Environmental and Social Impact Assessment (ESIA)

Project No. 54097 -001
March 2025
Final

Pakistan: Sindh Coastal Resilience Sector Project

This Environmental and Social Impact Assessment (ESIA) is prepared by Groupe Huit / Créocéan/JBA/PITCO to be submitted to Sindh EPA of the Government of Sindh for review and approval.

CURRENCY EQUIVALENTS

(as of 31 January 2025)

Currency Unit	–	pak rupees (Rs.)
Rs.1.00	=	$0.0036
$1.00	=	Rs. 278.82

ABBREVIATIONS

ADB	Asian Development Bank
APs	Affected Persons
BOD	Biochemical Oxygen Demand
CBO	Community Based Organization
CC	Construction Contractor
CHS	Community Health and Safety
COD	Chemical Oxygen Demand
CoI	Corridor of Impact
DMS	Detailed measurement survey (DMS)
DO	Dissolved Oxygen
EA	Executing Agency
EC	Electrical Conductivity
EHSGs	Environment, Health & Safety Guidelines
ES	Environment Specialist
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESU	Environmental and Social Unit
FRM	Flood Risk Management
GoP	Government of Pakistan
GoS	Government of Sindh
GPI	Gender Parity Index
GRM	Grievance Redressal Mechanism
IA	Implementing Agency
Ias	Implementing Agencies
IBA	Important Bird Area
IBIS	Indus Basin Irrigation System
IEE	Initial Environmental Examination
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
ILO	International Labor Organization
IMA	Independent Monitoring Agency
IP	Inspection Path
IP	Indigenous People
IUCN	International Union for Conservation of Nature
JFPR	Japan Fund for a Prosperous and Resilient Asia
LAA	Land Acquisition Act 1894
LARP	Land Acquisition and Resettlement Plan
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organization
NIO	National Institute of Oceanography
NIP	Non-Inspection Path
OHS	Occupational Health and Safety
P&DD	Planning and Development Department
PIU	Project Implementation Unit
PMC	Project Management and Supervision Consultant
RAP	Resettlement Action Plan
REA	Rapid Environmental Assessment
RFP	Resettlement Policy Framework
RoW	Right-of-Way

RoW	Right-of-Way
SAEMR	Semi-Annual Environmental Monitoring Reports
SCDA	Sindh Coastal Development Authority
SCRP	Sindh Coastal Resilient Sector Project
SDS	Social Development Specialist
SEP	Stakeholder Engagement Plan
SEPA	Sindh Environmental Protection Agency
SEQS	Sindh Environmental Quality Standards
SEQS	Sindh Environmental Quality Standards
SFD	Sindh Forest Department
SID	Sindh Irrigation Department
SPS	Safeguard Policy Statement
SR	Safeguard Requirement
SRSP	Sindh Coastal Resilient Sector Project
SWD	Sindh Wildlife Department
TSS	Total Suspended Solids
WHO	World Health Organization

WEIGHTS AND MEASURES

km	–	Kilometer
km	–	Kilometer
km^2	–	Square kilometer
m	–	Meter

NOTE{S}

(i) The fiscal year (FY) of the Government of Sindh ends on 30 June. “FY” before a calendar year denotes the year in which the fiscal year ends, e.g., FY2025 ends on 30 June 2025.

(ii) In this report, "$" refers to United States dollars, unless otherwise stated.

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I. INTRODUCTION

A. General

1. Pakistan consistently ranks among the top 10 countries worldwide most affected by climate change. Extreme weather events have increased in frequency and intensity, impacting ecosystems, people, settlements, and infrastructure. Heatwaves, heavy precipitation events, droughts, and cyclones are prevalent risks. The country experiences some of the highest temperatures in the world, with several areas recording temperatures of over 38 degrees Celsius annually. During the 2015 heatwave, more than 65,000 people were hospitalized with heatstroke, with 1,200 deaths recorded, mostly in Sindh Province. Projected temperature increases in Pakistan are higher than the global average, as high as 5.3 degrees Celsius by 2081-2100 under the highest emissions scenario Representative Concentration Pathway (RCP8.5), compared to a global average temperature increase of 3.7 degrees Celsius in the same scenario. There is also significant uncertainty surrounding future precipitation rates in Pakistan, underscoring the need for better preparedness for unforeseen extreme precipitation events. Research highlights the risk of increased frequency and intensity of flood and drought events, brought on by changes in the seasonality, regularity, and extremes of precipitation[1].

2. The probability of meteorological drought, usually brought on by below-normal precipitation, is set to sharply increase under all emission pathways – from the current probability of 3 percent to a 25-65 percent probability of severe drought. These can cause significant damage to crops and livelihoods. These changes in climate and extreme events are likely to disproportionately affect the most disadvantaged groups, among these low-income businesses, those engaged in manual labor jobs, poorer farmers, women and children.

3. The Indus Delta comprises about 41,440 square kilometers (Km^2) (4,144,000 hectares or Ha) area, with an estimated delta length of about 100 kilometers (Km). The region has fertile soils from the sediment carried to the region by the Indus River resulting in agricultural development. Development of the Indus Basin Irrigation System (IBIS) in the 1970s has significantly reduced riverine flows in the delta region downstream of the Kotri Barrage. Climate change (sea level rise, more frequent, erratic and higher intensity rainfall and storms) is intensifying the inland and coastal flooding of the Indus Delta.

4. The flat topography, poor drainage, and prolonged inundation cause damage to the infrastructure, loss of property and frequent crop failures. Reduced freshwater supply combined with sea level rise all contribute to salt water intrusion of adjacent lands and the groundwater aquifer. This causes degradation of land and water quality. The shrinking vegetation cover, declined diversity and reduced palatable grasses, trees, shrubs, and grazing opportunities are often linked with reduced freshwater supply, seawater intrusion and increased soil salinity vis-à-vis over grazing and other complications. The decreased livelihood opportunities and coping capacities of the communities living tin the Delya further exacerbate the intensity and frequency of livelihood shocks (crop failure, loss of property and health hazards), placing 3.5 million people and 22,872 Km^2 land in the three districts of Badin, Sujawal, and Thatta at further risk. The recent pluvial flood of 2022 has caused a loss of around $10 billion to Sindh Province. This, in turn, has caused a severe degradation of the quality of life and livelihoods in already poor socio-economic circumstances: poverty rates are high, education and literacy rates are low, and there is poor access to services and basic amenities.

5. Within the Indus Delta, earlier studies supported by the Asian Development Bank (ADB) identified seven priority flood risk management (FRM) catchments in the Badin, Sajawal, and Thatta districts which require improvement with an integrated flood and erosion risk management approach.

[1] Stakeholder Engagement Plan (SEP) – SCRP December, 2024

Improvement within these FRM catchments will comprise multiple subprojects – prospective structural and non-structural investment interventions to enhance resilience.

6. Therefore, **the Sindh Coastal Resilient Sector Project (hereinafter referred to as "SCRP" or the Project)**, financed by the Japan Fund for a Prosperous and Resilient Asia and the Pacific (JFPR) and administered by ADB, will help address these main challenges by supporting the development of a prosperous and resilient coastal region. Enhancing livelihood opportunities in the coastal region requires simultaneous improvement of the physical environment. SCRP will strengthen the building blocks of resilience: the underlying physical and non-physical elements that support the protection, improve health, food security and enable sustainable development of the communities in the coastal areas.

7. The following map (**Figure I-1**) represents the SCRP project area.

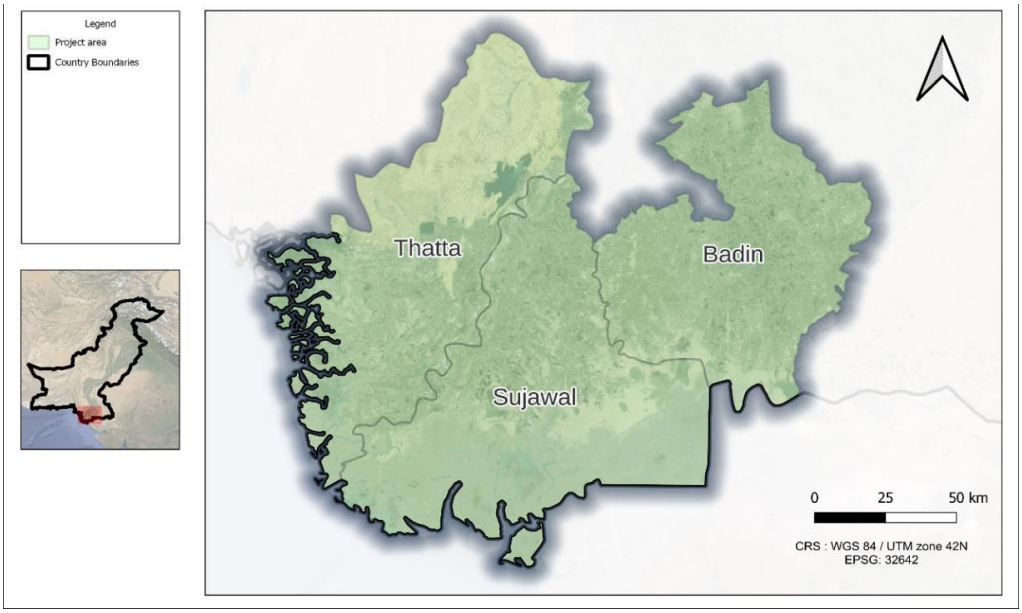


Figure I-1: SCRP Project Area

8. The SCRP will support the development of a prosperous and resilient coastal region[2]. The Project is aligned with the following impacts: (i) resilience of local communities against the adverse impacts of climate change enhanced, and (ii) impacts of flood events to coastal communities minimized[3]. The Project outcome is: risks of recurring damage to livelihoods, land, and freshwater from natural hazards and climate change in the coastal region reduced.

9. The SCRP has three integrated Outputs, namely:

- **Output 1: Climate resilient integrated water resources, drainage, and flood risk management solutions developed.** The output will strengthen coastal region water resources management, drainage, and flood risk management infrastructure. The output will support construction or upgrading of protective coastal and river management systems, bunds, weirs, and flow regulators. It will establish or upgrade drainage infrastructure, channels, and culverts and support the revival of dhoras (natural waterways) and dhands (depressions) for improved surface

[2] The preliminary design and monitoring framework is provided in the Sindh Coastal Resilience Sector Project Concept Paper of October, 2023.
[3] Government of Pakistan. 2021. Nationally Determined Contribution to the Paris Agreement, Islamabad; and Government of Pakistan. 2018. National Flood Protection Plan IV. Islamabad.

water connectivity. It will reduce impacts of coastal flooding, saline intrusion from seawater, and water logging; and improve freshwater availability for agricultural and household use.

