Carry out advocacy work. ▪ Promote champions of PES amongst high political figures, policy makers, and other opinion makers. ▪ Engage these key partners from start of the program.
Economic and Market	▪ Low prices for carbon and other ecosystem services. ▪ Low economic returns and insufficient revenues from ecosystem services to pay for opportunity costs, transactions costs	▪ Medium	▪ Slight price changes can be compensated through appropriate provisions and protections in the PES contracts. ▪ Work closely with PES services buyers to agree on equitable and fair compensation mechanisms. ▪ Work closely with government agencies and communities to mobilize resources for PES scheme

	and implementation costs visa-a-vis high risks. ▪ Inflation and rising costs for project activities implementation. ▪ Extreme fluctuations in country currency exchange rates.		from different sources available with the government and local communities.
Security	▪ Insurgency.	▪ Medium	▪ Be prepared to endure the risk.
External	▪ Wars.	▪ Medium	▪ Be prepared to endure the risk.
Natural	▪ Tsunamis. ▪ Earthquakes. ▪ Floods. ▪ Droughts. ▪ Forest Fires ▪ Diseases and Insects Pests Outbreaks ▪ Extreme weather events.	▪ Medium	▪ Establish and strengthen early warning systems. ▪ Train and capacitate stakeholders in disaster risk reduction strategies. ▪ Strengthen preparedness for various types of disasters. ▪ Strengthen disasters coping strategies at various levels. ▪ Take proactive actions.
Internal Risks			
Technical	▪ Scientific uncertainty. ▪ Establishing baselines. ▪ Diffuseness. ▪ Appropriate program size. ▪ Avoiding leakages. ▪ Accuracy in ecosystems services valuation. ▪ Non-excludability and free-riding ▪ Shortages of skills and experience. ▪ Complicated measurement, monitoring, reporting and verification methods.	▪ Medium	▪ Support research work on ecosystem services and PES related issues. ▪ Train staff and relevant members of communities in technical aspects of PES schemes. ▪ Strengthen Systems and Institutions on MRV as per the national MRV System. ▪ Assign sufficient resources (technical and financial at all levels). ▪ Adopt fully landscape approach ▪ Create a platform of jurisdictions within the landscape (e.g., large forest areas across several adjoining districts). ▪ Establish an enabling environment and good forest governance in all forest types and areas with sufficient resource support. ▪ Develop synergy with other projects and programs (Green Pakistan Program, Poverty Reduction Programs, Environmental Protection Programs, The Restoration Initiative, Sustainable Forest Management Program, etc.)
Organizational and Managerial	▪ Lack of capacities at organization level for project and program management. ▪ Organizational inertia.	▪ Low	▪ Create critical mass of qualified staff and PES promoters and facilitators in the organizations at national, provincial, district and local levels. ▪ Strengthen upfront the GIS and RS capability at federal and provincial levels for landscape planning and monitoring. ▪ Create partnerships with national and international centers of excellence on various aspects of PES schemes,

			including technical, policy, legal, marketing and research aspects, to name a few .
Fiduciary	▪ Weak financial management and over-sight capacities.	▪ Low	▪ Strengthen program management and financial oversight capabilities at federal, provincial,district and local levels. ▪ Ministry of Climate Change, Government of Pakistan and Provincial Forest Departments are accredited as Green Climate Fund (GCF) entities.
UNFCCC Cancun and Other Social and Environmental Safeguards	▪ Lack of or inadequate capacities for proper understanding of the safeguards. ▪ Inadequate capacities to address safeguards in policies, laws and planning mechanisms. ▪ Inadequate capacities to respect safeguards in the field. ▪ Lack of or inadequate capacities to report on the safeguards system.	▪ Low	▪ Implement UNFCCC and other social and environmental safeguards instruments through establishing and strengthening institutional set ups for the purpose. ▪ Prepare and implement the social and environmental management plan as per recommendations of the Climate, Law and Policy consultancy firm which has worked on these issues.
Stakeholders Engagement	▪ Inadequate engagement of key stakeholders.	▪ Medium	▪ Set clear, objective and transparent targeting strategy for the different stakeholders' engagement. ▪ Ensure stakeholders' engagement in work planning and monitoring of PES scheme. ▪ Create broader partnership with private sector and civil society both at landscape, provincial and federal levels.

CHAPTER-14

14 CONFLICTS AND CONFLICTS RESOLUTION MECHANISMS

14.1 Stakeholders

There a large number of government sector institutions and agencies, local communities and their organizations, and private sector bodies who are involved in the coastal areas of Pakistan. They are therefore stakeholders and have stakes in the management of mangroves in one way or another. Following is a list of these stakeholders:

- Federal Ministry of Climate Change
- Federal Ministry of Ports and Shipping
- National Institute of Oceanography (NIO)
- Pakistan Navy
- Zoological Survey Department (ZSD)
- Maritime Security Agency
- Marine Fisheries Department
- Pakistan Coast Guards
- Karachi Port Trust (KPT)
- Port Qasim Authority (PQA)
- Gawader Port Authority
- Federal Ministry of Food Security
- Federal Environmental Protection Agency (Pak-EPA)
- National Disasters Management Authority (NDMA)
- Provincial Forests and Wildlife Departments (Sindh & Balochistan Provinces)
- Provincial Coastal Development Authorities (Sindh & Balochistan Provinces)
- Provincial Revenue Departments (Sindh and Balochistan Provinces)
- Provincial Environment Departments (Sindh and Balochistan Provinces)
- Provincial Environmental Protection Agencies (Sindh and Balochistan Provinces)
- Provincial Fisheries Departments (Sindh and Balochistan Provinces)
- Provincial Disasters Management Authority (Sindh and Balochistan Provinces)
- Coastal Communities
- Grazing Communities
- General Communities
- IUCN-Pakistan
- WWF-Pakistan
- NGO's
- Academic and Research Institutions (Universities working on coastal areas)
- Tourism Departments of Sindh and Balochistan Provinces.
- Private Sector (e.g. Petroleum Exploration, Agro business and General trading sectors)
- Ecosystem Services Buyers

14.2 Conflicts Related to Mangroves PES Scheme

There can be a variety of sources or reasons for conflicts between different groups of actors and among actors within a group in this PES project. An improved understanding of the conflicts is important for conflicts management and resolution.

14.3 Potential Actors (based on discussions with stakeholders) in the PES Scheme Conflict

Major actors in the Mangrove PES Project Conflicts include the following:

- PES Services Providers
  - Forest Department
  - Local Communities-Fishing Community, Grazing Community and General Community
- PES Services Buyers
  - Port Authorities
  - Beneficiaries of Fish Spawning Ecosystem Service of Mangrove Forests
  - Industries
  - Eco-tourists
  - Disaster Management Authorities
  - City and Town Governments
  - Carbon Credits Buyers
- PES Services Intermediaries and Other Supporting Organizations, in situations where such organizations are made use of
  - PES Scheme Developers
  - PES Scheme Validators
  - PES Scheme Verifiers
  - Fisheries Department
  - Wildlife Department
  - Environment Department
  - Irrigation and Drainage Department
  - Other Regulatory Bodies
- Watch Dogs and Civil Society Organizations
  - NGOs
  - Civil Society Organizations
  - Media

14.4 Conflicts Analysis

Resolution of the different sources of conflicts among the different actors in the PES scheme would require proper understanding of the conflict. This would need conflict analysis, which will have to be integrated into the conflict management process, and a proper understanding of the allocation and distribution of rights, responsibilities, returns and relationships. Rights, responsibilities and returns are relationships that stakeholders have to the resource base:

- Rights are access and control over resources, as legally or informally defined.

- Responsibilities are roles and power in relation to the management of resources.
- Returns are the benefits and costs that a stakeholder derives from a resource, based on rights and responsibilities.

In addition, stakeholders have relationships among each other that are independent of the resource.

Five types of core issue may lead to conflicts:

- Problems with information
- Conflicting interests
- Difficult relationships
- Structural issues
- Conflicting values

Therefore, it is important to identify what gave rise to the issue:

- A perceived or actual difference or contending views
- A perceived or actual threat
- A gap - an absence or lack of important information, rules, regulations, etc.

Table 14. 1 ***: Matrix of Stakeholder who can potentially have conflicts in Mangrove PES Project***

	Forest Deptt:	Community	Fisheries Deptt:	Port Qasim Authority and Other Coastal Authorities as PES	EPAs	Industries	Eco-tourism Operators	Fisheries Society	Port Qasim Authority and Other Coastal Authorities as PES Services	Disasters Management Authorities	Carbon Buyers
Forest Deptt:		X				X			X		X
Community: Fishing, Grazing and General	X		X	X				X			
Fisheries Deptt:	X	X		X				X			
Port Qasim Authority and Other Coastal Authorities as PES Services Providers	X	X						X			
EPAs	X	X	X	X		X	X	X	X		
Industries	X	X			X						
Eco-tourism Operators	X	X									
Fisheries Society	X	X	X								
Port Qasim Authority and Other Coastal Authorities as PES Services Buyers	X	X									
Disasters Management Authorities		X		X							
Carbon Buyers	X	X									

14.5 Potential Sources of Conflict in the PES Scheme

Following are the potential sources of conflict among the above actors in the Mangrove PES scheme:

- Conflicts over resources and rights, when there is non-compliance with the agreed de jure and de-facto rights over resources and rights
- Conflicts over returns and benefits sharing
- Conflicts over responsibilities and performance, when there is non-compliance with the agreed responsibilities and performance
- Conflicts over relations

14.6 Conflicts Resolution Mechanism

The introduction of the PES scheme in mangrove areas can potentially have significant impacts on the dynamics of conflicts related to coastal resources and associated rights, returns and benefits sharing, responsibilities and performance, and over relations. Major strategies that are used in different situations include the following:

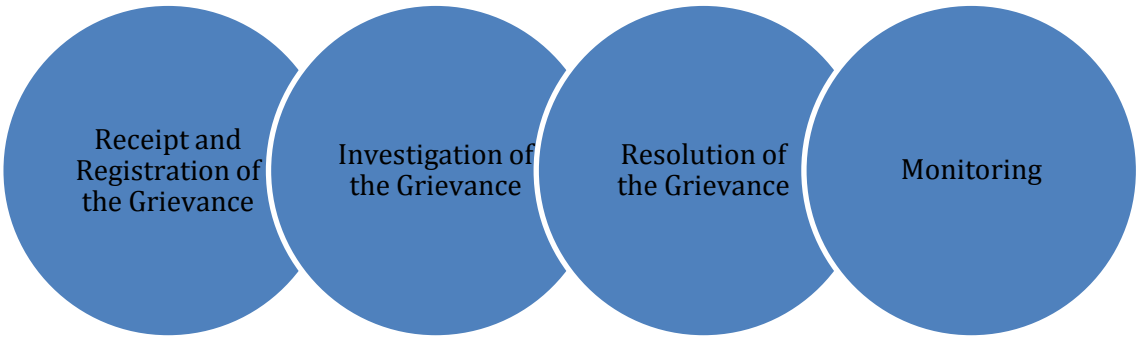
- ***Avoidance:*** acting to keep a conflict from becoming publicly acknowledged.
- ***Coercion:*** trying to impose one's will through the threat or use of force, including violence, protests, exertion of economic dominance and political contacts.
- ***Negotiation:*** following a voluntary process in which parties reach agreement through consensus.
- ***Mediation:*** using a third party to facilitate the negotiation process.
- ***Arbitration:*** submitting a conflict to a mutually agreeable third party, who renders a decision.
- ***Adjudication:*** relying on a judge or administrator to make a binding decision.

We propose to resolve PES related conflicts in one of the following four ways: negotiation, mediation and arbitration or adjudication. The use of negotiation, mediation and mediation strategies would require a Feedback and Grievance Redress Mechanism (FGRM).