- **Output 2: Nature-based solutions for coastal protection restored.** The output will support the planting and protection of mangrove, riverine, and inland forests, and native salt tolerant species for shoreline and soil stabilization and flood mitigation. Interventions will be linked with infrastructure investments in output 1 for integrated 'grey-green' solutions. It will support improved habitat and ecosystem services, carbon sequestration, and reduced local temperatures and impact of heatwaves. Community engagement, including women and other disadvantaged groups, will support sustainable management of the forest with opportunities for livelihood benefits. It will support the development of a provincial forest carbon strategy and plan.
- **Output 3: Institutional and community capacity for strategic action planning strengthened[4].** The output will build capacity in key government and community stakeholders for higher-level integrated and strategic planning for the coastal region, and climate change resilience. It will develop a strategic action plan and coastal zone management action plans. It will build capacity in relevant government departments to develop knowledge and the evidence base for coastal zone management. It will install systems for monitoring, mapping, modelling of coastal dynamics.

B. Objectives of ESIA

10. The objective of this ESIA is to Identify and assess the potential environmental and social impacts and risks stemming from the subprojects in the planning, construction and operation phases of the subprojects proposed under output 1 and output 2 of the SCRP. Design appropriate mitigation, management, and monitoring measures to implement an environmentally sustainable and socially responsible project without compromising its technical and economic feasibility and to help determine crucial elements that facilitate the making of choices and decisions as per ADB SPS, 2009 and Sindh EPA Act, 2014. The ESIA analyze occupational and community health and safety during construction and operation stages.

C. Executing/Implementing Agencies (EA/IA)

11. The Planning and Development Department (hereinafter referred to as "P&DD"), Government of Sindh, is the "Executing Agency (EA)" while the daily administration of the project will fall to the newly established Project Implementation Unit (hereinafter referred to as "PIU") under P&DD. The implementing agencies (IAs) are Sindh Irrigation Department (SID) and Sindh Forest Department (SFD).

12. There is no staff within the EA/IAs with capacity to prepare and implement the ESIA / ESMP in line with the ADB requirements. During implementation of the SCRP, to enhance the capacity of the EA/IA, an Environmental and Social Unit (ESU) is proposed to be established within the PIU, supported by the Project Management and Supervision Consultants (hereinafter referred to as "PMC").

D. Environmental and Social Impacts Assessment Methodology

13. This environmental and social impacts assessment (examination and evaluation) is based on comparative evaluation of the environmental quality before and after establishment of the project. For this purpose, the baseline at each subproject level was developed by collecting data, records and information on physical, ecological as well as socioeconomic environment, in particular the areas along subproject alignment. An assessment of impact at the different phases of the project, i.e., design stage was undertaken. The changes anticipated in the critical environmental aspects e.g., in the aquatic environmental parameters that may be significant have been identified. This

[4] Attached technical assistance will support implementation of Output 3.

leads to assessment and evaluation of significant impact, for which necessary mitigation measures have been proposed.

14. Figure below shows the step-by-step process for the preparation of this ESIA study.

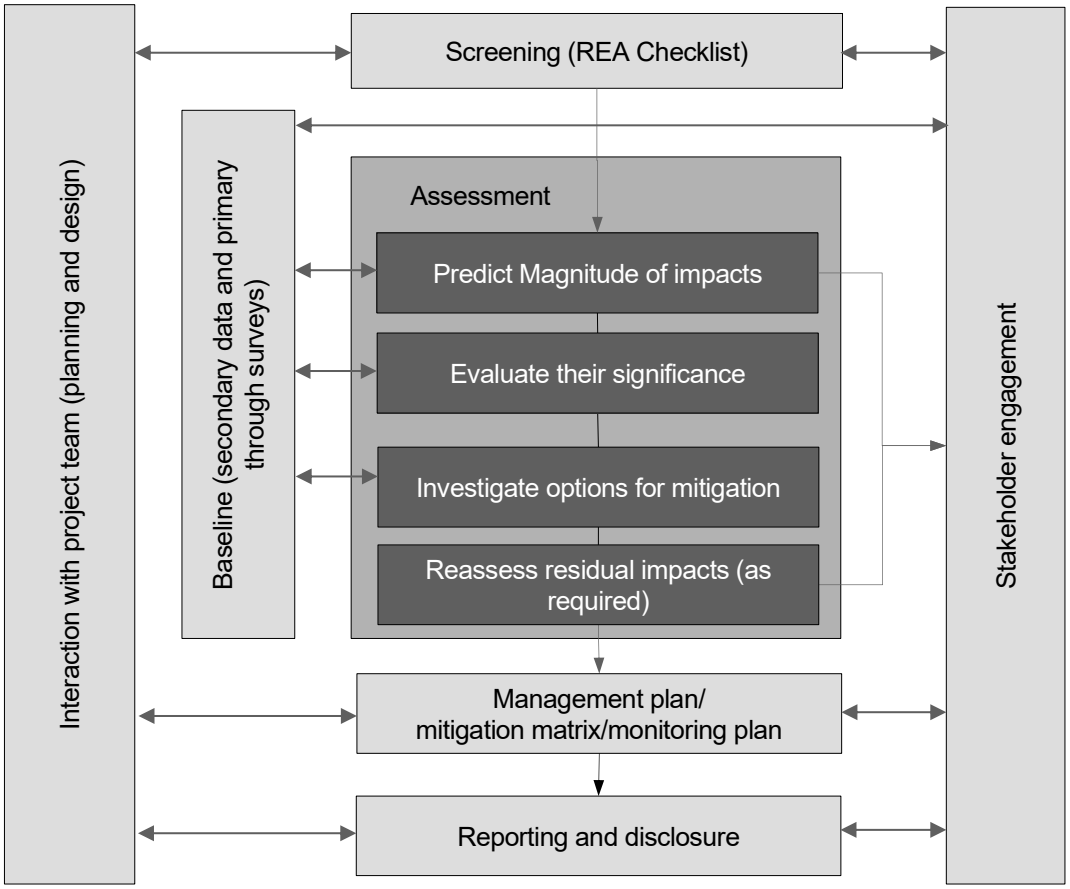


Figure I-2: Steps of ESIA

1. Acquiring Subproject Specific Data

15. This was the very first step to embark on the study initiated through meetings held with the officials of EA/IA and Design Teams of the TA Consultant. In the meetings, discussions were made to clarify the nature and location of subproject sites in environmental perspectives. Basic information on the form of raw input received from design team was analyzed by the environmental specialist to comprehend the project and to assess its influence on the environment.

2. Environment Safeguard Screening

16. The overall Sindh Coastal Resilience Sector Project (SCRP) has been categorized to Category B for environment safeguard[5]. Commensurate to ADB SPS, 2009 and Sindh EPA Act, 2014, all loans and investment subprojects under output 1 and output 2 of the SCRP are subject to categorization to determine environmental assessment requirements. The environmental safeguard categorization is to be undertaken using ADB Rapid Environmental Assessment (REA) checklists for each physical elements or subprojects proposed under output 1 and output 2 of SCRP.

17. The subprojects' screening will focus on collecting environmental and social (E&S) attributes from the subproject area.

[5] https://www.adb.org/projects/54097-001/main

3. Literature Review

18. While the subproject details were being acquired, desktop study was also initiated simultaneously to draft environmental and social baseline information for ESIA. The desktop study comprised of literature review, collection of updated authenticated published/printed data on the physical, biological and social environment related to the focused area.

4. Reconnaissance Surveys and Monitoring

19. Reconnaissance surveys of the microenvironment of were conducted and assessed any sensitive receptors as well as the baseline conditions.

5. Stakeholder Consultation

20. To collect the opinion and feedback of the communities located in the neighborhood of subprojects regarding proposed need for rehabilitation of drainage network and other physical interventions under output 1 and output 2 of the SCRP, and any foreseen impacts due to rehabilitation reconstruction works was carried out. Stakeholder consultations were performed to document the concerns of the local community, and to identify issues that may require additional assessment in order to address these concerns.

6. Identification of Aspects

21. Identification of environmental aspects and their significance is fundamentally important for determination of severity of incidence of impacts at different stages of the project. This step is aimed at obtaining an inventory of the aspects. The aspects identified during this step cover all activities in order to determine those which have or can have significant impact on the environment.

7. Impact Assessment

22. This ESIA study has analyzed and assessed the anticipated impacts that are likely to arise due to the identified aspects in design, construction and operation phases of subprojects. Each of the potential environmental and social impacts identified during the screening surveys and consultation sessions was evaluated using the environmental, socioeconomic, and project information collected. In general, the impact assessment discussion covers the following aspects:

- Present baseline conditions
- Potential change in environmental and social parameters due to project (checklist method)
- Prediction of potential impacts
- Evaluation of the potential impacts
- Defining of mitigation measures to reduce impacts to as low as practicable
- Monitoring of residual impacts.

23. Prediction of impact from different activities during all phases of the subprojects have been made to ascertain that the spatial extent, impact duration and significance along with its rating.

24. Assessment of potential environmental impacts involved combined use of checklist and matrix method along with professional judgment to effectively evaluate the potential impacts during different stages of each subproject activities.

8. Recommendations on Mitigation Measures

25. The TA Consultant have identified mitigation measures to help prevent or minimize all the potential environmental impacts of the project. These mitigation measures include management and monitoring practices, physical and administrative controls, or compensation. The mitigation measures proposed are based on a good understanding of the sensitivity and behavior of environmental receptors within the project area (gained on the basis of the secondary data and first-hand data collected in the field survey), past experience, case studies, legislative controls, guidelines and expert knowledge.

26. For any residual impacts (impacts remaining after applying the recommended mitigation measures) or for impacts in which there has been a level of uncertainty in prediction, the ESIA recommends monitoring measures.

9. Environmental & Social Management and Monitoring Plan

27. In the light of impacts identified and mitigations proposed, an Environmental and Social Management Plan (ESMP) has been developed which has a pivotal role in assigning tasks to personnel for the environmental management and implementation of mitigation measures as well as to monitor its effectiveness throughout the life cycle of the selected subprojects. It also provides monitoring plan to be followed for checking and compliance maintenance of environmental quality and legal requirements through suggested mitigation measures.

10. Documentation and Disclosure

28. This is the final step to complete the environmental assessment and compile all the work done in shape of an ESIA report. The report has been written and compiled by TA Consultant.

11. Structure of ESIA Report

29. The Report has been presented in the following sections:

- Section I: Provides an introduction and methodology of the assessment;
- Section II: Gives an overview of policy and legislation along with international guidelines relevant to the project;
- Section III: Details the project description, its objective, location of subproject sites, design and utilities
- Section IV: Provides description of the baseline of microenvironment and macro environment of the project sites.
- Section V: Stakeholder Consultation
- Section VI: Describes the potential environmental and social impacts of the project. General and project specific guidelines were used to assess the potential environmental impacts at the various– - design, construction and operations – stages of the project.
- Section VII: Presents the Environmental and Social Management Plan for the project
- Section VIII: Summarizes the report and presents its conclusions.

30. The main text of the report is supported by a series of annexures which provide auxiliary information including monitoring reports, quality standards and guidelines and other plans.

II. LEGAL AND POLICY FRAMEWORK

A. Local Institutional Framework

31. The constitution of Pakistan contains provision for environmental protection and resource conservation. The constitution mentions environmental pollution and the ecology as a subject in the concurrent legislative list, meaning that both the provincial and federal government may initiate and make legislation for the purpose.

32. Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject.

33. However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. The main consequences of this change are as follows: i) The Ministry of Environment at the federal level has been abolished. Its functions related to the national environmental management has been transferred to the provinces. The international obligations in the context of environment will be managed by various ministries and departments of the federal government, ii) The Pakistan Environmental Protection Act 1997 (PEPA 1997) is technically no longer applicable to the provinces. The provinces are required to enact their own legislation for environmental protection.

34. The Provincial Environmental Protection Agencies are formed by the respective Provincial Governments. A Director General who exercises powers delegated to him by the Provincial Government heads each Provincial EPA. IEEs and EIAs are submitted to provincial EPAs for approval.

35. The Government of Sindh (GoS) has designated its Ministry of Environment Climate Change & Coastal Development, to administer matters related to the environment in Sindh. The Sindh Environmental Protection Agency (hereinafter referred to as "SEPA") is directly under the Ministry of Environment Climate Change & Coastal Development.

B. Applicable National & Provincial Regulatory Framework

36. Legislative assembly of Sindh province of Pakistan passed the bill on 24th February 2014 to enact Sindh Environmental Protection Act 2014. The Act is the principal legislation for the protection, improvement, conservation and rehabilitation of environment of Sindh Province with the help of legal action against polluters and green awakening of communities. It equally lays emphasis for the preservation of the natural resources of Sindh and to adopt ways and means for restoring the balance in its ecosystem by avoiding all types of environmental hazards.

37. All applicable regulatory requirements for SCRP are summarized in below table.

Table II-1: Local applicable Policies and Legislations

Policy/Legislation	Summary	Relevance to the project
Policy Requirements		
National Environmental Policy, 2005	The National Environmental Policy aims to protect, conserve and restore Pakistan's environment particularly	This ESIA document aim to protect, conserve and restore the environment along the

Policy/Legislation	Summary	Relevance to the project
	freshwater bodies and coastal waters in order to improve the quality of life for the citizens through sustainable development.	subprojects by providing mitigation / compensation measures.
Statutory Requirements		
Sindh Environmental Protection Act 2014	The Act envisages protection, improvement, conservation and rehabilitation of environment of Sindh. Section 11 says "No person shall discharge or emit or allow the discharge or emission of any effluent waste, pollutant, noise or adverse environmental effects in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards". Section 14 says "No person shall undertake any action which adversely affects environment or which lead to pollute or impairment of or damage to biodiversity, ecosystem, aesthetics or any damage to environment etc." Section 17 of this Act requires that every development project has to be preceded by an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) depending upon the size and severity of impacts anticipated on commissioning of the project.	Heavy machinery operations may generate excessive noise and dust, impacting nearby communities and workers, is a matter of concerns. Impacts will be minimal and for short duration only during construction phase. Raising and strengthening of embankments may disrupt local flora along the IP and NIP sides of sub-projects. Compensatory measures are provided in this ESIA. Suitable mitigation measures and monitoring requirements are proposed in this ESIA. is the subproject specific IEE or EIA will be prepared in accordance with section 17 of the Act.
Sindh Environmental Quality Standards 2016	Sindh EPA has revised the Environmental Quality Standards (EQS) and developed Sindh Environmental Industrial Wastewater, Effluent, Domestic Sewerage, Industrial Air Emission, Ambient Air, Noise for vehicles, Air Emissions for Vehicles and Drinking Water Quality Standards which are applicable for all pollution streams.	All the subprojects need to comply with SEQS 2016. A monitoring plan has made part of this ESIA, which will guide EA/IAs and Contractor(s) to monitor the compliance of SEQS for any pollutant streams. Concerns of unchecked fuel, oil and lubricant spills in soil and waterways cannot be ruled out. Drifts of such spills may become dangerous to the ecosystem. Mitigation measures are proposed in this ESIA document. Construction workers, tool/plant operators will regularly be educated and trained in safeguards. Construction and rehabilitation activities may increase sedimentation, affecting downstream water quality in creeks. Regular water quality monitoring, sediment control measures, and proper waste disposal methods will be implemented to minimize contamination and safeguard the beneficial uses of water downstream.

Policy/Legislation	Summary	Relevance to the project
The Sindh Wildlife Protection, Preservation, Conservation and Management Act, 2020	This Act provide the protection, conservation, preservation, sustainable use of wildlife for establishment, management and maintenance of protected areas in the Province of Sindh and to provide for matters connected therewith. The Act specifies classifications of the protected areas: national parks, wildlife sanctuaries and game reserves. Activities such as hunting, trapping wildlife, polluting / diverting resources, damaging infrastructure / cultural resources, cutting flora, cultivation, creating noise, quarrying / mining etc. is prohibited in protected areas.	Subproject drains proposed under Output 1 are outfalling in Indus Delta which is designated as Ramsar Site. The improvement and rehabilitation work along the drains will increase the water availability of Ramsar site which will in turn improve its ecological characteristics, however, undertaking project activities including excavation and related earthworks during peak flow periods is likely to further increase turbidity levels, potentially impacting the ecology of the receiving waters of Indus Delta. Adequate mitigation measures are proposed in ESMP. Under output 2, one of the subprojects namely Bijora Bao Norang Wetland is located close to a wildlife sanctuary namely Bijoro Chach. The wildlife sanctuary is known for important breeding area for Water Fowl. However, development of wetland and improved water retention and periphery tree cover will enhance the ecological characteristics of the wetland. Under output 2, one of the subprojects namely Mangroves Plantation (Nagan Dhoro) will be undertaken in Indus Delta which is a Ramsar Site as well as 15 km away from Keti Bundar South Wildlife Sanctuary, but the purpose is to plant mangrove and improves ecological characteristics and forest cover. Under output 2, one of the subprojects namely Inland Plantation (Jati) will be undertaken in Indus Delta which is a Ramsar Site as well as a about 25 km away from Keti Bundar wildlife sanctuary, but the purpose is to plant trees and improves ecological character and forest cover. Further analysis of the above sites by tailoring the proposed physical elements with the anticipated impacts on the reported protected sites will be carried out through establishment of robust baseline and enhanced and careful site-specific impacts assessment.
Antiquities Act 1975	Makes it illegal to undertake any construction work within 200 ft (60 m) of a building, site or monument protected under the Act. Requires that the Department of Archaeology and Museum, Government	There is no gazette archeological / cultural heritage site protected under this act falls within 200ft. of the subproject alignment.

Policy/Legislation	Summary	Relevance to the project
	of Pakistan should be informed if any archaeological artefact is found during excavation.	
The Sindh Cultural Heritage (Preservation) Act, 1994	Makes it illegal to destroy, damage, remove or alter any cultural heritage site designated under this Act.	No cultural / religious heritage sites have been reported within the drainage corridor. The possible discovery of heritage resources particularly archeological resources or random findings during the execution of rehabilitation works, will require measures to manage chance finds. This ESIA includes "Chance Find" procedures for protection of any tangible cultural heritage (archeological) discovery during construction phase. The Chance Find procedure is provided in **Annex III**.
The Forest Act (Sindh Amendment) Act, 1994	The Act empowers the provincial forest departments to declare any forest area as reserved or protected. This Act prohibits the tree cutting in reserved and protected forest designated under the Act. Permission must be taken from the Sindh Forest department to execute the cutting of any tree. Section 1(1) of this Act mentions that illegal tree cutting is subjected to pose liability or punishment to the project owner.	Most of the subproject alignments do not intrude or affect any reserved / protected forest designated under this Act. The Bijora Bao Norang Wetland is located inside the reserved forest Called Bijora Forest designated by forest department. The land use around the wetland is encroached upon with cultivation by locals and no forest land use was observed. However, development of wetland and improved water retention and periphery tree cover will enhance the ecological characteristics of the wetland. Pinnah Lake is located inside the reserved forest called Pinnah Forest designated by forest department. However, development of wetland and improves water retention and periphery tree cover will enhance the ecological characteristics of the wetland.
Land Acquisition Act 1894	This Act provides law for the acquisition of land needed for public purposes and for companies and for determining the amount of compensation to be made on account of such acquisitions. The LAA comprises 55 sections pertaining to area notification and surveys, acquisition, compensation and appointment, awards and disputes resolution, penalties and exemptions. The LAA has been the de facto policy regarding resettlement and compensation to the Title holders only. It lays down procedure for acquisition of private properties for public purposes and their compensation.	For improvement of existing drains and canals, it is unlikely that the land acquisition will be required. However, in case, a component of subproject requires land acquisition, land to be acquired as per the provisions of LAA 1894 and ADB SPS, 2009 SR2.

Policy/Legislation	Summary	Relevance to the project
The Sindh Prohibition of Employment of Children Act, 2017	This Act prohibits the employment of any children to take part in any hazardous work including lifting and carrying of heavy weight as listed in Schedule of this Act.	It will be ensured in the subprojects' EMP/ESMP that child employment is prohibited during subproject activities and provisions of this Act will be followed.
International Treaties and Conventions		
ILO Conventions	C138 - Minimum Age Convention, 1973 (No. 138) Minimum age specified: 14 years	It will be ensured in the subprojects' EMP/ESMP that any of the labor/workers working in the improvement of drainage works and other subprojects is not less than 14 years of age.
The Montreal Protocol (a protocol to the Vienna Convention for the Protection of the Ozone Layer) on Substances that Deplete Ozone Layer and associated amendments, 1987	This convention makes it illegal to use such substances which may contribute to cause depletion to ozone layer.	It is least expected that during drains/canals improvement works, any substance which contribute to cause depletion to ozone layer will be used. However, it will be ensured in the subprojects' EMP/ESMP that any of the substance will be avoided during the subprojects' activities.
Ramsar Convention on Wetlands, 1971	One of the obligations of signatories of the Ramsar Convention are, to designate wetlands for the List of Wetlands of International Importance; There are nineteen Ramsar sites in Pakistan.	Indus Delta is a designated Ramsar site (number 1,284) as per Annotated List of Wetlands of International Importance. Based on preliminary information, the following species are supported by the Delta; • Dalmatian pelican (Dalmatian pelican) reported near threatened and moderately depleted by IUCN; • Indian Ocean Humpback Dolphin (*Sousa Plumbea*) declared as endangered species in the IUCN redlist,, • Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*) declared as Vulnerable species globally by IUCN. • Bottlenose *dolphin (Tursiops aduncus),* reported as near threatened by IUCN; • humpback whale (Megaptera novaeangliae) reported as least concern globally by IUCN. • Reptilian species are also reported in the area. However; further baseline studies are underway and will be reported in the subproject EIA or IEE. Only mangrove plantation is proposed in the Indus Delta. None other subprojects are encroached upon this Ramsar site. The only impact which is anticipated in the delta is the release of excessive sediments during construction period which is temporary and of short duration. Further protection measures will be proposed in the subprojects' EMP/ESMP.
Convention on the Conservation of Migratory Species of Wild Animals	This convention aims to conserve migratory species within their migratory ranges.	Number of scattered inundations due to water logging are a common site along the

Policy/Legislation	Summary	Relevance to the project
		drains in Sindh which attracts migratory birds. A number of undesignated wetlands along Indus River also attract migratory birds and water fowl population. Indus Delta is also a site for visiting migratory birds. Suitable mitigation measures in line with best international practices will be proposed in the subprojects' EMPs/ESMPs.
IUCN Red List of Threatened Species	Identification of threatened species as per the IUCN Red List defines the global conservation status of biological species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies.	The mangroves plantation proposed in intertidal zones of Indus Delta has species reported to be found in IUCN red list. However, based on preliminary analysis, the interventions proposed in these zones will not negatively affect the threatened species.