14.7 Feedback and Grievance Redress Mechanism

This is an out of court conflict resolution mechanism, for which a unit will be established in each province. The proposed system is the one recommended by the consultants engaged for the purpose by the National REDD+ Office of the Ministry of Climate Change, Government of Pakistan. It is recommended that a Provincial FGRM is developed in both Sindh and Balochistan Province for this scheme on the analogy of the national FGRM, if the parties agree to go for an out of court solution of the grievance.

In line with this national FGRM, this provincial FGRM should also be implemented as a four-step process as given below:



Such a mechanism needs to be available from the start of the PES scheme so that problems are addressed at their initial stages before they turn into bigger issues. A 60-day resolution process is contemplated from the time the complaint is first registered. For this a dedicated person or complaints officer, based in the office of concerned Provincial Chief Conservator of Forests, is to be made responsible.

Step-1: Receipt and Registration of Grievance

The designated person in the field and relevant organizations (DFO, Conservator, Chief Conservator and Joint Mangrove Management Committee) can and will be able to receive complaints and take the initial steps to respond to them.

The PES scheme FGRM is designed to reach out to all stakeholders in the PES scheme. Complaints and grievances may be presented through multiple low cost channels that inter alia include email, website, feedback/complaint box, toll free number, SMS/WhatsApp, letter form, in person appearance, etc. For ease of access to various stakeholders, the provision and registration of complaints is to be permissible in local language, Urdu as well as English language.

The total time envisaged for registration of the grievance is seven working days.

Step 2: Investigation of Grievance

Once the grievance has been registered, the concerned person in the PES scheme is to compile the relevant information to help determine if it is possible and in what way the issue can be resolved. The concerned person will contact the complainant, other relevant parties, and organizations to obtain first-hand information in order to better understand the problem. The concerned staff officer gathers the opinions of the complainant and other principal parties involved by completing the matrix below. This includes potential resolutions and / or solutions to the complaint.

Table 14. 2: Complaints Processing Form

Actors	Complaint/ Issue	Position and interest	Legal basis	Witnesses and evidence	Proposed resolution	Recommended solution
Who are the relevant parties?	What is the complaint (s) or issue (s)?	What does the claimant request and why? What is the position of the other party?	What is the legal right or obligation that has been violated or not recognized?	What evidence is available to substantiate the complaint? Are there witnesses and if so, who are they and what is the information they provide?	What is the resolution requested by the claimant?	What is the resolution approach recommended?

The research process would take 20working days.

Step 3: Resolution

Once all the necessary information has been collected, the concerned officer recommends and implements a resolution approach at the appropriate level (mediation at village, district or province).

In the mediation the claimant and another party (affected) mutually discuss the resolution proposed and shape it in a process acceptable to both parties.

The concerned officer formulates a written response about the decision process and resolution. The way in which the response is formulated is as important as the content of the response, ensuring cultural sensitivity. A response generally consists of: i) the complaint and the issues that are being considered in the response, ii) the opinion of each party on the issues, iii) the justification for the decision, iv) the decision and the approach of the resolution.

The delivery of the response will be made by the complaints officer in a face-to-face meeting with the claimant. The complaints officer explains the resolution proposed. If the complainant is not satisfied with the resolution, he / she can appeal or proceed to use the available and applicable grievance mechanisms. If the complainant is satisfied with the resolution, he/she will receive additional instructions from the complaints officer how to implement the resolution.

The outcome of the procedure is an agreement between the parties. The parties will sign this agreement and will be obliged to comply with its stipulations.

If an acceptable solution is not found, complaints officer issues a report of the results of the session. The report is transmitted to the claimant and to all other parties.

Minutes and decision logged by complaints officer and stored in Provincial FGRM Unit office database.

The process of evaluation and decision making takes maximum of 20working days.

Step 4: Monitoring

The provincial PES Office in both Sindh and Balochistan provinces will be responsible for monitoring the implementation of the resolution of complaints. The provincial FGRM monitoring system can be a simple database from which the information can be analyzed to recognize the patterns of complaints, identify the causes of the complaint and evaluate how effectively the complaints are handled by the FGRM Unit.

It is recommended that a database is created to keep track of statistical information on complaints.

The monitoring process will take as long as the duration of the agreement and resolution of the complaint (usually between 3-12 months).

It has to be noted that the above proposed mechanism is not intended to replace the judiciary or other forms of legal recourse as may be specified in the PES contracts. Therefore, the procedure described above would apply in case the affected parties decide to use the FGRM in preference to other available mechanisms.

CHAPTER-15

15 ROADMAP FOR PES PROJECT IMPLEMENTATION

In the following we provide a generic flow chart for the conception, design, development, validation, registration, implementation, monitoring, verification and documentation of lessons learned of a PES project.

The conception and design phases of the PES project are being done under the current REDD+ Readiness Phase grant of FCPF to the government of Pakistan. In the work plan given below we describe the following steps and actions that need to be taken for Pilot PES Project Implementation:

- Consultations on and Review of the First Draft of Project Description Document
- Finalization of Project Description Document
- Validation of Project Description Document
- Registration of Pilot PES Project
- Implementation of Pilot PES Project
- Monitoring, Measurement and Report of Project Implementation
- Verification
- Issuance of Carbon Credits and Other PES Benefits
- Documentation of Lessons Learned from Pilot Project Implementation

The above steps are further detailed in the following action plan.

Roadmap Objectives	Action Steps	Timeline	Objectively Verifiable Indicators of Success	Primary Responsibility	Supporting Responsibility
Conducting Consultation on and doing review of the Draft Project Description Document	Activate the Mangrove Coordination Committee already constituted and notified. If need be, revise the composition and ToRs of the Mangroves Coordination Committee. The Ministry of Climate Change, Sindh and Balochistan Provincial Forest Departments and the Mangrove Coordination Committee in collaboration with conservation organizations like IUCN and WWF hold consultative meetings with different stakeholders in the PES scheme and get their feedback on the proposed Mangrove Forests Pilot PES scheme.	December, 2018.	Meetings of the Mangrove Coordination Committee are held and agenda for the meetings and minutes of the meetings are available. Consultative Meetings program for holding of joint consultative meetings of Ministry of Climate Change, Sindh and Balochistan Provincial Forest Departments and the Mangrove Coordination Committee with the different stakeholders in the PES scheme is prepared, implemented and minutes of the consultations held are available.	Ministry of Climate Change, Government of Pakistan.	Sindh and Balochistan Provincial Forest Departments.
Finalize the Project Description Document after the consultative and review process	Revise and finalize the Project Description Document.	March, 2019.	Copy of revised and final Project Description Document is prepared and available.	Ministry of Climate Change, Government of Pakistan.	Sindh and Balochistan Provincial Forest Departments.
Getting Letter of Endorsement for the Project from the Competent Authority in the Government of Pakistan	Liaise and interact with relevant agencies in the Government of Pakistan to get letter of endorsement for the project from the competent. The Project Proponents/Ministry of Climate Change, Government of Pakistan, lists the Project Description on the VCS Project Pipeline so that it appears in a section of the VCS Project Database for forthcoming projects. The Project Proponents/Ministry of Climate Change, Government of Pakistan opens an account with one of the two VCS Registry Operators (APX or Markit), both of which are linked with the VCS Project Database.	September, 2019.	Letter of endorsement for the project from the competent authority in the Government Pakistan is obtained and is available. The Project is listed in VCS Project Pipeline list and its Project Description is available in the VCS Project Database for forthcoming projects. Account is opened with one of the two VCS Registry Operators and Account Number is available.	Ministry of Climate Change, Government of Pakistan.	Sindh and Balochistan Provincial Forest Departments.
Conduct Third Party Validation of the Project Description Document	Engage independent Third Party Validator for validation of the Project Description Document.	December, 2019.	Project Description Validation letter is procured and available.	Ministry of Climate Change, Government of Pakistan.	Sindh and Balochistan Provincial Forest Departments.
Complete Project Registration with Verified Carbon Standard (VCS) and Climate Community and Biodiversity (CCB) Standard	Register Project with the Verified Carbon Standard and Climate, Community and Biodiversity Boards.	June, 2020.	Project Registration letter is procured and available.	Ministry of Climate Change, Government of Pakistan.	Sindh and Balochistan Provincial Forest Departments.
Project Implementation as per Project Description Document	Start Project Implementation as per approved and registered Project Description Document.	July, 2020.	Project Implementation is officially started.	Sindh and Balochistan Provincial Forest Departments.	Ministry of Climate Change, Government of Pakistan.

Putting in place Threshold Conditions for PES					
Advocacy for making constitutional amendment that recognizes and makes provisions for ecosystem services of forests.	Draft constitutional amendment after due consultation with all federating units.	December, 2020.	Draft of constitutional amendment by the Ministry of Climate Change after due consultation with all federating units for further processing is prepared and available.	Ministry of Climate Change, Government of Pakistan.	Provincial Governments.
Review and revision of forestry legislation at the national level and make appropriate provisions for PES.	Draft a new national level framework legislation for implementation of the national framework forest policy that has provisions for PES in the forestry sector.	December, 2020.	Draft of proposed legislation is prepared and available.	Ministry of Climate Change, Government of Pakistan.	Provincial Governments.
Review and revision of provincial forestry legislation and incorporate therein the required provisions for PES, rights to ecosystem services and other discernable regulatory regimes for PES.	Draft provincial forestry legislation that has provisions for PES, rights to ecosystem services and other discernable regulatory regimes for PES.	December, 2020.	Draft of proposed legislation is prepared and available.	Provincial Forest Departments.	Provincial Law Departments.
Addressing UNFCCC Cancun Safeguards and World Bank Social and Environmental Policies Safeguards.	Take concrete steps to address the recommendations made by Climate, Law and Policy and Hagler Bailey Consultancy with regard to UNFCCC Cancun and World Bank Environmental and Social Safeguards.	As per time line provided by the Consultancy Firms.	Drafts of proposals for accommodating the Cancun and Other Social and Environmental Safeguards are prepared and available.	Ministry of Climate Change, Government of Pakistan.	Provincial Governments.
Taking steps to address land tenure issues.	Take concrete steps to put in place the proposed strategies for legal recognition and protection of tenure of relevant PES services providers. Take concrete steps to put in place the proposed strategies for tenure rights implementation by governments and right holders. Take concrete steps to put in place the proposed strategies for supporting the enjoyment of tenure rights.	December, 2020.	Drafts of strategic actions are prepared and available.	Provincial Forest Departments.	Provincial Law Departments
Addressing key good forest governance factors: pillars and principles of good forest governance.	Take steps towards good forest governance for achieving positive and sustained resources conservation, development and environmental protection outcomes.	December. 2020.	Draft of forest governance reform is prepared and available.	Provincial Forest Departments.	Federal Ministry of Climate Change, Government of Pakistan.
Addressing drivers of deforestation and forest degradation and over-exploitation of other natural resources like wildlife, biodiversity, fishes.	Take steps to address the drivers of deforestation and forest degradation related to managing the demand and consumption of various forest and other natural resources products and services, e.g., fuelwood, timber, fodder, grazing of livestock, harvesting of fisheries, extraction of various non-timber forest products, etc.	December, 2020.	Action plan implementation of agreed interventions is prepared and available.	Provincial Forest Departments.	Federal Ministry of Climate Change, Government of Pakistan.