C. Provincial Environmental Assessment Procedure

38. Section 17 of Sindh Environmental Protection Act 2014 and other regulatory documents such as Sindh Environmental Protection Agency (Review of IEE/EIA) Regulations 2014 requires that every new development project in Sindh Province has to be preceded by an Environmental Screening (through check list) or Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) depending upon the magnitude of the project and severity of impacts anticipated at the time of commissioning of the project.

39. SEPA (Environmental Assessment) Regulations 2021 categorizes projects into three separate schedules depending on whether a project requires a checklist (Schedule-I) or IEE (Schedule-II) or an EIA (Schedule-III). Irrigation systems and drainage system with the area of less than 15,000 hectare are included in Schedule II Category G(3) requires an IEE study which requires a lesser degree of impact assessment. Irrigation and drainage projects serving more than 15,000 hectares and above are included in Schedule III Category F(2) require a comprehensive ESIA study.

40. Hence this ESIA has been developed and is ready to be submitted to the Sindh Environmental Protection Agency (SEPA), which is the main stakeholders for issuance of the Non-Objection Certificate (NOC) for the project against the ESIA study.

D. Safeguard Policy Statement (SPS) of ADB

41. The following standards, manuals and policy documents are relevant to SCRP in respect to the safeguard policy of ADB:

- Safeguard Policy Statement (June 2009);
- Safeguard Requirements (SR) 1: Environment (2009);
- Safeguard Requirements (SR) 2: Involuntary Resettlement (2009);

42. Safeguard Requirements (SR) 3: Indigenous Peoples (2009);

43. ADB's SPS sets out the objectives, principles and delivery process of ADB's safeguard policy. The objectives of ADB's safeguards are to:

    i. Avoid adverse impacts of projects on the environment and affected people, where possible;

    ii. Minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and

    iii. Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks".

Table II-2: ADB Policy Principles and Compliance with the project

Policy Principle	*Summary*	*Compliance to the Sub-project*
Safeguard Requirements 1: Environment		
Screening and Categorization	Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.	For determination of the appropriate extent and type of the environmental assessment, all the subprojects proposed under SCRP will be screened and categorized as per ADB SPS, 2009 by applying sector specific rapid environmental assessment (REA) Checklists.
Environmental Assessment	Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate.	This ESIA study assesses the impacts associated with the rehabilitation of the selected subprojects under output 1 and output 2 of the SCRP and provides mitigation measures. Section VI identifies potential impacts and provides generic mitigation measures to be adopted during construction / rehabilitation phase. Transboundary impacts are not anticipated.
Alternatives	Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.	It is envisaged in proposed rehabilitation works for each subproject that all the proposed rehabilitation works shall be carried out within the existing ROW. The project will ensure that no works shall be carried out beyond the RoW. In unavoidable circumstance, appropriate impacts assessment and mitigation measures will be part of the subprojects' EMP or ESMP. Alternatives to the subproject's location is not feasible as the project is planning to rehabilitate the existing infrastructures. However; if needed, the project will evaluate alternatives for design, technology selection

		Alternative alignment options are not applicable in case of drain rehabilitation / reconstruction as the existing drains are the only available alternative for the interventions keeping in mind the potential environmental and social impacts.
Impact Mitigation	Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle.	ESMP section is provided as part of ESIA document. For each subproject, subprojects' EMP or ESMP will be prepared includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.
Public Consultations	Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance.	Consultations with male and female community members for each subproject was carried out to discuss environmental and social issues; the findings of the consultations are presented in social section of this report.
Disclosure of Environmental Assessment	Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.	The IEEs and EIA reports for each subproject will be disclosed by EA/IAs.
Environmental Management Plan	Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.	ESMP section is included in the ESIA study and for each subproject, subprojects' EMP will be part of the IEE or EIA.
Biodiversity	Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected	Most of the drains proposed in Output 1, out falling in Indus Delta which is designated as Ramsar Site. The improvement and rehabilitation work along the drains will increase the water availability of Ramsar site which in turn improve its ecological

	area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.	characteristics, however, undertaking project activities including excavation and related earthworks during peak flow periods is likely to further increase turbidity levels, potentially impacting the ecology of the receiving waters of Indus Delta. Adequate mitigation measures are proposed in this generic ESMP and will further be enhanced in the site-specific EMP. Bijora Bao Norang Wetland is located close to a wildlife sanctuary namely Bijoro Chach. The wildlife sanctuary is known for important breeding area for Water Fowl. However, development of wetland and improved water retention and periphery tree cover will enhance the ecological characteristics of the wetland. Mangroves Plantation (Nagan Dhoro) will be undertaken in Indus Delta which is a Ramsar Site as well as close to Keti Bundar wildlife sanctuary, but the purpose is to plant mangrove and improves ecological characteristics and forest cover. Inland Plantation (Jati) will be undertaken in Indus Delta which is a Ramsar Site as well as a close to Keti Bundar wildlife sanctuary, but the purpose is to plant trees and improves ecological characteristics and forest cover.
Pollution Prevention	Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.	The ESIA study provides pollution prevention measures for the drainage project and complies with ADB safeguards requirements. The ESMP provided in later section outlines the specific mitigation and management measures to prevent and control pollution. However; this requirement of the ADB safeguard policy will further be enhanced/complied in the subprojects' IEE or EIA. No pesticides will be used during the sub-project development activities.
Occupational Health and Safety Community Safety	Provide workers with safe and healthy working conditions and prevent accidents, injuries, and	The ESIA study outlines the requirement for health and safety

	disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.	and emergency response. However; the occupational health and safety (OHS) and community health and safety (CHS) aspects will further be enhanced in the subprojects' IEE or EIA in line with the World Bank Group general environment, health and safety guidelines (EHSGs)[6].
Physical cultural resources	Conserve physical cultural resources and avoid destroying or damaging them. Conduct field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of "chance find" procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.	No such locally designated physical cultural heritage site is located within or in near vicinity of RoW of subprojects. Also, no such movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance, are observed near the alignments.
Safeguard Requirements 2: Involuntary Resettlement		
Involuntary Resettlement	The involuntary resettlement requirements apply to full or partial, permanent or temporary physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) resulting from (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. A land acquisition and resettlement plan (LARP) to be prepared for the Project to ensure compliance with the safeguard on Involuntary Resettlement.	Lack of title should not be a bar to compensation. Requires equal treatment of those without clear land titles (for example squatters, or other informal settlers) in terms of their entitlements for resettlement assistance and compensation for the loss of non-land assets. Subproject specific resettlement issues shall be addressed to assist non-titleholder persons and bridge the gap between existing practice and the main guidelines of the ADB SPS 2009 with regards to involuntary resettlement. To reconcile the inconsistencies between LAA (1894) and the ADB SPS 2009, subproject specific LARPs to be prepared, ensuring that compensation is provided at replacement cost for all direct and indirect losses so that no one is worse off as a result of the subproject interventions.
Safeguard Requirements 3: Indigenous People		
Indigenous People	The objective is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples themselves so that they	No Indigenous People are located in Sindh Province. Therefore, the ADB SPS 2009 SR 3 is not applicable.

[6] https://documents1.worldbank.org/curated/zh/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf

	(i) receive culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts as a result of projects, and (iii) can participate actively in projects that affect them.	

E. Relevant Local & International Standards

1. Sindh Environmental Quality Standards 2016

44. Sindh EPA has provided the Environmental Quality Standards (EQS) and developed

- Sindh Environmental Industrial Wastewater, Effluent, Domestic Sewerage standards;
- Industrial Air Emission standards;
- Ambient Air Quality Standards;
- Ambient Noise Standards;
- Noise and Air Emissions for Vehicles and
- Drinking Water Quality Standards which are applicable for all pollution streams.

45. The standards are provided in **Annex I**.

46. All the subprojects need to will comply with SEQS 2016. A monitoring plan shall be made part of safeguard documents, which will guide EA/IAs and contractor(s) to monitor the compliance of SEQS for any pollutant streams.

2. IFC General EHS Guidelines

47. The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities at reasonable costs by existing technology[7].

[7] https://www.ifc.org/content/dam/ifc/doc/2023/ifc-general-ehs-guidelines.pdf

III. DESCRIPTION OF THE SUBPROJECTS

A. Project Objectives

48. The proposed Sindh Coastal Resilience Sector Project (SCRP) will help reduce flood risks and build the resilience of local communities and households by improving physical infrastructure and creating livelihood responses to those facing climatic risks. The SCRP project area is the Sindh delta and coastal region within the administrative districts of Thatta, Sujawal, and Badin.

    i Development of improved and climate resilient integrated water resources, drainage, and flood risk management solutions (a summary of Output 1);

    ii Restoration and improvement of nature-based solutions for coastal protection and marine ecosystems (a summary of Output 2);

    iii Strengthening of institutional and community capacities for strategic action (a summary of Output 3).

49. Output 3 will be implemented with support of ADB technical assistance.

B. Screening Criteria

50. The following types of subprojects should not be eligible and not be included in the project framework: i) subprojects that are not necessary to improve irrigation system, flood resilience, coastal resilience management and coastal protection proposed under Output 1 and 2; ii) subprojects to be financed by other donors; iii) subprojects in transboundary systems; and iv) require land acquisition for construction new drainage and canals: new irrigation systems or expansion of existing irrigation systems into new irrigable service areas.

1. Subprojects Selection Criteria

51. Based on the inception workshop held on the April 30,2024 along with numerous consultations done with different stakeholders, the following criteria were decided to be used:

- Flood Resilience and Community Engagement.
- Safeguards.
- Economic Benefits, Political Priority, and the IFAD.
- Project readiness.

52. The TA consultant proposed to perform a first set of prioritization on a long list of 72 schemes provided. The schemes were groups into 16 groups (A to P) and each group thus constitutes a subproject. The groups were decided on the basis of geographical location and how complementary the schemes are to one another. The following map shows an overview of the grouping.

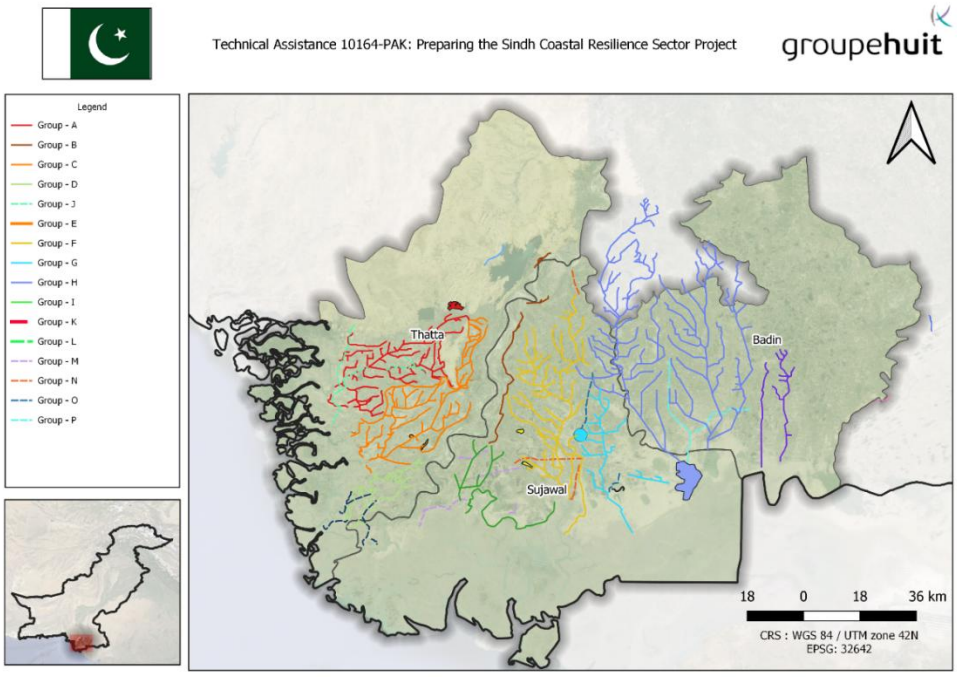


Figure III-1: Grouping of Projects Stage 1

53. More schemes were identified through stakeholder consultations that allow for a more integrated approach. The following schemes were identified:

- Mangrove plantation
- Inland plantations that are complementary to the mangrove plantations
- Wetlands
- Village bunds

54. The following maps represent the different groups and there components whereby the team has identified new schemes to be added for the retained groups as follows:

- Group A: Mangrove and inland plantation.
- Group B: Wetlands.
- Groups C: Mangrove plantation, inland plantation, and wetlands.
- Group D: Mangrove plantation, inland plantation, and a village bund.
- Group E: Mangrove plantation, inland plantation, and village bunds.
- Group F: Mangrove plantation, inland plantation, and village bunds.
- Group G: Mangrove and inland plantation.
- Group H: Mangrove and inland plantation.
- Group I: Mangrove and inland plantation.

55. It is then proposed to further consider these 3 groups to make the final selection of subprojects to be considered under feasibility and advance feasibility studies.

56. A workshop on how to devise, plan and deliver Adaptation Pathways in response to climate issues faced in Pakistan (and more specifically the ADB-financed Sindh Coastal Resilience Project (SCRP) area) and to collectively prioritize SCRP's sub-projects with the greatest potential for delivering climate resilient benefits and protecting communities from disaster risks, was held on

25th November, 2024. The workshop was convened by the P&DD, GoS and co-convened by the ADB at the Movenpick Hotel in Karachi, Pakistan.



Figure III-2: Adaptation Pathways Workshop

57. Based on conceptual phase findings and as per consultation with provincial stakeholders and inception workshop and the above-mentioned Adaptation Pathways Workshop, 3 groups of No Regret sub-projects were identified for feasibility level studies and detailed design, as follows:

- Group C - Ghora Bari Project Feasibility;
- Group F – Nagan Dhoro Project Advanced Feasibility; and
- Group G – Jati Malkani Project Feasibility.

58. The TA Consultant is preparing the feasibility and detailed engineering design has prioritized and finalized “03 groups of subprojects and 19 Components” from the long list of 72 subprojects. The list of priority subprojects is provided in Table III-1.

C. Subproject Components

Table III-1: List of priority subprojects and their components

COMPONENTS	IMPLEMENTING BODIES	DETAILED ACTIVITIES
1. Group C – Ghora Bari Project FEASIBILITY LEVEL		
1.1. Improvement & Remodeling of Ghora Bari Outfall Drain	Executing Agency: P&D Implementing Agency: PIU Irrigation Department	▶ Improvement of outfall drain and strengthening and raising of embankments; ▶ Armoring of banks at certain locations for countering erosion effects; ▶ Raising and strengthening of guide banks and their armoring; ▶ Desilting and weed clearance; ▶ Improvement of major structures along the drain (road bridges, village road bridges, syphons/watercourses etc.); ▶ Improvement of existing inlets and construction of new inlets for efficient disposal of effluent of area; ▶ Improvement of outfall regulator of Ghora Bari outfall drain;
1.2. Improvement and Rehabilitation of Garho Outfall Drain		▶ Raising and strengthening of embankments; ▶ raising and strengthening of guide banks and their armoring ▶ Desilting and weed clearance; ▶ Improvement of outfall regulator; ▶ Construction of inlets, village road bridges and water courses;

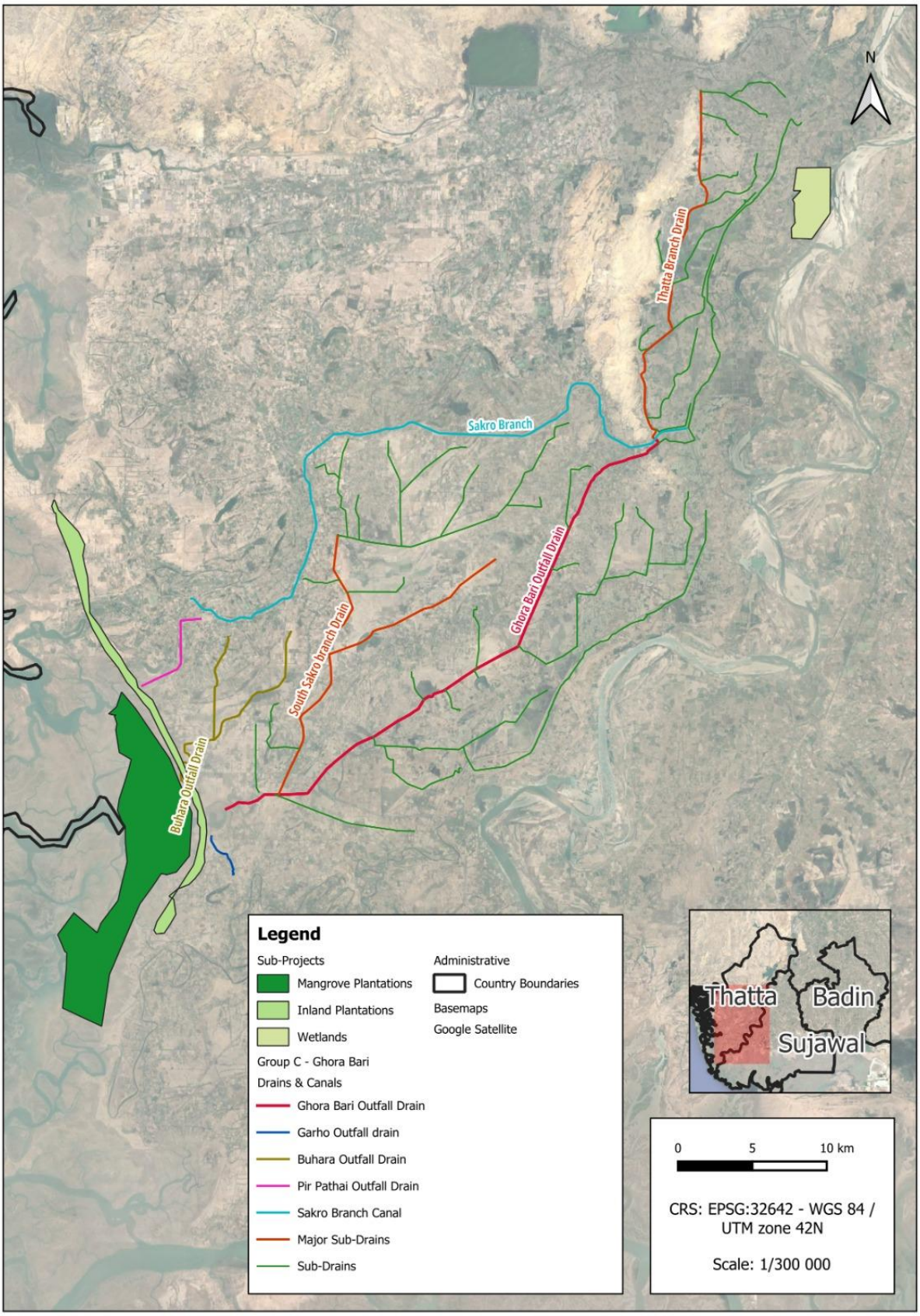
COMPONENTS	IMPLEMENTING BODIES	DETAILED ACTIVITIES
1.3. Improvement and Rehabilitation of Pir Pithai Outfall Drain		▶ Raising and strengthening of embankments; ▶ Raising and strengthening of guide banks and their armoring; ▶ Desilting and weed clearance; ▶ Rehabilitation of outfall regulator; ▶ Construction of inlets, village road bridges and water courses;
1.4. Improvement and Rehabilitation of Buhara Outfall Drain		▶ Raising and strengthening of embankments; ▶ Raising and strengthening of guide banks and their armoring; ▶ Desilting and weed clearance; ▶ Rehabilitation of outfall regulator; ▶ Rehabilitation of existing and construction of new inlets, VILLAGE ROAD BRIDGEs and water courses; ▶ Revamping of subdrain 1-LB with allied structures along the span;
1.5. Improvement of Sakro Branch Canal		▶ Rehabilitation, raising and strengthening of canal embankments; ▶ Rehabilitation of escape regulator; ▶ Desilting of canal section; ▶ Repair of cross and head regulator structures/gates;
1.6. Restoration and Improvement of Bijora Bao Norang Wetland	Executing Agency: P&D Implementing Agency: PIU Forest Department	▶ Raising and strengthening of banks of wetland; ▶ Desilting where necessary; ▶ Improvement of inlet and outlets of wetland; ▶ Provision of structures e.g. culverts etc. where necessary;
1.7. Inland Plantation		▶ Plantation of inland indigenous and salt tolerant species in designated areas; ▶ Arrangement for proper watering;
1.8. Mangrove Plantation		▶ Plantation of mangroves in designated areas;
2. Group F – Nagan Dhoro Project ADVANCED FEASIBILITY		
2.1. Improvement and Remodeling of Nagan Dhoro Outfall Drain	Executing Agency: P&D Implementing Agency: PIU Irrigation Department	▶ Improvement of outfall drain and strengthening and raising of embankments; ▶ Armoring of banks at certain reaches for countering erosion effects; ▶ Desilting and weed clearance; ▶ Improvement of major structures along the drain (road bridges, village road bridges, syphons/watercourses etc.); ▶ Improvement of existing inlets and construction of new inlets for efficient disposal of effluent of area; ▶ Construction of control structures at out falling points of branch/sub drains; ▶ Improvement of outfall regulator;
2.2. Improvement of Guide Banks of Nagan Dhoro Outfall Drain		▶ Improvement and strengthening of guide banks and their armoring; ▶ Construction of inlets;
2.3. Improvement of Geri Branch Drain of Nagan Dhoro		▶ Improvement of Geri Branch Drain; ▶ Stone pitching at certain reaches of drain; ▶ Improvement of structures along the drain; ▶ Construction of new structures as required along the drain;