	Take steps to address the drivers of deforestation and forest degradation that result in converting forest land into other land uses such as agriculture, settlements, infrastructure, mining, etc. Take steps to reduce the pressures resulting on forests, wildlife, fisheries and other PES resources resulting from natural or human made hazards, such as climate change, droughts, floods, extreme weather events, fires, landslide, wave action of passing ships, insects pests and diseases of these resources.				
Instituting appropriate institutional mechanisms for PES at national and provincial levels.	Ministry of Climate Change at the national level takes steps to design and develop an appropriate institutional apparatus for PES in the Ministry. Provincial Forest Departments take steps to design and develop appropriate institutional mechanisms for PES in the province.	December, 2019.	Draft of Proposal for PES Institutional Architecture at the national is prepared and available. Draft of Proposals for PES Institutional Architectures at provincial levels are prepared and available.		
Identification and targeting of potential buyers for the identified PES services (Coastal protection and pollution prevention; protection of spawning sites of fishes and shrimps; biodiversity conservation and ecotourism; climate change mitigation; and shoreline stabilization and prevention and control of sea intrusion).	Identify and target potential buyers of various ecosystem services of mangrove forests. Negotiate with the potential members in communities who would be partners in the proposed PES pilot scheme. Identify and target potential intermediaries to bring together buyers and sellers of ecosystem services and provide other needed services for PES pilot project materialization. Develop criteria for price setting of different PES services and initiate negotiations between buyers and sellers of PES services. Develop and negotiate sale and purchase agreements between buyers and sellers of different PES services.	March, 2019.	Potential buyers for various ecosystem services identified and negotiations held with the buyers. Records of meetings and negotiations held are prepared and available.	Sindh and Balochistan Provincial Forest Departments.	Ministry of Climate Change, Government of Pakistan.
Addressing Policy Gaps					
Reviewing and revising national and forest, wildlife, fisheries and environment policies to make them conducive for and supportive of PES.	Review and revise national forest, wildlife, fisheries and environment policies to make these conducive for and supportive of PES program in the forestry sector. Develop an action plan for implementing PES related provisions of various national policies.	December, 2019.	Review completed and draft of revised policies prepared and available. Action plan for implementation modalities of the revised policies prepared and available.	Ministry of Climate Change, Government of Pakistan.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.

Reviewing provincial forest, wildlife, fisheries and environmental policies to make them conducive for and supportive of PES program.	Review and revise provincial forest, wildlife, fisheries and environment policies to make these conducive for and supportive of PES program in the forestry sector. Develop an action plan for implementing PES related provisions of various provincial policies.	December, 2019.	Review completed and draft of revised policies prepared and available. Action plan for implementation modalities of the revised policies prepared and available.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.
Addressing Institutional Gaps and undertaking institutional development and organizational strengthening activities at the national level.	Undertake institutional capacity assessment exercise at the national Ministry of Climate Change level and identify capacity gaps. Develop capacity building plan for the identified institutional capacity gaps. Prepare a project document for institutional development and organizational strengthening.	December, 2019.	Institutional capacity assessment done and report prepared and available. Capacity building plan prepared and available. Project document for institutional development and organizational strengthening prepared and available.	Ministry of Climate Change, Government of Pakistan.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.
Addressing Institutional Gaps and undertaking institutional development and organizational strengthening activities at provincial levels.	Undertake institutional capacity assessment exercise at the Forest, Wildlife, Fisheries and Environment Departments level and identify capacity gaps. Develop capacity building plan for the identified institutional capacity gaps. Prepare a project document for institutional development and organizational strengthening.	December, 2019.	Institutional capacity assessment done and report prepared and available. Capacity building plan prepared and available. Project document for institutional development and organizational strengthening prepared and available.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.
Identifying, involving and strengthening the role of intermediaries.	Identify intermediaries for the PES program who could perform different supporting functions for PES program design and implementation. Negotiate with the intermediaries and involve them. Strengthen the role of intermediaries in the PES program.	December, 2019.	A panel of intermediaries is available. Minutes of discussions and negotiations held with intermediaries. A list of steps and measures taken to strengthen the role of intermediaries.	Provincial Forest Departments.	Federal Ministry of Climate Change, Government of Pakistan.
Engaging stakeholders and ensuring their effective participation in PES program.	Identify and liaise with all the relevant stakeholders at the national and provincial levels. Develop a plan for stakeholders' engagement. Implement the stakeholders' engagement plan.	December, 2019.	Stakeholders' engagement plan prepared and available. Project proposal prepared for effective implementation of the stakeholders engagement plan. Resources procured for implementation of the plan and plan implementation underway and progress reports of implementation prepared and available.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.

Developing incentives allocations and benefits distribution and disbursement mechanisms.	Develop incentives allocations and benefits distribution and disbursement mechanisms. Discuss with and get endorsement of local communities and other PES participants for the proposed incentives allocation and benefits distribution and disbursement mechanisms. Implement the developed and agreed plan.	December, 2019 to end of project in December 2050.	Incentives allocation and benefits distribution and disbursement plan prepared and available. Discussions with local communities and other PES participants held and minutes of the meetings held prepared and available. Implementation of the plan is underway and progress reports of implementation prepared and available.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.
Ensuring funding for PES project from different sources.	Prepare proposals for securing funding for PES project from different sources. Advocate for procuring the needed funds.	December, 2019.	Proposals for securing funding for PES projects prepared and being processed. Advocacy material for PES financing prepared and being widely circulated to relevant parties.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.
Making Project Proposals for GCF Funding	Prepare and process project proposals for GCF funding of PES programs.	July, 2019.	GCP Project concepts prepared and under process.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.
Implementing Awareness Creation Program					
Implementing awareness programs among local communities to increase their appreciation of the long-term value of mangrove forests and their ecosystem services and the benefits that can be generated through implementing PES schemes, and their understanding of the impact of their activities to the mangrove ecosystems and their ecosystem services.					
Conducting a campaign (workshops, exhibitions, etc.) at local, provincial and national levels to promote the attraction and value of mangrove ecosystem (biodiversity, water purification value, natural disaster protection, economic value, recreation etc.)					
Establishing a Stakeholders Forum for discussing the mangrove					

management issues Between Forest and other government departments, local community, private sector, NGOs, media, and PES services buyers.					
Conducting radio / TV talk-shows and writing press articles to promote the project.					
Implementing Training and Capacity Building Program					
Training local community in the skills necessary to involve in the project activities.					
Training other departments (fisheries, wildlife, environment etc.) in the skills necessary to involve in the project activities.					
Training NGOs and Other Stakeholders like Media in the skills necessary to do advocacy work in support of the PES project.					
Training Provincial Forest Departments para-professional staff in the skills necessary to implement various project activities.					
Training other project partners relevant staff (Port Qasim Authority, Industries, Karachi City Government, Hospitals, Industrials Estates, etc.) in the skills necessary to involve in the project activities.					
Training religious leaders and other opinion makers in the skills necessary to involve in the project activities					
Improving the capacity of project staff and government partners on technical and project management, climate change mitigation, biodiversity conservation, eco-tourism, pollution control, shoreline stabilization, etc.					
Implementing PDD Activities related to outcome 1: Reduced threats to existing mangrove forests in the project area	The following tasks are accomplished:	July 2020 to end of project period in December 2050.	Plans for protection of existing natural forests and enhancement of forest area through planting of mud flats are prepared and under implementation.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.

and increased area of mangrove forests thereby maintaining and enhancing the capacity of mangrove forests to provide ecosystem services.					
	Consultations held and industrial pollution reduction plan developed and being implemented.				
	Consultations held and urban pollution and hospital waste reduction plan developed and being implemented.				
	Consultations held and municipal waste pollution reduction plan developed and being implemented.				
	Consultations held and Port Qasim Area pollution reduction plan developed and being implemented.				
	Consultations held and solid waste dumping pollution reduction plan developed and being implemented.				
	Consultations held and agro-chemicals and agricultural waste pollution via coastal rivers (Lyari, Malir and Hub) reduction plan developed and being implemented.				
	Consultations held and shipping vessels and ships breaking facility pollution reduction plan developed and being implemented.				
	Consultations held and measures for controlling cutting of mangrove trees for fuelwood purposes agreed, codified and being implemented.				
	Consultations held and measures for controlling cutting of branches and lopping of mangrove trees for animal fodder purposes agreed, codified and being implemented.				
	Consultations held and plan for controlling unauthorized construction of habitation and business purposes developed and being implemented.				
	Consultations held and plan developed for controlling sea level intrusion into terrestrial coastal belts and being implemented.				
	Consultations held and plan developed for controlling intrusion of saline water into fresh water and being implemented.				
	Consultations held and plan developed for planting of mangroves over 11,550 ha mud flats in the project areas and being implemented.				

Implementing PDD Activities related to outcome 2: Models of public and private sector PES and related schemes developed and demonstrated within the project area, and the approach replicated in the wider coastal region of Pakistan.	The following tasks are accomplished:	July 2020 to end of project period in December 2050.	MoUs developed and signed for public-private sector mangrove forests PES schemes. These PES schemes are meant to reward the maintenance, improvement or adoption of mangrove forests conservation and expansion-friendly measures. Copies of Project Design Documents and copies of signed MoUs between public-private partners for PES Schemes implementation are available and under implementation.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.
	At least two project proposals for public-private PES program developed by the Ministry of Climate Change and are under implementation.				
	At least one project proposal for public-private PES program developed by Sindh Forest Department and is under implementation.				
	At least one project proposal for public-private PES program developed by Balochistan Forest Department and is under implementation.				
Implementing PDD Activities related to outcome 3: Enhanced technical capacity of key stakeholders to develop and implement PES schemes and recommendations made for improved policy, legal and institutional framework at the national and provincial levels so as to institutionalize PES concept in forest resources conservation and management.	The following tasks are accomplished:	July 2020 to end of project period in December 2050.	At least 70 % of key stakeholders in coastal areas with mangrove forests are aware of PES and related sustainable financing mechanisms, and are considering adopting them for the conservation and sustainable management of mangroves forests in their areas. Concrete proposals for policy, legal and institutional reforms that are supportive of PES program are prepared at the national level as well as the provincial governments levels.	Relevant Provincial Government Departments-Forests, Wildlife, Fisheries and Environment.	Ministry of Climate Change, Government of Pakistan.
	Proposals for policy, legal and institutional reforms at the national level that are supportive of PES programs are developed.				
	Proposals for policy, legal and institutional reforms at provincial levels that are supportive of PES programs are developed.				
Implementing PDD Activities related to outcome 4:	The following tasks are accomplished:	July 2020 to end of project period in 2050.	Project experiences and lessons learned ('how-to' manuals, good	Relevant Provincial Government Departments-Forests, Wildlife,	Ministry of Climate Change, Government of Pakistan.

Increased availability of information on, and awareness of, PES concepts, schemes and opportunities increased in the provinces and at the national level.			practices guidelines, etc.) captured and available to key provincial, national and international conservation and development community through project website.	Fisheries and Environment.	
	Design, develop and implement large-scale awareness creation and training and capacity building program on PES in the forestry sector for the staff of Provincial Forest Departments.				
	Design, develop and implement large-scale awareness creation and training and capacity building program on PES in the forestry sector for the relevant communities.				
	Design, develop and implement large-scale awareness creation and training and capacity building program on PES in the forestry sector for the staff of other relevant departments.				
	Design, develop and implement large-scale awareness creation and training and capacity building program on PES in the forestry sector for politicians, policy makers and other opinion makers.				
Adopting and Implementing a UNFCCC Cancun and Other Social and Environmental Safeguards System	Adopt the UNFCCC and Other Social and Environmental Safeguards System developed by Climate, Law and Policy Consultants under the Readiness Phase Project. Implement the UNFCCC and Other Social and Environmental Safeguards System developed by Climate, Law and Policy Consultants under the Readiness Phase Project. Report to the UNFCCC Secretariat on Safeguards as per requirements of UNFCCC on the safeguards reporting.	The Safeguards Information System (SIS) is developed as per time frame proposed by the Climate, Law and Policy consultants. The safeguards system is implemented all along during the project period.	A system for proper Understanding of the Safeguards developed by the consultants is available and being implemented. A system for proper Addressing of the Safeguards developed by the consultants is available and being implemented. A system for proper Respecting of the Safeguards developed by the consultants is available and being implemented. A system for proper Reporting of Safeguards (Safeguards Information System) developed by the consultants is available and being implemented.	Ministry of Climate Change, Government of Pakistan.	Provincial Forest Departments.
Monitoring, Measurement and Reporting of Project Activities	Prepare and implement a comprehensive monitoring system for various ecosystem services so as to cover the following:	All along during project implementation.	A comprehensive monitoring system for various ecosystem services is prepared and functioning as evident from different	Provincial Forest Departments.	Ministry of Climate Change, Government of Pakistan.

	A monitoring system of forest cover using remote sensing; A system for monitoring carbon on the ground through activity data emission factors data, and greenhouse gases emissions and removals using latest IPCC Guidance; A system for monitoring industrial pollution going into the sea; A system for monitoring for monitoring urban, hospital and municipal waste going into the sea; A system for monitoring agricultural and other waste going into the sea; A system for monitoring biodiversity conservation and eco-tourism activities going in the project area; A system for monitoring coastal protection happening as a result of mangroves; A system for monitoring fisheries catch going on in the project area; A system for monitoring shoreline protection and sea intrusion control; and Integrate the provincial monitoring system with national forest inventory and national greenhouse gases inventory. Train staff with regard to UNFCCC and IPCC Guidelines. Train staff with regard to GIS and remote sensing as well as managing the information produced. Train staff for field measurements for forest carbon stock and other ecosystem services and to manage the information produced. Establish MRV units with necessary equipment, software, financial resources and qualified staff. Design, develop and implement a system for		project progress reports. Training and capacity building is prepared and implemented as evident from different project progress reports. Training and capacity building modules on various topics are prepared and available. Training program implementation progress reports are prepared and available. MRV reports are prepared and available.		

	reporting on various ecosystem services.				
Verification of Project Activities Through Third Party Verifiers	Submit the monitoring reports for Third Party Verification as per agreed frequency.	All along during project implementation.	Third Party Verification Reports are prepared and available.	Provincial Forest Departments.	Ministry of Climate Change, Government of Pakistan.
Arranging for Issuance of Carbon Credits and Other PES Incentives	Prepare claims for carbon credits and other PES benefits in light of verification reports of Third Party Verifiers, duly accounting for any amounts that have to go to buffers. Receive, record and manage the credits.	All along during project implementation.	Claims for carbon credits and other PES benefits in light of verification reports of Third Party Verifiers are prepared. Record of credits received is prepared and available.	Provincial Forest Departments.	Ministry of Climate Change, Government of Pakistan.
Distribution and Disbursement of Project Benefits to concerned Beneficiaries	Design and develop a benefits allocation, distribution and disbursement system. Establish institutional mechanisms for operation of the benefits distribution and disbursement system. Keep records and accounts of the incentives and benefits distributed. Undertake audit of the accounts of benefits distributed.	All along during project implementation.	A benefits allocation, distribution and disbursement system is designed, developed and available. Institutional mechanisms for the benefits distribution and disbursement are in established and functioning. Records and accounts of the incentives and benefits distributed are prepared and available. Audits of the accounts are done and audit reports are available.	Provincial Forest Departments.	Ministry of Climate Change, Government of Pakistan.
Receiving Feedback and Addressing Grievances of Stakeholders	Develop and establish feedback receiving, conflicts resolving and grievance redress mechanisms at different levels for different stakeholder groups. Receive feedback from different stakeholder groups. Manage any conflicts regarding the PES scheme. Document the feedback received, conflicts that have arisen and the functioning of the grievance redress mechanisms.	All along during project implementation.	Feedback, conflicts resolution and grievance redress mechanism are established and functioning at different levels. Documentation of feedback received, conflicts and grievances that have arisen, redressed and managed is prepared and available.	Provincial Forest Departments.	Ministry of Climate Change, Government of Pakistan.
Documentation of Lessons Learned under the Project	Collect information on best practices and lessons learned. Document the best practices and lessons learned.	All along during project implementation.	Information on best practices on PES schemes implementation in the context of Pakistan is collected and available. The information on best practices and lessons learned is documented	Ministry of Climate Change, Government of Pakistan.	Provincial Forest Departments.

			and copies of documents available.		
Dissemination of Lessons Learned	Disseminate the lessons learned to concerned agencies and stakeholders.	All along during project implementation and beyond.	The information on best practices and lessons learned is disseminated to all concerned agencies and stakeholders and record of dissemination of the documents is available.	Ministry of Climate Change, Government of Pakistan.	Provincial Forest Departments.
Preparation of Project Proposals for replication of pilot PES Projects in other Forest Ecosystems and Geographic Regions of Pakistan.	Prepare project proposals for PES Project Schemes in the following forest ecosystems: Moist Temperate Forests in Neelum Valley, Azad Kashmir. Murree Guzara Forests, Rawalpindi. Ziarat Juniper Forests, Balochistan. Temperate Forests in Astore, Gilgit-Baltistan. Dry Temperate Forests in Chitral, Khyber Pakhtunkhwa. Chilghoza Pine Forests in FR D.I.Khan and South Waziristan Agency. Chilghoza Pine Forests in Sherani District, Balochistan. Coniferous Forests in Naltar, Gilgit-Baltistan.	June, 2020.	PES Project Proposals for different forest ecosystems in Pakistan are prepared and available.	Ministry of Climate Change, Government of Pakistan.	Concerned Provincial and Territorial Forest Departments.

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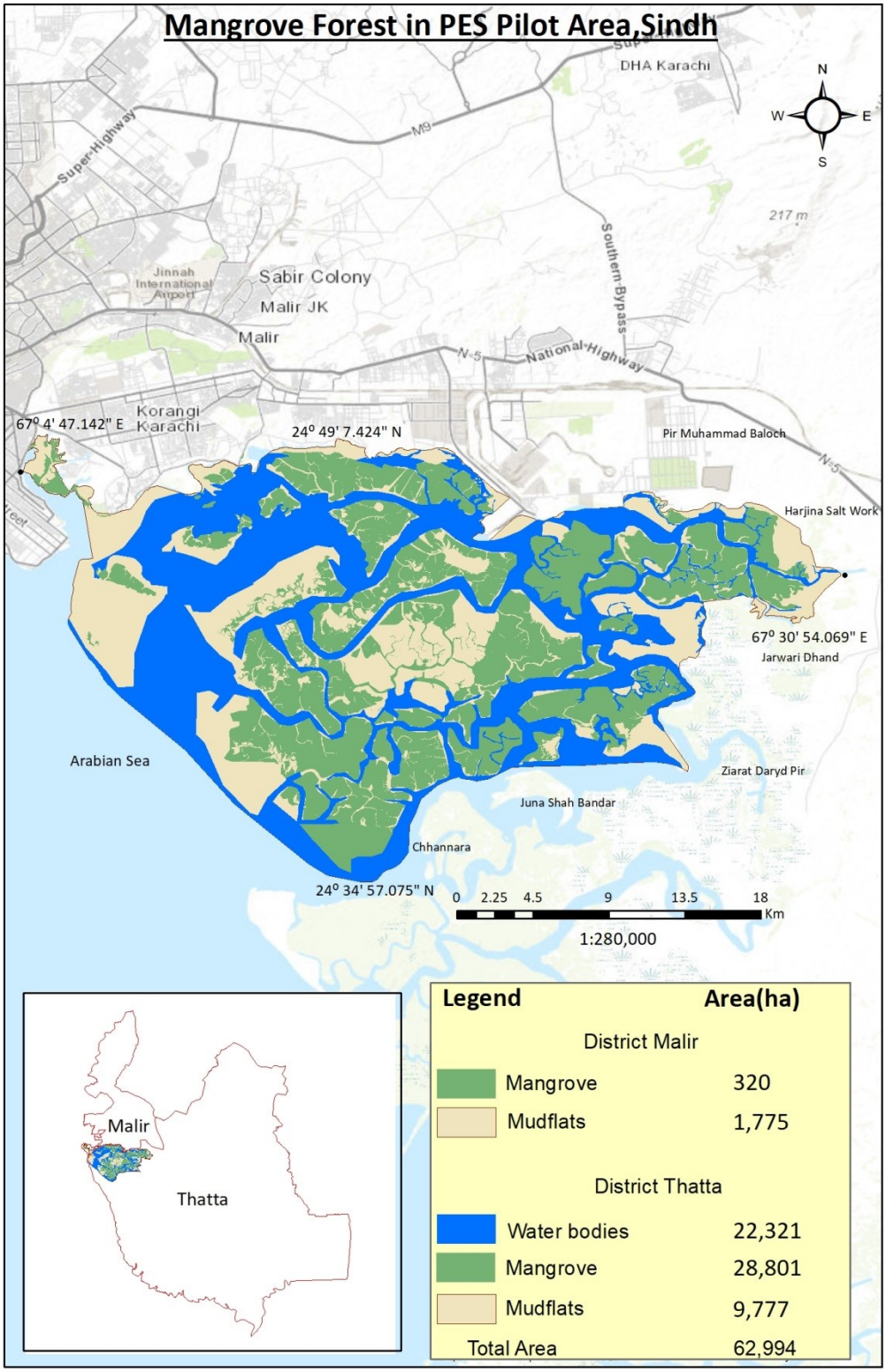
Annex-1

Map of Mangrove Forest Pilot Area of Sindh



Annex-2

Map of Mangrove Forest Pilot Area of Balochistan

Annex-3

Glimpses of Focus Group Discussions in Sindh PES Pilot Area

Rehri Got, Karachi

Latbasti, Karachi

Latbasti, Karachi

Chashma Got, Karachi

Annex-4

Background of fishery situation

The drastic reduction of freshwater flows in the Indus River Delta region and its consequences in the form of environmental and livelihood degradation at the Sindh coastal area begun with the construction of large-scale irrigation infrastructure upstream some hundred twenty years ago in 1890s when the first Punjab irrigation system was developed. The additional construction of SukkurBarrage in 1932, Kotriin 1955 and Guddu Barrage in 1962 further reduced massively the quantity of freshwater reaching the Indus Delta - thereby causing huge degradation of land, and almost closure on agriculture, forestry and other natural resources in the delta region stretching from Karachi in northwest to border with India in southeast along the Sindh coast.

Before the construction of dams and barrages, the freshwater discharge from the Indus River was so strong that it pushed back the sea currents up to a hundred miles from the shore. The freshwater was also seeping inside the ground on both sides of the Indus and the water pressure was strong enough to stop saline seawater from infiltrating the coastal land area soils and thus people had freshwater in their surface wells, which could be used for irrigating of their farmlands. Due to the enormous quantity of fresh water and the silt deposition the delta lands became the richest in the area. Agriculture yields were high in consequence. People along the delta coastwould grow a variety of crops after the recession of floods. The silt brought during high floods would settle in the vast catchments and provide a fertile bed for red rice cropping and pastures for livestock grazing. The red rice used to be major cash crop of the area, which was exported to India and Gulf countries. Most of the households used to be farmers and were quite wealthy.

The local harbours along the coastwere full of boats from foreign countries loading rice and other export produce. With the reduction in fresh water flow, major ecological and livelihood changes started setting in. Cultivation of most agriculture crops in the flood plains almost vanished. Red ricecultivation vanished and almost so did almost also orchards of banana, papaya and guava cultivation and this radically altered the livelihoods of local communities in a negative manner.

Earlier fishing was the main livelihood of a minority of the coastal population. With the vanishing agricultural potential fishing has now become the key livelihood opportunity for the communities along the Sindh coast. However, fish catches have during the last ten years drastically become reduced due to increase in fishing boat capacity, and from the substantially increasing numbers of fishermen. Today are all the commercially valuable fish and shrimp species, that used to be an important source of export earnings for the country and the local population main livelihood source, have come under severe threat.