COMPONENTS	IMPLEMENTING BODIES	DETAILED ACTIVITIES
2.4. Restoration of Pinnah Lake	Executing Agency: P&D Implementing Agency: PIU Forest Department	▶ Improvement and strengthening of banks of lake(s); ▶ Desilting and weed clearance; ▶ Improvement of inlet and outlets of lake; ▶ Provision of structures e.g. culverts, field courses etc. where necessary;
2.5. Inland Plantation		▶ Plantation of inland indigenous and salt tolerant species in designated areas; ▶ Arrangement for proper watering;
2.6. Mangroves Plantation		▶ Plantation of mangroves in designated areas;
3. Group G – Jati Malkani Project FEASIBILITY LEVEL		
3.1. Improvement of Malkani Outfall Drain	Executing Agency: P&D Implementing Agency: PIU Irrigation Department	▶ Improvement and strengthening of embankments; ▶ Raising and strengthening of guide banks and their armoring; ▶ Improvement of outfall regulator; ▶ Improvement of existing and construction of new structures along the drain; ▶ Revamping of 1- LB sub-drain with allied structures etc.;
3.2. Improvement of Jati Outfall Drain		▶ Raising and strengthening of embankments; ▶ Raising and strengthening of guide banks and their armoring; ▶ Construction of outfall regulator; ▶ Construction of control structures for preceding associated network; ▶ Improvement of existing and construction of new structures along the drain; ▶ Revamping of sub-drain with allied structures etc.;
3.3. Improvement of Control Structures/Group of Regulators at Pinyari Irrigation Canal		▶ Improvement of cross/head regulators with gates;
3.4. Inland Plantation	Executing Agency: P&D Implementing Agency: PIU Forest Department	▶ Plantation of inland indigenous and salt tolerant species in designated areas; ▶ Arrangement for proper watering;
3.5. Mangroves Plantation		▶ Plantation of mangroves in designated areas;

D. Description of each Subproject

1. Group C

Map for Group C Sub-projects



Name	**Ghorabari Outfall Drain**
District	Thatta
Type of Infrastructure	Drain
Components	• Revamping of the entire span of NIP Side • Revamping of IP from RD -3.7 to RD 40 and from RD 105 to RD 122 • Stone pitching in reaches between RD -3.7 to RD 0, RD 20 to RD 26, and RD 106 to109 • Road bridge strengthening 4 No.at RD 26, 45, 89 and 97 • Watercourses repair 4 No. at RD 40, 47, 92 and 100 • Outfall Regulator reconstruction with new gates • Desilting and weed clearance along the drain • Repair of Syphon at RD 10 • Proposed Inlets pipe 20 at different RDs • Road bridge new construction 1 No. at RD 11
Current Situation	The Ghora Bari Outfall Drain, constructed in the 1970s in Thatta District, was designed to drain effluent from 332,800 acres of agricultural land into Dubo Creek. The main drain spans 122 RDs (37 km) with a design discharge of 1040.40 cusecs. The drain is supported by an extensive network of 48 branches, sub, and link drains of varying lengths and discharges. The Thatta branch drain alone has 11 sub and link drains, which carry effluent into the Thatta branch before ultimately discharging into the Ghorabari Outfall. Similarly, branch drains such as 1L, 2L, 3L, and South Sakro, along with their sub and link drains, connect to the Ghorabari Outfall at various RDs and directly discharge into Dubo Creek. **Current Condition of Drain** During the site visit along with officials of the Irrigation Department, it was found that the inspection path of the Ghorabari outfall drain is on Right Side from RD 0 to RD 40, and on the left side from RD 40 to RD 105 and again on Right side from RD 105 to RD 122. The berm condition along various reaches of the Ghorabari outfall drain is severely degraded, with entire sections missing. Reconditioning is required from RD 0 to RD 10, RD 20 to RD 40, and RD 60 to RD 100. A reconnaissance of embankments revealed that most of the non-inspection paths (NIP) are degraded and damaged, while the inspection path (IP) road from RD 40 to RD 105 is mostly intact but requires further assessment. The sharp curve between RD 106 and RD 109 has caused severe bank erosion, wiping out sections that now need raising, strengthening, and protection with stone pitching and a toe wall. Similarly, the banks between RD 20 and RD 26, where the berm is missing, are critically degraded and require similar repairs. The reaches upstream from the outfall regulator, RD -3.7 to RD 0, have suffered significant erosion due to tidal effects, degrading both the banks and berms. These sections also need bank raising, berm formation, and stone pitching. Lastly, the left and right guide banks of the Ghorabari outfall regulator require full revamping and stone pitching on both sides for stability. The 8-gated outfall regulator at RD -3.7 is completely damaged, civil works are deteriorated, the gates condition is miserable, and hoists are completely dysfunctional. So, it needs the complete reconstruction of the outfall regulator. Moreover, from Reaches

RD 113 to RD 122 a massive growth of weeds was found, which impedes the proper passage of drainage.

Road bridges were visited along the span of the main outfall drain and found that the road bridge at RD 97 needs to be extended and repaired, RD 26, RD 45 and RD 89 needs repair work only and one new road bridge at RD 11 was proposed. Similarly, the syphon at RD 10 needs repair work.

The condition of inlets along the Ghorabari drain was found to be poor, with many broken, damaged, or inadequate for efficient surface water disposal from agricultural lands. The field team with department staff proposed installing 10 open-type gated inlets and 10 RCC culvert-type inlets, however looking into the insufficiency of inlets in number, it is advisable to augment the number of inlets to appropriate standard on both IP as well as NIP, to enable the surrounding effluent to be disposed of in quick and efficient manner.

Additionally, it was observed that the branch and subdrains discharging into the Ghorabari outfall drain lack control mechanisms, such as gates. It is essential to install gated structures at each discharge point to manage the flow effectively. Nine branches and sub-drain out falling at various RDs of the Ghorabari system require such control structures.



Figure III-3 The current condition of Embankments and Berms

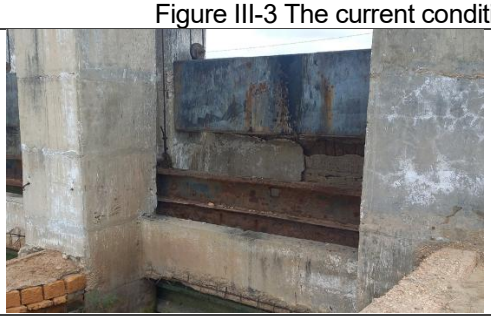
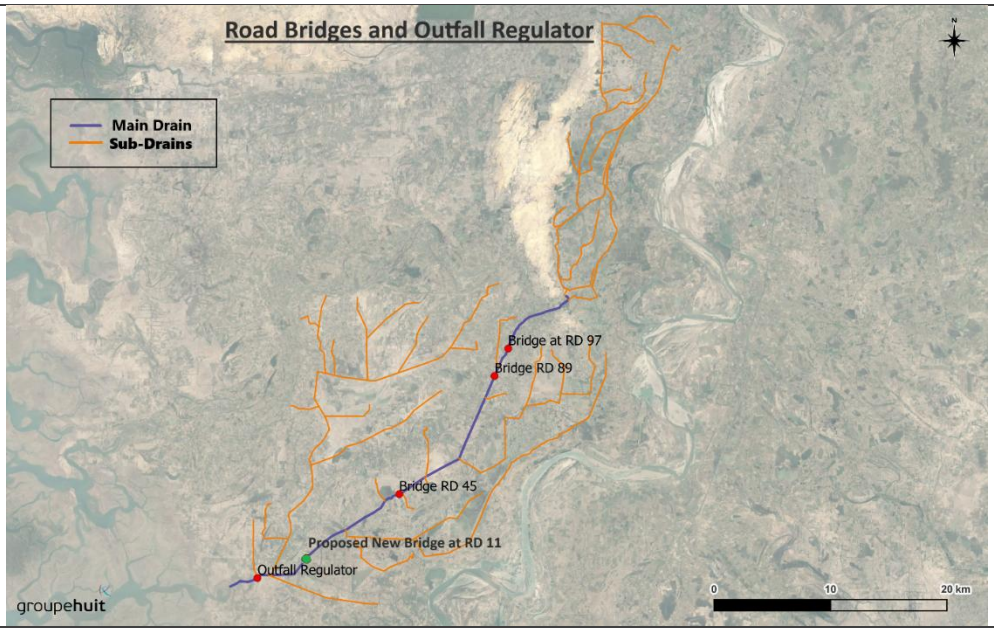


Figure 2 Ghorabari outfall regulator condition



Figure 3 Civil Structure at Ghorabari Outfall drain

		
	Figure 4: Weed Growth Hindering Flow	Figure 5: Road Bridge Condition
Proposed Infrastructure	**Strengthening and improvement WORKS** • **Revamping of the entire span of NIP** to raise and strengthen the berms and banks and to enhance the discharge carrying capacity of the drain • **Revamping of IP from RD -3.7 to RD 40 and from RD 105 to RD 122 to** raise and strengthen the berms and banks and to enhance the discharge carrying capacity of the drain • **Stone pitching in reaches between RD -3.7 to RD 0, RD 20 to RD 26, and RD 106 to109** for countering erosion effects due to wave action • **Repair of Road bridge 4 No. at RD 26, 45, 89 and 97** for countering interruption in flow and ensuring connectivity of the area • **Water courses repair 4 No. at RD 40, 47, 92 and 100** for removing interruptions to stream an adequate supply of irrigation water to fields • **Outfall Regulator (RD –3.7) reconstruction with new gates** for properly controlled, safe, and efficient operations of outfall drainage into the creek. • **Desilting and weed clearance in certain reaches** to maintain a smooth flow in the perimeter. • **Repair and reconstruction of Syphon at RD 10** to augment the life of the structure and may help in removing hindrances to flow **NEW PROPOSED CONSTRUCTION** • **Proposed Inlets pipe 20 at different RDs** for efficient disposal of surface water from fields • **Road bridge new construction 1 No. at RD 11** in support of ensuring/enhancing connectivity of the area	
Implementing agency	Irrigation Department	

Location Map	

Name	**Sakro Branch Canal**
District	Thatta
Type of Infrastructure	Canal
Components	• Rehabilitation of Outfall Regulator at RD 163+00 • Strengthening of Canal Embankments • Desilting of the main canal • Strengthening and Improvement of stone pitching of 12 RDs • Strengthening and improvement of road bridges (Nos 07) • Repair and strengthening of 3 cross regulators • Repair and strengthening of distributary head regulators (Nos 9) • Repair of Head Regulators at RD 0+00, the main head regulator requires rehabilitation, and one distributary head regulator requires mechanical work only. • Provision of Guide banks with stone pitching and apron on both sides
Current Situation	The Sakro Branch Canal stretches 163 RDs (49.7 kilometers) with a design discharge of 2500 cusecs. It is an integral part of the Kotri Barrage irrigation system. This canal is historically significant, with some of its hydraulic structures dating back to 1937, while others were constructed in 1962. The canal is responsible for distributing irrigation water to a large agricultural area, and its efficient operation is crucial for maintaining equitable water distribution among farmers. The current condition of the canal is poor, with most gates and operating mechanisms of the cross-regulators and head regulators severely eroded, corroded, and damaged, making them largely non-functional. All of these regulators are operated manually, and due to poor condition of infrastructure, complications used to appear in proper water management and regulation. In addition, the canal's civil works are in bad condition, with weak embankments and significant silt buildup that reduces its discharge capacity. As a result, equitable water distribution has become difficult, especially for tail-end farmers who are not receiving their fair share of irrigation water. This unequal distribution leads to substantial financial losses for them, exacerbating disparities among stakeholders within the irrigation system. The stone pitching along the canal is also deteriorating. Furthermore, damaged road bridges over the canal create difficulties for local communities.