There are presently some major conflicts between the original fishermen communities of the outer coast areaand surrounding villages consisting of people who used to be engaged in agriculture and livestock previously but have been forced to take up fishing as their profession, due to the land degradation. The newcomer fishermen are seen as competitors by the original fishermen communities. What seems to irritate the most is that the newcomers are accused of using harmful nets, especially *Boolo-Gujo,* which is detrimental to juvenile fish – to cope with the

competition. However, according to the newcomer fishermen community do also the indigenous fishermen use harmful nets such as, *Katra* net, which according to them is as harmful as *Boolo-Gujo*(IUCN 2013).

Fish, shrimp and crabs are key natural resources for the communities along the Sindh delta area coast. The peak fishing season continues from September to March. During winter season, more fish is caught from the coastal waters. Presently many of the artisanal fishermen rely on small fish, which they call *Gand* (waste) which is used in chicken feed. The catch of shrimp, crabs and lobster has dropped to become low in the area.

Fishing in deeper seawater with the *Katra* net is usually done during full moon days, which is called locally *Jawar*. A medium to full size boat is needed for Katra fishing as about 15-30 labourers can work onboard the boat during the fishing trip. An amount of Rs 7000 to Rs. 10000 is needed for the boat oil and food for the fishermen onboard the boat. The fish catch is after the trip distributed according to the*Patti* system. Under this system the boat owner can claim six shares, one for the net, one for the boat and four shares for the engine while the remaining shares are distributed among the crew memberson equal basis. The overall fisherman income per trip ranges normally from Rs. 30,000 to 40,000. However, the fishermen may also return without substantial catch and in such case the owner of the boat sustains the loss.

A narrowcontinental shelf – in much of the Pakistani coastal area, only 15-50 kilometres wide at the 200-metreisobaths – defines the extent of the coastal waters. From here on the continental slope dipssharply, delimiting an extensive, deep offshore zone. Thecoastal waters of Pakistan are still rich with a large variety of fish and shrimp resources. Thecommercially important marine fishery resources of Pakistan comprise about 350differentspecies, although totally some 800 fish species have been found along Pakistani coastline. Of the commercial ones are some 240 demersal fish, another 50 are small pelagic, followed by 10 medium sizedpelagic and 18 large pelagic fish species. In addition, there are 15 species of shrimps, 12 ofsquid/cuttlefish/octopus species and 5 species of lobsters (IUCN 2004).

The FAO has since 1950s reported on behalf of Pakistan the total annual fish catch. However, it has become clear that the reported annual fish catches merely contain the statistics from commercial industrial fish catches. Pakistan keep registering only this commercial industrial fish catches, while artisanal (both commercial and subsistence) as well as discarded by-catch of fish has been all these years been left unreported. In 2010 the Marine Fisheries Department of the Ministry of Ports and Shipping, Sindh Province made some calculations over the true fish catches and came up with a figure of approximately 38 million tonnes of fish caught between 1950 to 2010. This total catch (including discarded fish) is 2.6 times larger than the official catch landing statistics of about 14.7 million reported by FAO for these years. Likewise, the shrimp and crab statistics was also under reported at 6.8 million tonnes for the same time period. The new calculated estimate for 1950 to 2010 became some 13.8 million tonnes. During this time-period the small-scale fishery (artisanal commercial plus subsistence) was estimated to have been around 55% of total catches (Khan 2017).

Based on the reconstructed assessment of the Marine Fisheries Department from 2015 we have concluded that the total marine fish catch in 2010 was 860 870 tonnes

and the annual catches had been at this level since the late 1990s. The highest peak year was 1993 when a total of 1 121 739 tonnes were caught in the Pakistani seawaters. The Marine Fisheries Department has further concluded that the current fishing fleet and fishing effort is about double to the sustainable yield level of fish populations in Pakistani waters. A 50% reduction in annual fishing effort would result in major improvements in fish and other seafood populations. In 2015 a demersal biomass survey was conducted along the whole coastline and it was found that various types of fish stocks have declined by 60 to 91% since 1980s and for some important commercial species have declined to very low figures (Marine Fisheries Department 2017).

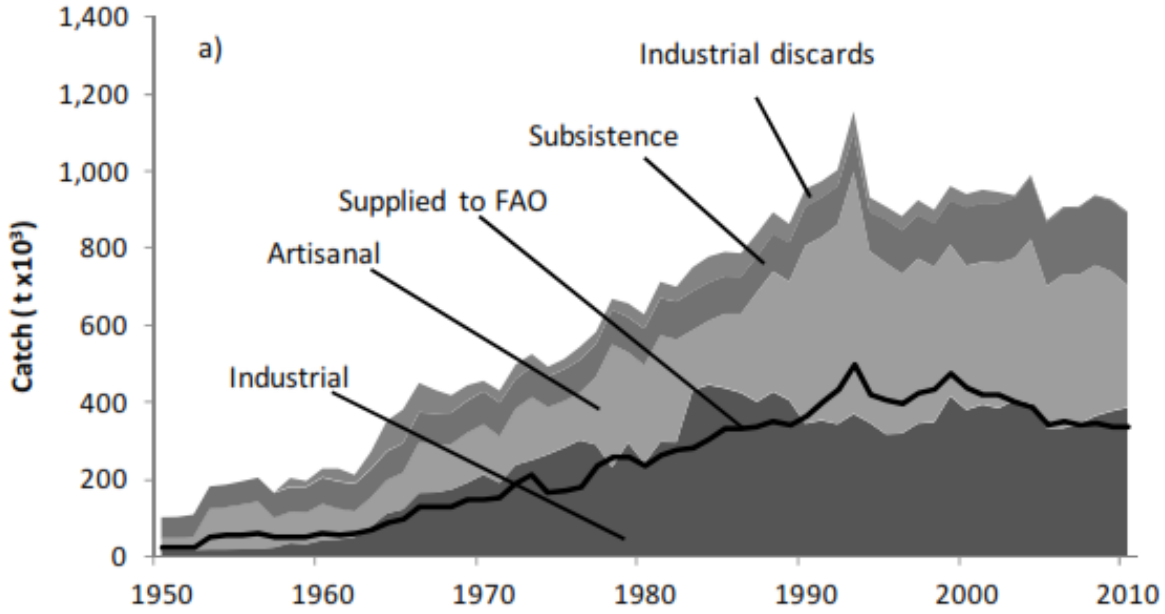


Figure 1. The Marine Fisheries Department's (Sindh Province) fishery survey result from 2010, which indicate that fish and other seafood catches are annually actually 2.6 times the official statistics.

Figure 1 and a table developed based on it allows us to assess annual trends between commercial industrial and artisanal as well as artisanal subsistence catches over long term. Combined with some additional information on the size of recent annual catches of finfish and shrimp/crab catches along both Sindh and Balochistan coasts is possible to fairly accurately extrapolate the 2015 finfish and seafood catches for both Sindh and Balochistan. The total annual catch becomes approximately 700,000 tonnes for 2015. The Sindh province statistical data from 2016 present the Sindh Province commercial industrial fish landings and from this it is possible to calculate also the same Balochistan statistics (i.e. the other province along the coast). With some additional information from Sindh Forest Department (2017) and Marine Fisheries Department (2017) we can thereafter estimate the remaining shares of commercial and subsistence artisanal catches as well as by-catch discharges for both provinces. Based on interviews with fishermen (i.e. PFI's

own survey 2018, IUCN 2013, and some recent newspapers) we are able to estimate likely shares between marketed fish sales, and chicken feed industry sales for the artisanal fishery sector, which is shown as Table 2 in Chapter 4 of this report.

Background on fish spawning sites in mangroves

According to McLeod and Salm (2006) do mangroves, coral reefs, and fisheries often have a synergisticrelationship, based on their connectivity. The mangroves can benefit adjacent ecosystems by filtering the seawater from sediments, salinity and pollutants that provide good nursery habitats for various marine benthic meiofauna, fish shrimp and crab eggs and fingerlings, and juvenile individuals until these are sufficiently big to swim into deeper water along the coast. IUCN estimated in 1998 that approximately 90% of all commercially important marine fish species in tropical waters.

Mangroves also stabilize sediments and trap heavy metals and nutrient rich run-off, thus improving the waterquality for seagrasses, corals, and fish communities. There is a mutual beneficial relationship between seagrass, coral reef and mangroves that all together support the fish populations, for instance, along Pakistan coast line. Without the mangroves' waste water cleaning ability would almost all fish caught near Karachi and other port cities of Pakistan have high heavy metal content and perhaps therefore be useless for human consumption. According to Hagler Bailly Pakistan (2015) are the fish caught near the PQA industrial areas quite safe for human consumption.

The Gharo/Phitti creeksin the PES area receive large quantities of nutrients as part of the sewage effluent andgarbage that are discharged in these creeks. According to Amjad et al. (2016) do not nutrients in this area appear to be limiting the primary productivity of biotic biomass in the mangrove area nor in the creeks. If there is any limitation, it is due to water turbidity that restricted the photic zone.Higher concentrations of nutrients result in overproduction and subsequently leading towards exhaustion of dissolvedoxygen in the seawater.Amjad et al (2016) reported that the overall productivity of biotic biomass in the mangrove areas along the Pakistani coast is high(365 - 780 gC/m2/year) as compared to non-mangrove coastal waters (50 - 200 gC/m2/year). The same researchers found that in the PES area the biotic biomass production was on average 572.5 gC/m2/year (i.e. average also for mangrove areas along Pakistan coast), which means that for the whole area of 64400 ha the total fish (including also shrimp/crabs and lobsters) biomass comprised 36,640 mtC/year. The severe Karachi town and industrial effluent discharges have not so far impacted on the fish biomass in the PES area.

During recent years there has been new industrial plants established near the PQA harbor and the ship channel to the harbor has been recently dredged. According to Hagler Bailly Pakistan (2016) will some 3.8 million cubic metres of sediments be lifted from the bottom of the main ship channel, which will cause turbidity plumes, release contaminants and increase oxygen depletion in the PES area. Some studies on the impact of dredging on marine benthos show that dredging can result in a 30 to 70% reduction in species variety, a 40 to 95 % reduction in the number of individuals and a similar reduction in biomass in dredged areas. These losses will mainly be confined to the immediate surroundings of the ship channel leading to the harbor.

Annex-5

Cleaning of Karachi sewage and industrial effluents with the PES area mangroves

Topographical and hydrological background

The present-day Indus Delta south east of Karachi covers an area of about 263,000 hectares and is characterized by 16 major creeks and innumerable minor creeks, dominated by mangrove covered mud flats, and some open mud flats. The tidal creeks are linked with each other and several small islands with variable density of mangrove vegetation, mud banks, swamps, and lagoons formed because of changes in river courses. The actual PES area comprises the 64,000 ha of mangrove forests (including also open mud flats and creeks) which have been given to the Port Qasim Authority to have administrative control over (Amjad et al., 2016). The major land use of the area adjoining the PES area includes industrial zones and areas of Port Qasim habour itself. The city of Karachi has some 70% of all major industries in Pakistan and some 8000major industrial facilities are situated in several industrial areas that borders to the PES area.

The Karachi coastline between Korangi creek inlet and Kadiro Creek encompasses the islands of Bundal, Buddo and Khiprianwala, and there are two large and deep openings towards the sea which constitute the mouths of Phitti Creek (i.e. the approach channel of Port Qasim) and the Kadiro Creek. The southeastern PES area creeks are linked with a network of creeks of the Indus Delta itself. The administrative area of Port Qasim Authority consists of three major creeks systems, combinedly called the Gharo-Phitti Creek System that include Gharo Creek, Kadiro Creek and Phitti Creek. All three creeks are connected in a series starting from Gharo Creek at the north-eastern end to the Phitti Creek at the south-western end located some 22.5 km from Karachi. This creek system is about 28 km long and its width ranges from 250 to 2500 m. The Korangi Creek and Kadiro Creeks connect at the northeastern end while it acts as main waterway connected with the open sea at the southwestern end. The main ship entry channel of Port Bin Qasim lies in this creek system, which has been dredged to maintain a navigable depth of −11.3 meters (Amjad et al., 2016).

Tides along Karachi Coast are normally semi-diurnal with occasional diurnal inequality. The daily tidal cycle has therefore two high waters and two low waters which also vary considerably from each other in tidal heights. The tides move from northwest to southeast, which means that the tide at the Hub River Coast arrives about 20 minutes earlier than at Karachi. Similarly, the tides at Karachi Harbour arrive at about 10 minutes earlier than at entrance of Port Qasim. As the tide progress up the Phitti Creek its magnitudeincreases and there is a certain time lag. The tides reach Port Bin Qasim after 22 minute which is about 32km from Karachi and is located about 24 km up the creek from the open sea. At Gharo Creek tides reduces rapidly in height due to frictional effects and the gradual weakening of the tidal forces. At Gharo56 km from the Phitti Creek entrance the tide height is almost half of the mean sea tide at the entrance (EMC, 2008).

The speed of the current is an important factor in distribution of waste water pollution along the coastline. The current is normally about ½ knots, but it can speed up to 1 knot during SW monsoon season. The direction of the set is directly related with the prevailing wind system. The set is generally easterly in the SW monsoon and

westerly in the NE monsoon. The difference in direction in the western and eastern part of the Karachi Coast is due to circulatory current pattern around gyrals, which are usually formed at the center of the North Arabian Sea. There is a clockwise gyre during SW monsoon and anti-clockwise gyre during NE monsoon (ECM, 2008).

Another important factor affecting the coastlines near Karachi is the sea level rise which has been estimated as 1.1 mm per year (mm/year) from 1856–2000 along this streach of the coast. According to the IPCC AR5 Working Group I report, global mean sea level rose 0.19 meter (m) over the period 1901–2010 and the rate of change was markedly higher during the latter half of the period. The mean rate of the global average sea level rise was assessed to be 1.7 mm/year between 1901 and 2010, incorporating a 3.2 mm/year between 1993 and 2010. The change in sea level was due to two major processes of thermal expansion of ocean from global warming and glacier mass loss (ADB, 2017).

In the Karachi harbour some fresh water of Layari and Malir rivers meet the ocean water the salinity varies from 30.0 to 35.9 ppm.(Royal Haskoning 2011 based on measurements from 2008), which increases to 34 to 39 ppm. near the Port Qasim habour. The salinity may raise up to 40 ppm or even sometimes 41 ppm in the inner reaches of Bhanbore area further southeast in the PES area (Khan et al. 2015).

Current water pollution discharges in Port Qasim harbour area

According to the Business Recorder Report of December 31, 2017is theexisting sewage and effluents discharged from Karachi city area at a level of 460 million gallons per day (MGD), which comprises of 363 MGD from municipal, 3 MGD from hospital and 94 MGD from industrial sites. Due to the tides and currents along the coast line will most of the polluted effluents become circulated via the Gharo Creek. Table 1 presents the mean and variation of physical characteristics of Rehri Creek waters at five sample sites from western parts of Rehri Creek (Site 1) to the eastern parts (site 5). The site 1 and 3 are located close to where industrial effluents are lead out into the Rehri Creek, while site 4 is located near the effluent outlet from a cattle colony and site 2 and 5 are next to human communities.

Table 1. Mean and variation of physical characteristics of Rehri Creek waters.

Site	Measure type	pH	TSS (mg/L)	COD (mg/L)	BOD (mg/L)	O&G (mg/L)	O.M (mg/L)	PO_4 (mg/L)	TKN (mg/L)	Some NEQS standards
Site 1	Mean	8.9	497	1088	315	29.15	4362	2.63	4.67	BOD=80
	S.E.	0.6	76.7	32.8	30.1	2.42	163	0.64	0.77	
	Min.	7.8	310	800	210	20.8	3817	1.2	2.8	
	Max.	**10.9**	**740**	**1333**	**420**	**36**	**4845**	**5.3**	**7**	
Site 2	Mean	7.3	350	445	165	6.52	3635	1.75	26.78	BOD=200
	S.E.	0.06	44.5	28.4	8.8	0.66	141	0.04	2.45	
	Min.	7.1	246	355	140	4.4	3066	1.6	20.7	
	Max.	**7.5**	**490**	**533**	**198**	**9.2**	**3901**	**1.9**	**38.1**	
Site 3	Mean	7.4	105	162	30.3	5.23	613	0.42	1.3	BOD=80
	S.E.	0.2	5.5	4.5	4.8	0.3	36.1	0.09	0.08	
	Min.	6.9	91	146	16	4.3	495	0.2	1.1	
	Max.	**7.9**	**130**	**180**	**50**	**6.4**	**746**	**0.8**	**1.7**	
Site 4	Mean	7.6	1670	5218	1812	40.72	10778	78.92	69.62	BOD=200
	S.E.	0.06	123	1835	392	3.49	1746	9.18	15.03	

	Min.	7.4	1224	666	350	25	6039	37.5	25.2	
	Max.	**7.9**	**2100**	**13333**	**3300**	**49.2**	**18609**	**101.2**	**101.1**	
Site 5	Mean	7.3	147	265	48	2.76	573	2.22	2.65	BOD=200
	S.E.	0.2	12.7	11.5	7.4	0.57	25.5	0.38	0.68	
	Min.	6.4	110	230	22	1.1	532	1.2	1.2	
	Max.	**7.8**	**192**	**296**	**71**	**5.2**	**695**	**3.6**	**5.6**	
Some NEQS standards		**6-9**		**400**	**80 or 200**	**10**			**< 3 (2 is normal)**	

Source: Khan M.A. 2009.
Key: TSS= Total Suspended Solids; COD= Chemical Oxygen Demand; BOD= Biological Oxygen Demand; O.M= Organic Matter; O&G= Oil and Grease; PO_4= Phosphate; TKN= Total Kjeldahl Nitrogen; S.E.= Standard Error.

The main reason for larger variations between measurement sampling results of each sampling spot shown in Table 1 relate to differences in time of the year and water temperatures, which was also clearly seen in another study of Sharif et al. (2013). At the main industrial effluent site (i.e. site 1) the pH was clearly alkaline, which was also the case in Sharif et al. (2013) industrial effluents vicinities. For other sampling sites are the pH samples more neutral. The metallic iones stability and solubility in water is affected by pH that may directly or indirectly impact on the aquatic environment.

Effluents with high Total Suspended Solids TSS (sites 1, 2 and 5) as indicated in Table 1may cause high turbidity that can prevent light from entering the water and thereby reduce the process of photosynthesis of vegetation and plankton biomass, while it may also cause eutrophication.

The COD values of all five sampling sites 1-5 as indicated in Table 1 can be considered high and this COD value is mostly affected by effluents of industrial origin. The permissible range for BOD_5 values are according to NEQS (National Environmental Quality Standards) 200 mg/L for industrial effluents and 80 mg/L for municipal sewage and effluents. The Table indicates that sites 2 and 5 are at acceptable level, while the rest are quite a lot over the acceptable level. The highest BOD_5 value was measured near the cattle colony (site 4) and this high amount may cause asphyxiation that causes loss in biodiversity.

The NEQS standard limit for Oil and Grease is 10 mg/L, which means that sites 1 and 4 have exceeding values of O&G. Petroleum and oil grease in water bodies cause an immediate rise in BOD5 due to activities of hydrocarbon degraders and a blockage of oxygen dissolution. The amount of dissolved oxygen is reduced by oil film on water and this will impact on aquatic life and microbial activities that also affect the aquatic biodiversity.

No NEQS standard limit is recommended for Organic Matter, but high amount (as is the case at all sites) leads to depletion of dissolved oxygen and causes eutrophication as it contain phosphate and nitrogen. A severely eutrophicated creek may turn the water body into a swamp or marsh area.

Total Kjeldahl Nitrogen (TKN) is the sum of bot ammonia and organic nitrogen. Total nitrogen is thus a combination of the organic nitrogen and all forms of inorganic nitrogen (i.e. NH_4, NO_3 and NO_2). the TKN has not got any NEQS standard limit, but 3.0 mg/L is considered excessive and normal values in water bodies are below 2.0 mg/L. The Table BB indicate that TKN at sites 2 and 4 almost outside the scale completely, while only site 3 show a normal value. The site 3 is located almost

exactly where the tide and current bring in new sea water into Rehri Creek, which may be the reason for this low TKN value.

Khan et al. (2009) further measured heavy metal concentration in the water bodies at the same sample sites (Table 2 below) and the values are very high and all exceed the NOAA health standard concentrations.

Table 2. Heavy metal concentrations in sediments of the Gharo Creek in 2008.

Site	Measure type	As (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Effect Low Range standards NOAA (ERL) for metals (mg/kg)
Site 1	Mean	20.0	20.0	870.0	65.0	260.0	120.0	Zn = 150; Cu= 34; Pb= 46.7;
	S.E.	2.0	2.0	81.0	2.0	30.0	2.0	As= 8.2; Ni= 20.9
	Min.	14.0	11.0	690.0	57.0	180.0	112.0	All values exceed NOAA
	Max.	**26.0**	**24.0**	**124.0**	**72.0**	**360.0**	**130.0**	standards
Site 2	Mean	15.0	30.0	120.0	50.0	250.0	100.0	
	S.E.	1.0	6.0	4.0	1.0	20.0	6.0	
	Min.	11.0	12.0	110.0	47.0	180.0	85.0	All values exceed NOAA
	Max.	**18.0**	**54.0**	**140.0**	**57.0**	**310.0**	**120.0**	standards
Site 3	Mean	30.0	40.0	650.0	80.0	460.0	670.0	
	S.E.	4.0	8.0	40.0	3.0	30.0	106.0	
	Min.	21.0	12.0	550.0	66.0	330.0	390.0	All values exceed NOAA
	Max.	**50.0**	**64.0**	**780.0**	**89.0**	**510.0**	**970.0**	standards
Site 4	Mean	20.0	25.0	560.0	30.0	250.0	90.0	
	S.E.	2.0	2.0	48.0	1.0	30.0	1.0	
	Min.	17.0	14.0	440.0	24.0	180.0	84.0	All values exceed NOAA
	Max.	**30.0**	**33.0**	**710.0**	**39.0**	**410.0**	**95.0**	standards
Site 5	Mean	40.0	30.0	770.0	40.0	520.0	520.0	
	S.E.	6.0	4.0	85.0	2.0	30.0	122.0	
	Min.	19.0	19.0	450.0	29.0	440.0	140.0	All values exceed NOAA
	Max.	**64.0**	**46.0**	**1000.0**	**46.0**	**610.0**	**870.0**	standards

Source: Khan M.A. 2009; Note! Concentrations changed from mg/g to mg/kg in the above table for reason of comparison.

The Khan et al. (2009) heavy metal concentrations are about ten times higher than found in previous studies. He refers to Rizvi et al. (1988) that had values for Gharo Creek are similar to Hagler Bailly Pakistan (2016), which are shown in Table 3 below.

Table 3. Heavy metal concentrations in sediments of the Gharo Creek

Sampling stations in the Gharo Creek	Heavy metal concentration (mg/kg)										
	Cd	Zn	Cu	Ca	Pb	As	Se	Sb	Hg	Ni	Ag
St. 1	0.327	44.674	48.622	227.238	14.405	2.837	2.613	0.027	0.201	25.689	0.115
St. 2	0.542	34.117	43.922	417.852	22.618	8.604	5.822	0.043	0.235	44.615	0.287
St. 3	1.405	39.646	16.044	207.28	21.254	9.611	6.401	0.066	0.240	41.668	0.624
St. 4	0.241	52.061	43.002	315.43	16.824	4.197	3.475	0.041	0.223	48.575	0.248
St. 5	0.661	36.817	41.602	340.87	21.273	7.814	6.287	0.032	0.118	39.244	0.280
Effect Low Range stads NOAA (ERL) for metals (mg/kg)	1.2	150	34	NA	46.7	8.2	NA	NA	0.15	20.9	NA

Source: Hagler Bailly Pakistan 2016

Table 3 present recently measured heavy metal concentrations in sediments of Gharo Creek next to Rehri Creek. The Table 3indicates that among the above presented heavy metals the concerning ones are foremost mercury (Hg), copper (Cu), nickel (Ni), and cadmium (Cd), which are either fully or partly exceeding the NOAA standards for heavy metals in the creek bottom sediments. An article by Khan et al. (2015) further measured mercury concentrations in Gharo Creek during 2006 – 2008 and found that the mercury values were about double to the ones presented in Table 3.