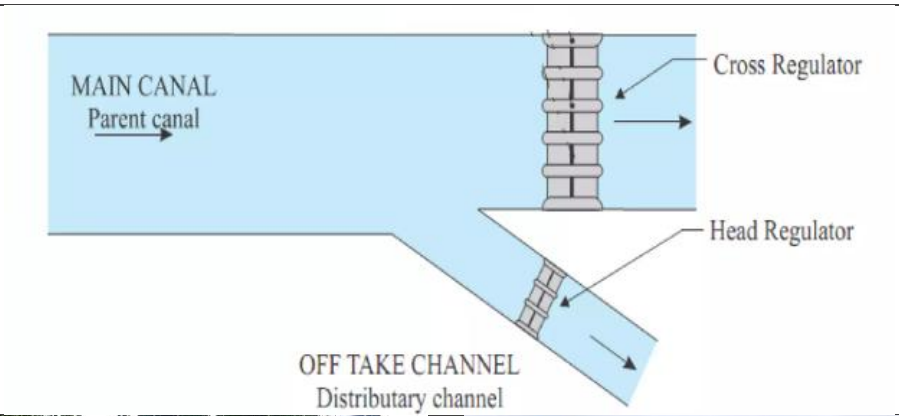




Figure 1 Cross Regulators at RD 97



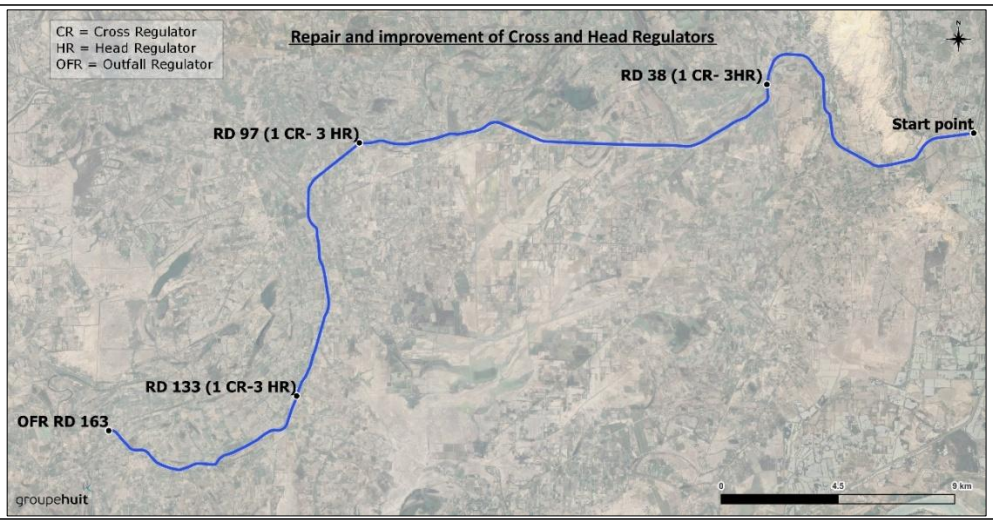
Figure 2 Outfall Regulator at RD 163+00



Figure 3 current condition of Inspection Path

Proposed Infrastructure

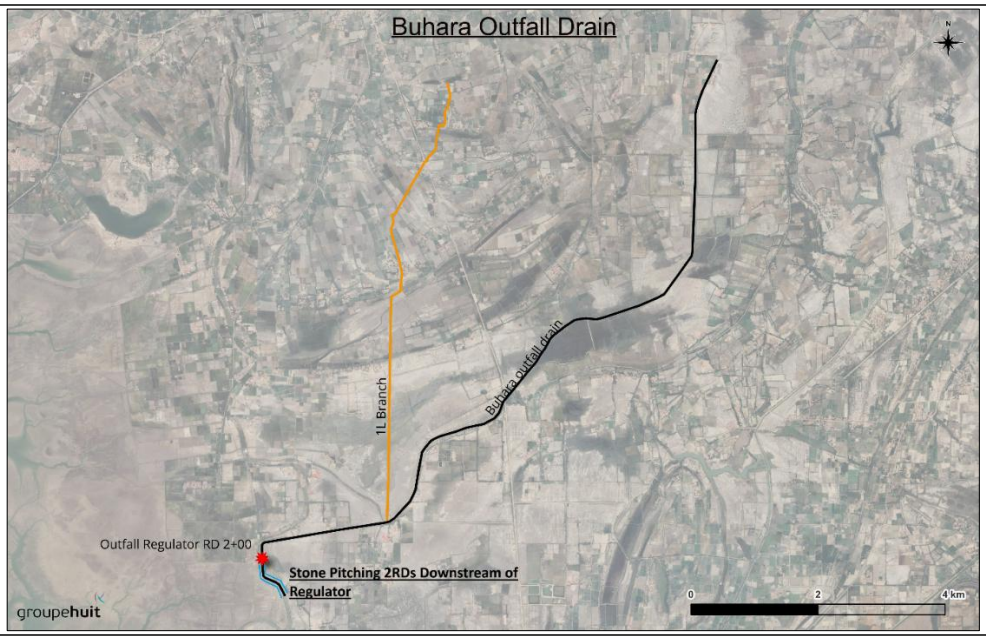
- **Rehabilitation of Escape Regulator and distributary head regulators at RD 163+00**
  There are three regulators: one escape regulator and two distributary head regulators. Both the structural and mechanical components of the distributary regulators need rehabilitation, while the escape regulator is completely deteriorated.
- **Rehabilitation of Cross and Head Regulators at RD 133**
  There are four regulators, including one cross regulator and three distributary head regulators. The cross regulator needs complete rehabilitation, while two of the distributary regulators require full rehabilitation, and one regulator needs only mechanical work.
- **Rehabilitation of Cross and Head Regulators at RD 97**
  There are four regulators, including one cross regulator and three distributary head regulators. The cross regulator needs complete rehabilitation, while two of the distributary regulators require full rehabilitation, and one regulator needs only mechanical work.
- **Rehabilitation of Cross and Head Regulators at RD 38**
  There are four regulators, including one cross regulator and three distributary head regulators. The cross regulator needs complete rehabilitation, while three distributary regulators require mechanical work as well as structural rehabilitation of slab, piers, wing walls.
- **Rehabilitation of Head Regulators at RD 0+00** Total of five regulators but the main head regulator requires rehabilitation, and one distributary head requires mechanical work for water distribution.

	• **Raising and Strengthening of Canal Embankments** are deteriorated and need to increase height and stability, preventing overtopping and breaches. • **Desilting of the main canal:** currently the canal is silted and its discharge carrying capacity is reduced, it is necessary to remove accumulated sediment and debris that impede water flows to restore the flow capacity of the canal. • **Rehabilitation of stone pitching 42RDs.** The rehabilitation of stone pitching is proposed along the canal to prevent erosion. • **Rehabilitation of road bridges (Nos 07)** The rehabilitation of seven road bridges is necessary to ensure safety and functionality for both vehicles and pedestrians. • **Provision of Guide Banks 10 RDs both side with stone pitching and apron** in order to safe withdrawal of water from escape regulator and ensuring the safety of escape regulator.
Implementing agency	Irrigation Department
Location Map	

Name	**Buhara Outfall Drain**
District	Thatta
Type of Infrastructure	Drain
Components	• **<u>Main Drain</u>** • Repair and improvement of 10 Water Courses intersecting the drain • Repair and Improvement of 6 Road Bridges • Strengthening and Raising of the Embankment (IP/NIP side) • Stone pitching Downstream of Regulator 2 RDs both sides • Strengthening and improvement of 4 Open Type Inlets • Strengthening and improvement of 25 RCC Pipe Inlets • Strengthening and improvement of Outfall Regulator • **<u>Sub-Drain 1L</u>** • Strengthening and improvement of 2 Syphons • Strengthening and improvement of 5 Pipe Inlets • Proposed 2 new Road Bridges • Strengthening and improvement of IP/NIP along the sub-drain • Raising of Embankment 3ft along the sub-drain • Desilting 2 ft along the sub-drain • Clearing of weeds and vegetation 40%
Current Situation	The Buhara drain originates near Buhara town in Taluka Mirpur Sakro, District Thatta, and discharges into Dabbo Creek. The drain extends over a length of approximately 35 RDs and was originally constructed to handle a specific design discharge capacity of

	38.36 cfs. It drains the effluent of the catchment area of 12275 acres, supported by 01 sub-drain (1L) with a length of 34 RDs which enhances its overall functionality. There is a total of one regulator structure along the length of the drain, which is currently operated manually. **Current condition of the Drain** The field team, in collaboration with the irrigation department, assessed the current condition of the main drain and subdrain and identified several critical issues. The embankments alongside the drain have proven inadequate during previous flooding events, and their condition has deteriorated, necessitating raising and strengthening. Additionally, significant weed growth and silt accumulation within the drain have drastically reduced its discharge capacity, compromising its overall functionality. The structure of the existing outfall regulator is damaged, and all the gates have deteriorated, requiring rehabilitation. The team observed that the existing inlets are insufficient to effectively drain agricultural water into the main drain. In addition, to address persistent waterlogging issues, the installation of four inlets two upstream and two downstream of the regulator is proposed to enhance drainage efficiency and mitigate flooding risks. The inspection paths along the drain have also significantly deteriorated, hindering maintenance work and requiring strengthening and improvement.
	