Exhibit 4.5: Land use Pattern in Close Proximity of the Proposed Project Area

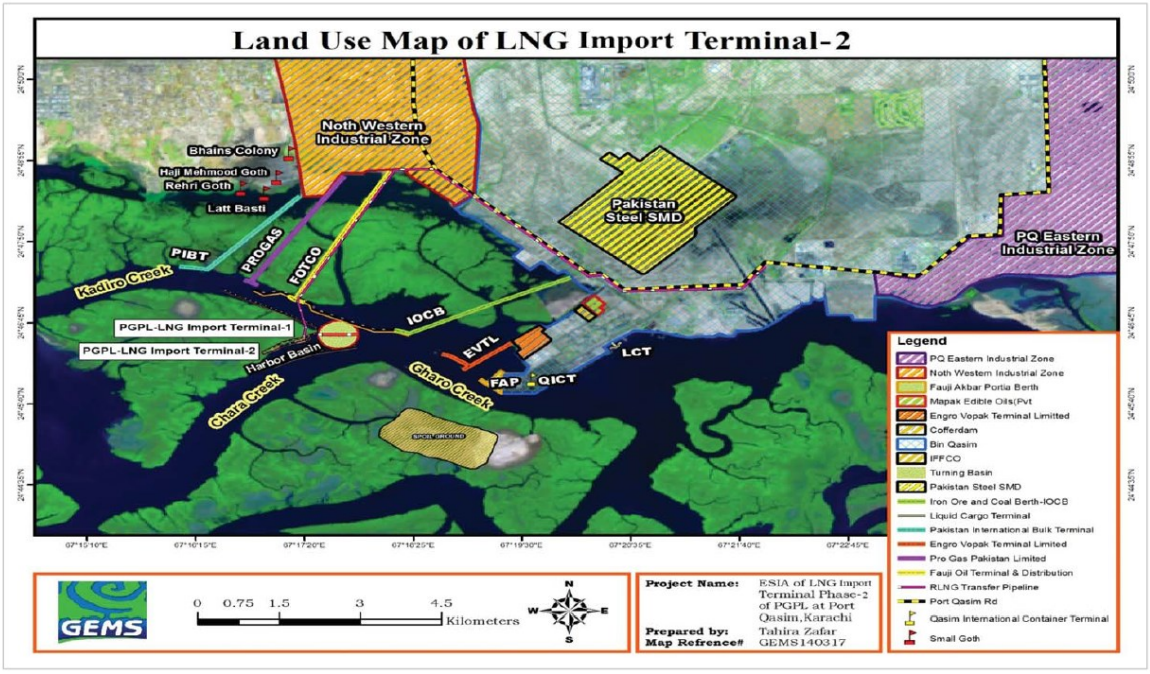


Figure 1. Land use pattern in close proximity to the PES area (the map is extracted from Hagler Bailly Pakistan (2016).

Neither Khan et al. (2009) nor Hagler Bailly Pakistan (2016) provide any reason for the differences in their measurement with other studies. By studying the different papers more closely there seem to be differences in how close the sampling spots are to land and thereby from loose sediments at the sea bottom. We will therefore still add another heavy metal concentration measurement result table of Sharif et al. (2012) from the inner end sediments of Korangi Creek at the mouth of Lyari river which is shown in Table 4 below.

Table 4. Summary of mean heavy metal concentrations in sediments of inner Korangi Creek at Lyari River mouth.

Parameters	Units	Sample site 1	Sample site 2	Sample site 3	Sample site 4
Cadmium (Cd)	mg/kg	1108	987	1060	1240
Lead (Pb)	mg/kg	930	1230	987	1020
Chromium (Cr)	mg/kg	517	428	706	654
Zinc (Zn)	mg/kg	1380	1260	1276	1410
Mercury (Hg)	mg/kg	197	118	204	242
Organic carbon	%	4.28	3.96	4.49	2.84

Source: Sharif et al. 2012

The heavy metals originate from industrial effluents, which have almost no cleaning treatment before being discharged into the coastal waters in Korangi Creek and Karachi Harbour. Fish, birds and humans may accumulate these heavy metals via their food intake.

To conclude on the wastewater cleaning effort needed to be performed by mangroves in the PQA area it has been decided that we will use Tables 1 and 2 above as the level of pollution to be cleaned. These tables indicate the highest amounts of pollution, which thus covers also the results in the other tables.

Cleaning of polluted waters and marine areas with mangrove trees

Constructed wetlands for wastewater treatment have become increasingly popular particularly in Asia in recent years, but also elsewhere in developing countries where waste water cleaning is considered expensive. In China there were established by 2014 more than 277 constructed wetlands in 24 provinces, among which Guangdong Province is the fastest growing region for promoting constructed wetland technology and have so far got 49 constructed wetlands. The most commonly used wetland plants include *Phragmites*, *Cyperus*, *Canna*, *Disporum*, *Cymbopogon* and *Acorus, Arundo*. The removal percentage of chemical oxygen demand(COD), biological oxygen demand (BOD), suspended solid (SS), total nitrogen (TN), ammonium-nitrogen(NH4+-N) and total phosphorus (TP) in wastewater averaged 37-90%, 71-94%, 88-98%, 22-62%, 53-90%and 61-96%, respectively (Chen et al.2010).

Most of the plants used in conventional, constructed wetlands are fastgrowing annual and perennial herbaceous vascular plants, which require frequent harvesting.Compared to conventional constructed wetlands, the employment of constructed mangrove wetlands for*in situ* wastewater treatment is still lacking, although extensive research has demonstrated their greatapplication potential in this field (Tam and Wong 2014). Mangroves that forms perennial woody plant vegetation in tropical andsub-tropical inter-tidal zones often exists or can grow next to cities and communities with polluted waters. For wastewater treatment initiatives, mangroves plants have been found to prevail over the herbaceous vascular wetland plants. This is partly because the latter requires frequent harvesting, which is not onlylabour-intensive and time-consuming, but also leads to poor plant growth and fluctuating treatmentperformance. Mangrove wetlands are further highly efficient in adsorbing wastewater-bornepollutants, including nitrogen, phosphorus, heavy metals and toxic organic pollutants. The removalefficiencies of nutrients and metals from the wastewater in constructed mangrove wetlands ranged from 75 to98% (nitrogen and phosphorus) and 88-96% (heavy metals and toxic organic pollutants), respectively (Tam 2016, Tam and Wong 2014 and Lambs et al. 2011).

The cleaning results for wastewater borne pollutants are depending on seawater salinity, pollution concentration, water temperature, sea currents and similar factors. In Table 5 we have tried to compile some wastewater cleaning results of mangroves based on scientific articles.

Table 5. Removal of pollution in a 10-year treatment in Futian wastewater cleaning plant

Mangrove species	COD (mg/L)	BOD_5 (mg/L)	TN (mg/L)	NH3 -N (mg/L)	TP (mg/L)	SP (mg/L)	Comment
Influent amount	**119.03**	**53.02**	**16.17**	**13.53**	**1.61**	**1.26**	The influent values here correspond rather well with wastewater amounts for site 2 in Table BB for Rehri Creek above.
Sonneratia caseolaris	**43.35**	**13.38**	**8.56**	**6.87**	**0.65**	**0.45**	Existing from East Africa to East Asia and Australia
removal %	64.9	75.5	53.6	52.6	65.0	69.2	
Aegiceras corniculatum	**37.75**	**13.61**	**7.98**	**6.00**	**0.45**	**0.32**	A riverine mangrove species that cannot tolerate too much salinity
removal %	67.8	74.1	55.1	58.4	74.5	76.9	
Kandelia candel	**41.98**	**13.75**	**8.25**	**7.27**	**0.64**	**0.47**	*Amangrove* in the family Rhizophoraceae, which family also exist in Indus Delta
removal %	62.8	73.8	50.0	45.2	62.2	64.8	

Source: Tam 2014 with additional author's own comments

Experimental trials indicate that the mangroves' removal ammonia nitrogen and inorganic nitrogen is dependent on the salinity and pollution concentration level of the wastewater. At salinity levels of 30 ppt the removal efficiency can be expected to be around 80% $\pm$ 11.50. For higher salinity such as 40 ppt the removal may be reduced to 65-70%. For phosphorus the removal efficiency does not much vary with increasing salinity (Tam 2014).

Experimental trials with heavy metals have indicated that mangroves efficiently can remove over 99% from strong industrial wastewater effluents that meet discharge standards, for instance, in Hong Kong. When the pollution concentration become highly excessive (i.e. concentrations that are at the level of the bottom sediments of Gharo and Rehri Creek amounts as presented in table above) many mangroves can still remove 50% of the heavy metals – among these mangrove species is also *Avicennia marina.* The results concerning Policyclic Aromatic Hydrocarbons (PAHs) and Polybrominated Diphenyl Ethers (PBDEs) show similar cleaning efficiency if not even better (Tam 2014).

The mangrove trees can tolerate toxic heavy metal pollutants due to a special root anatomy. The root system of a mangrove tree is rather extensive and it has a large biomass. The roots have additionally a specialized ventilation system based on so-called parenchyma tissue, which allows them to get and release substantial amounts of oxygen. The release of oxygen (ROL) from root to its surroundings, provide aerobic pockets in anoxic sediment for oxidation and detoxification. On the root surface is then formed plaque towards any metal the root identifies in its surroundings. This plaque immobilizes the uptake of these metal pollutants quite efficiently. The root further exudate some organic acids which can support diverse groups of microbes (arbuscular mycorrhizal fungi or bacteria) that are resistant or degrading tolerant against metal ions in sediments or water bodies around the root (Tam 2014, Wang et al. 2014 and Lambs et al. 2013).

Seifullah et al. (2004) measured how iron pollution is taken up by mangrove (*Avicennia marina*) in the coastal area of Karachi. They measured how the concentration of iron is changing from the sea water and sediments into various parts of the mangrove tree as indicated in Table 6 below.

Table 6. Overall average concentration of Fe (ppm) in seawater, sediments and different parts of the mangrove. SE is the standard error.

Components	Sediments	Pneumato-phores (roots)	Bark	Leaves	Flowers	Twigs	Water
No. samples	40	14	27	72	7	25	35
Minimum	6369.2	218	528.5	60.2	122.4	58.2	0.010
Maximum	34 436.0	7494	1886.0	825.0	492.0	454.4	0.24
Mean	**22 773.6**	**1047**	**985.7**	**309.8**	**194.1**	**180.1**	**0.083**
+ S.E.	+ 1497.5	+ 168.8	+113.7	+ 29.3	+ 30.5	+ 10.4	+ 0.004
Conversion factor CF=	**1**	**0.045**	**0.043**	**0.013**	**0.008**	**0.008**	CF= 1/274380

Source: Seifullah et al. 2004

Table 6 indicates that the concentration in the sediment was maximally as high as 34 436 ppm and as minimally as low as 0.01 ppm in seawater, while vegetative mangrove parts like pneumatophores, bark, twigs, and leaves possessed generally less than 1000 ppm. The concentration factor (CF) of mangroves was very low, indicating minimum bioavailability of iron from the sediment. The concentration of iron decreases progressively through different sections of the mangrove habitat in the following sequence: from sediment to pneumatophores to bark to leaves to twigs to seawater. Water temperature in the area varied between 18^{o}C in January and 35^{o}C in May.Salinity values generally fluctuated between 35 and 40 ppm but could sometimesbe as high as 47 ppm (Saifullah, 2002; Saifullah et al., 2004).

Iron enters the sea in large quantities through four major sources: industrial effluents, municipal waste, corrosion of underwater structure, and atmospheric fallout. Therefore, iron could be expected in relatively higher concentration in the water, but this is not the case. A larger proportion forms oxides and hydroxides in the suspended matter and is also precipitated as iron sulfide in the sediments as pyrite. The concentration of Fe in the sediments is extremely much higher than that in seawater, which is almost 300 000 times more than that in the seawater. Pneumatophores and bark are relatively permanent tissues andthese tissues can accumulate iron for longer periods of time, whereas the other three parts aretemporary ones that are shed in shorter periods of time such as weeks and months. Additionally, tannins are present in significant concentrations in both pneumatophoresand bark, which are known to bind to trace metals (Saifullah et al., 2004).

The same reaction as with iron has also been proven with heavy metals like copper, arsenic, mercury and cadmium, but should be the same with all heavy metals (Saifullah, 2002; PCM, 2008; Lambs et al., 2011, Wang et al. 2014, Tam 2014, and Mohiuddin and Naqvi 2014). Table 7 presents the results of measurements with copper in various Karachi coastal water areas (from Seifullah 2002). The table does also include various sediment concentrations for iron in those same sampling spots.

Table-7. Measurements of copper and iron in sediments and mangrove habitat waters

Locality	Cu average concentration in sediments (ppm) ± SE	Cu average concentration in mangrove habitat waters (ppb) ± SE	Fe average concentration in mangrove habitat sediments (ppm) ± SE
Sandspit	48.09 ± 2.43	1.5 ± 0.49	25 624 ± 1778
Port Qasim	44.02 ± 0.07	3.06 ± 0.63	27 120 ± 2481
Lut Basti	69.02 ± 8.09	1.50 ± 0.35	23 310 ± 4105
Chara Creek	46.55 ± 1.35	0.78 ± 0.49	30 067 ± 2515
Korangi Creek	48.10 ± 0.0	1.17 ± 0.87	34 436 ± 2249
Miani Hor	9.80 ± 0.0	0.041 ± 0.0	1 248 ± 0.0

Source: Saifullah 2002

To conclude this Annex 2 and to determine a firm opinion on how much wastewater cleaning we can expect the PES area mangroves to perform as provider of pollution abatement instead of a man-made treatment plant we can now quite safely conclude on the basis of the above available information and results, that with the current pollution concentrations in the Karachi coastal waters the mangroves can clean about 50% of the pollutions in the PES area. The 50% concerns both BOD_5, COD, TKN, TP, Oil and Grease, heavy metals, PAHs and PBDEs.

Annex-6

Tsunami and cyclone protection with mangroves

The whole of Pakistan's coast locates on the crossroads of earthquake lines. It is particularly the Makran Subduction Zone (MSZ), which forms some risk for tsunami genetic earthquakes in the coastal belt. Alternatively, there may also be smaller localized tsunamis associated with several smaller thrust faults around Karachi. The historical tsunami records, however, show only one tsunami in 1945 for the last hundred years while the few other ones have been in 19th century (3 registered ones) or older (5 during the last two thousand years). Therefore, tsunamis have been rather rare along Pakistani coast, but the risk still exist which can materialize at any moment (Hagler Bailly Pakistan 2016).

The tsunami on 28th November 1945 was generated by an earthquake of magnitude 8.3 in the Northern Arabian Sea and affected also the Indian Ocean coasts in India. The waves produced were 12-15 m high and killed over 4000 people in Pasni and its surroundings. Additionally, Karachi that was situated 450 km from the epicentre experienced 2 m high sea waves which affected the city's harbor facilities.

Tropical cyclones have become more common in recent years and through large waves these can be collectively discussed with tsunamis. A cyclone is called hurricane around the Atlantic Ocean and typhoon around the Pacific Ocean. Cyclones are generally rare in the Arabian sea area which is a part of North Indian Ocean and cyclones that forms in this sea mostly move towards Western India rather than Pakistan. Cyclones in the Arabian sea occurs mostly from May til June and then from September til October as a consequence of the monsoonseason and they form due to warm moisture raising from the sea. Tropical storms that hit Pakistan are often already declining by the time they reach Pakistan and make landfall in southeastern Sindhwhile they rarely hit the Balochistan coast (Wikipedia retrieved in May 2018).

Below is a list of cyclones and tornadoes (from the Wikipedia 2018) and their damage impacts from 1940 to 2010, which can give an overview on how destructive these wind forces can be along Pakistani coastline. The worst cyclones in the list have been underlined and cursivated, so that these stand out:

- 27 July 1944 – A cyclone left some 10,000 people homeless in Karachi.
- 8 June 1948 – Moving ashore near Pasni along the Makran, a storm brought rainfall to Balochistan and Sindh.
- *12 June 1964 – A cyclone made landfall in Tharparkar and Hyderabad district in Sindh province. It killed 450 people and left some 400,000 people homeless.*
- *15 December 1965 – A cyclone struck Karachi, killing 10,000 people. It is the deadliest cyclone on record in Pakistan.*
- May 1985 – A cyclonic storm made a landfall in the eastern direction of Karachi. The cyclonic storm in 1985 which was moving towards Karachi

actually had weakened over the sea while still a few 100 Kilometers away south of Karachi.

- *16 November 1993 – A cyclone dissipated near the Sindh-Gujarat border. It caused massive rainfall and flooding in Karachi, but Thatta and Badin districts were the worst affected where the cyclone killed 609 people and displaced some 200,000 others.*
- 9 June 1998 – Striking Gujarat in neighboring India, a cyclone electrocuted 12 people in Pakistan.
- *20 May 1999 – The strongest cyclone to hit Pakistan moved ashore near Keti Bandar at Category 3 intensity on the Saffir-Simpson scale. It killed 6,200 people in the country. At least $1 million in relief funds was to be supplied by the government.*
- May 2001 – More than 100,000 people evacuated in southeastern Pakistan due to the threat from a powerful cyclone in the Arabian Sea. The storm struck Gujarat as a weakened cyclone on 29 May.
- 1 October 2004 – Cyclone Onil became the first named storm in the Indian Ocean, and meandered for several days off the coast of Gujarat. In Pakistan, Onil brought heavy rainfall and gusty winds.In Karachi, nine people died from the storm, as flooded streets and power outages contributed to at least two electrocution deaths.

Figure 1. Cyclone 2A making landfall near Karachi at peak intensity as Category-3 cyclone in May 1999

- June 2007 – Powerful Cyclone Gonu remained well southwest of Pakistan, but it still produced heavy rainfall and strong winds in the city of Gwadar in Balochistan, where it caused damage to dozens of boats and school buildings

in the area. It also caused high winds with light rainfall in Karachi and other coastal areas.

- *23 June 2007 – Cyclone Yemyin, which developed over the Bay of Bengal and intensified into a cyclone over the Arabian Sea, killed 200 people alone in Karachi city due to heavy rainfall and intense windstorms as it was moving towards Balochistan province. It made landfall near the towns of Ormara and Pasni in the Balochistan province on 26 June where it killed 300 people. Overall it killed 730 people and affected the lives of 2 million people in Pakistan making it the third deadliest cyclone in the history of the country.*
- In November 2009, remnants of Cyclone Phyan caused gusty winds along the Sindh coast including Karachi. However, six Pakistani fishermen were trapped in the storm later rescued by the Indian Navy.
- *6 June 2010 – Cyclone Phet made landfall near Karachi as a depression, having earlier dropped heavy rainfall along the Makran coast. Gwadar recorded 370 mm (15 in) of rainfall, which damaged 10,000 houses, and disrupted portions of the Makran Coastal Highway. Phet killed at least 18 people in Pakistan – 11 by electrocution, and 7 due to collapsed walls. The storm also injured dozens of others and left thousands of Pakistanis homeless. Damage was estimated at RS7 billion (US$80 million).*
- November 2010 – The remnants of Cyclone Jal caused dusty winds in Karachi while it caused light to moderate rainfall in southeastern Sindh.

By retrieving recent Pakistani newspapers on Internet it was possible to find some more recent cyclones:

- 21 August 2017. Five people, including three women, lost their lives in rain-related incidents. All three women were electrocuted by fallen down power lines in different parts of Karachi. The heavy rainfall also led to many power cuts and water stagnating at various roads and intersections in the metropolis, thereby causing blockages and traffic jams around midnight.
- 29 August 2017. Another similar cyclone with similar kinds of damages.
- May 2018. At least five killed in a cyclone hitting Karachi city. In Karachi, hours of rain left roads under more than a foot of water. Electricity was cut in many districts in the mostly low-lying parts of the city

As one analyzes closer the above list of cyclones over the years there are two things that catches the eye about the heavier cyclones that are underlined and cursivated. The first issue is that the ones in 1990's occur when the mangrove forests along the Sindh coastline had mostly disappeared due to lack of fresh water (when Indus river ceased to bring fresh water due to newly established barrages and dams upriver) or been deforested due to coastal population wood and fodder needs. In the 1990's only 86,000 ha of degraded mangroves existed, which presumably could not impact much on the cyclone intensities. The other heavy cyclones underlined and cursivated took landfall west of Karachi or in Balochistan where there are only small areas of mangroves (i.e. totally some 4000 ha) and they were not sufficient to withstand the cyclones. All the lesser cyclones in the list have taken landfall in Sindh Province

coastal areas from Karachi to the Indian border when there have been substantial amounts of mangroves along the coastline.

Figure 2. Cyclone Phet making second landfall near Karachi on 6 June 2010

The above mentioned two observations are important as Ouyang et al. (2017) have concluded based on their assessments of coastal wetlands (mainly mangrove forest areas) that the larger such mangrove areas are the less destructive are the cyclones in their landfall areas. The reason for this issue is that the cyclones gather strength in the warmer shallow coastal waters before they move in over land and when there is a mangrove forest the cyclones may not be able to get the same strength as when they move over open shallow warm waters. We will now use this observation in determining from the above list of cyclones hitting Pakistan in the past from 1940 to date to estimate the difference between an almost no mangroves situation and a current situation with substantial amount of mangrove forests along southeastern Sindh coast.

Firstly, we will record that the most devastating cyclone which occurred in 1999 took landfall in Thatta and Badin districts wiped out 73 settlements and resulted in the loss of 168 lives. Nearly 0.6 Million of people got affected, besideskilling of 11,000 cattle. It destroyed 1,800 small and big boats and partially damaged 642 boats thatcaused a loss of about 380 Million PKR (1999 currency). The losses to infrastructure were estimatedof about Rs.750 Million PKR (1999 currency).The period 1944 to 2018 records at least 18 cyclones. The coast of Sindh is the most vulnerable and exposed to cyclones with a 20% chance of getting a major cyclone in a year (Swathi 2015).

Secondly, we can assess that the listed underlined and cursivated cyclones killed in some cases a hundred times more people and livestock than each of the other listed cyclones. This is probably partly due to the heavy floods from sea waves and heavy rainfall that hit the open lands. The above-mentioned cyclone from 1999 killed approximately ten times more people than the non-underlined and non-cursivated cyclones. We could therefore perhaps use as an assumption and estimate for the Badin - Thatta district coastline that the mangroves seem to reduce the cyclone to 10% of its devastating power it would have had without mangroves. This is of course, simplicity, but it is the best possible estimate we can reach when determining the mangroves' mitigation against cyclones. The tsunami protection can be incorporated into the same protection figure as these occur so seldom and the mangroves there also can substantially reduce the power of the tsunami waves.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