	Figure III-4 Outfall Regulator
	
	Figure III-5 current condition of upstream of Outfall Regulator
	
	Figure III-6 Downstream of Regulator requires stone pitching
	
	Figure III-7 Current condition of embankments
Proposed Infrastructure	**<u>STRENGTHENING AND IMPROVEMENT WORKS ON MAIN DRAIN</u>** • **Strengthening and Raising of the Embankment (IP/NIP side)** alongside the drain requires rehabilitation up to a height of 3 to 4 feet to enhance the structural stability and flood protection. • **Strengthening and Improvement of Stone pitching** is necessary to protect the drain embankments from erosion caused by the backflow of seawater during high tides. The high-velocity flows generated during tidal events contribute to significant scouring of the drain's bed and banks. Stone pitching will provide a protective layer, reducing erosion potential, and enhancing the long-term stability of the drain's downstream section • **Desilting of Drain up to 1 to 1.5ft along 26 RDs** is essential to restore and increase the drain's discharge capacity. Removing the excess sediment will improve the hydraulic performance, prevent waterlogging in adjacent areas, and reduce the risk of flooding.

	• **Clearing of Weeds and Vegetation along the Drain** is essential to restore its full discharge capacity, as overgrown plants obstruct the flow, reducing the drain's efficiency. Additionally, excessive vegetation can lead to sediment accumulation, further decreasing the conveyance capacity and increasing the risk of waterlogging and flooding. • **Rehabilitation or repair of Outfall Regulator** to enhance the effective control of drainage discharge. • **Repair of existing inlets** for enabling convenient disposal of effluent from surrounding fields • **Provision of Guide bank with stone pitching for 2 RD each side** to enable proper discharge of drainage ensuring safety of regulator • **Repair of Outfall Regulator** for safe discharge of drainage to creek **NEW PROPOSED CONSTRUCTION** • **Proposed 4 Road Bridges** across the drain to facilitate access for the community. These bridges will provide essential crossings over the drain, allowing farmers and residents to transport goods, equipment, and livestock without disruption. • **Proposed 4 inlets**, two upstream and two downstream of the regulators to effectively drain excess water from agricultural lands and reduce waterlogging issues. Adding new inlets will enhance the drainage network, ensuring timely removal of surface water from the fields into the main drain. • **Provision of Control Structure with gates at subdrain outfall point** in order to smoothen the operations with proper control and management. **STRENGTHENING AND IMPROVEMENT WORKS ON SUB DRAIN 1L** • **Strengthening and improvement of 2 Syphons to** ensure structural integrity enhances water flow efficiency, reducing blockages and flood risks. • **Repair and improvement of 5 Pipe Inlets** to effectively drain excess water from agricultural lands and reduce waterlogging issues. • **Strengthening and improvement of IP/NIP along the sub-drain** is necessary to facilitate proper maintenance and monitoring of the drain. The IP provides easy access for maintenance and machinery, enabling regular inspections, desilting, and repair activities. • **Raising of Embankment 3ft along the sub-drain** alongside the sub drain to enhance the structural stability and flood protection. • **Desilting 2 ft along the sub-drain** to increase the drain's discharge capacity. Removing the excess sediment will improve the hydraulic performance, prevent waterlogging in adjacent areas, and reduce the risk of flooding. • **Clearing of weeds and vegetation 40%** is essential to restore its full discharge capacity, as overgrown plants obstruct the flow, reducing the sub drain's efficiency. **NEW PROPOSED CONSTRUCTION** • **Proposed 2 new Road Bridges** across the sub-drain to facilitate access for the community.
Implementing agency	Irrigation Department

Location Map	

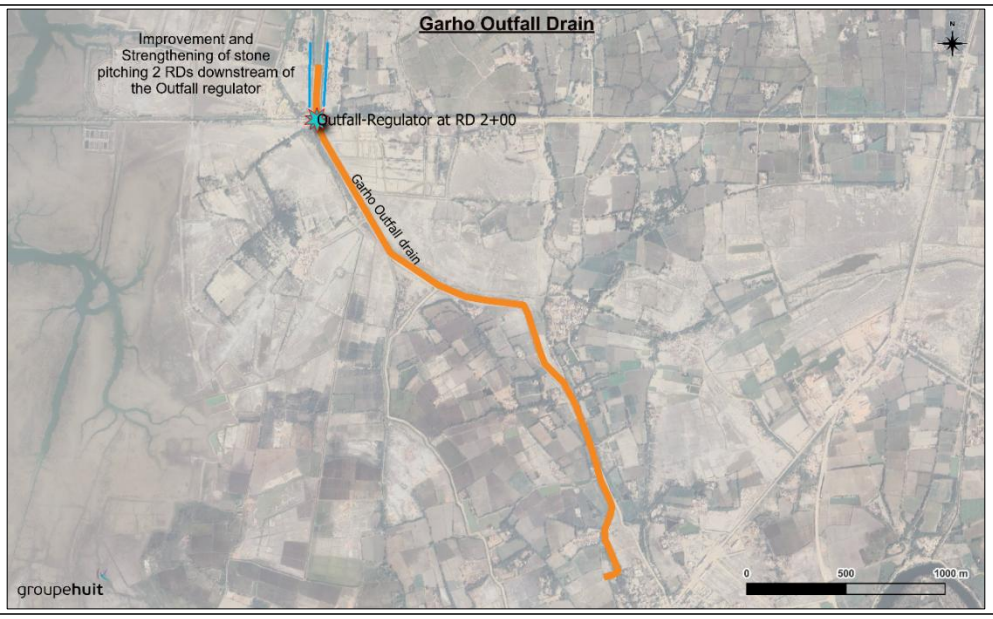
Name	Garho Outfall Drain
District	Thatta
Type of Infrastructure	Drain
Components	• Desilting of Drain • Strengthening of Inspection Paths • Strengthening of Stone pitching 2 RDs downstream of the outfall regulator • Clearing of Weeds and Vegetation along the Drain • Repair of Outfall Regulator • Proposed new construction of 2 Village Road Bridges (VRB) • Proposed new construction of 12 inlets to solve waterlogging problems from agricultural lands • Proposed new construction of 2 water courses
Current Situation	The drain begins near Garho town in Taluka Ghora Bari, District Thatta, and extends for a total length of approximately 3 kilometers (RD9.84) with a discharge capacity of 6 cusecs, eventually discharging into Dubbo Creek. This drain serves as the tail end of the Malirari Distributary. **Detailed current situation of drain components** The main drain has become heavily silted, and its discharge capacity is reduced which requires at least 2 feet of desilting according to the discussion between the field team and the irrigation department during field visits. The inspection paths along the drain have significantly deteriorated and hinders the maintenance work of the drain. Additionally, the banks downstream of the regulator are eroded and require stone pitching to protect the outfall regulator and prevent erosion of banks in downstream of the regulator. There is currently not sufficient access across the drain, so the field team along with the irrigation department have proposed the construction of two Village Road Bridges (VRBs) to facilitate community crossing over the drain. To mitigate waterlogging and salinity in adjacent agricultural lands, the new construction of Twelve inlet pipes, six for the IP side and six for the NIP side is proposed. Additionally, new construction of two watercourses is proposed to cross fresh water to the agricultural fields, ensuring adequate irrigation supply.

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<tr><td></td><td> 
Figure III-8 Current condition of stone pitching downstream of outfall regulator</td></tr>
<tr><td>Proposed Infrastructure</td><td><u>Strengthening and Improvement WORKS</u>

• Desilting of Drain 2ft to restore and increase the drain's discharge capacity. Removing the excess sediment will improve the hydraulic performance, prevent waterlogging in adjacent areas, and reduce the risk of flooding.
• Strengthening of Inspection Paths is necessary to facilitate proper maintenance and monitoring of the drain. The IP provides easy access for maintenance and machinery, enabling regular inspections, desilting, and repair activities.
• Stone pitching 2 RDs downstream of the regulator is necessary to protect the drain embankments from erosion caused by the backflow of seawater during high tides. The high-velocity flows generated during tidal events contribute to significant scouring of the drain's bed and banks. Stone pitching will provide a protective layer, reducing erosion potential, and enhancing the long-term stability of the drain’s downstream section.
• Clearing of Weeds and Vegetation 10% along the Drain is essential to restore its full discharge capacity, as overgrown plants obstruct the flow, reducing the drain's efficiency. Additionally, excessive vegetation can lead to sediment accumulation, further decreasing the conveyance capacity and increasing the risk of waterlogging and flooding.
• The strengthening and improvement of the Outfall Regulator to accommodate the higher flow rates and ensure efficient operation.
• Re-Sectioning Garho Outfall Drain from RD.0.0 to 12.0 is proposed by the field team along with the irrigation department and can be refined after getting modeling results from JBA.

<u>NEW PROPOSED CONSTRUCTION</u>

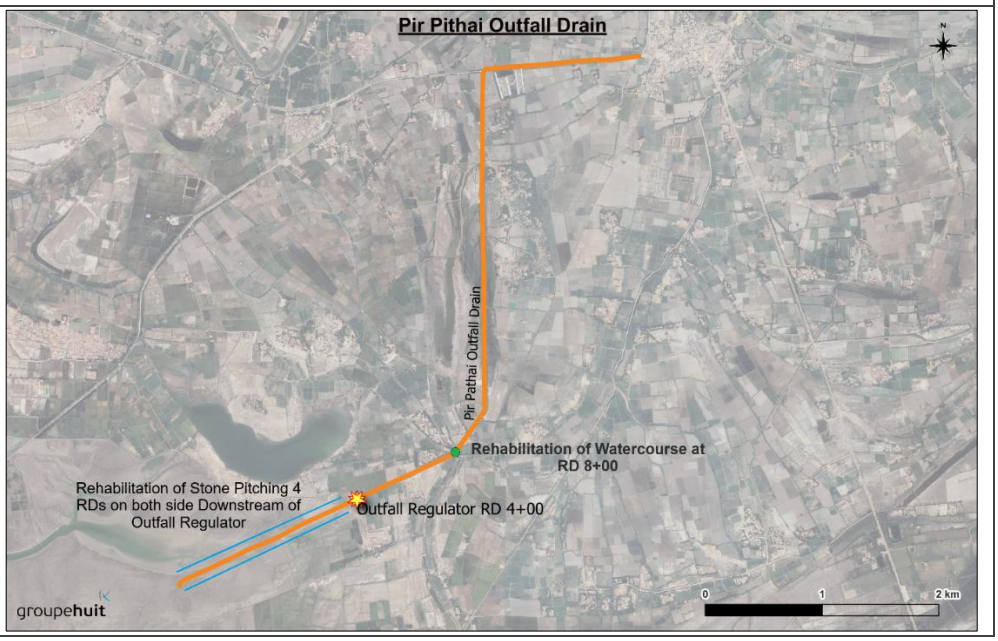
• Proposed new construction of 2 Village Road Bridges (VRB) across the drain to facilitate access for the community. These bridges will provide essential crossings over the drain, allowing farmers and residents to transport goods, equipment, and livestock without disruption.
• Proposed new construction of 12 inlets is essential to effectively drain excess water from agricultural lands and reduce waterlogging issues. Adding new inlets will enhance the drainage network, ensuring the timely removal of surface water from the fields into the main drain.
• Proposed new construction of 2 new watercourses to allow fresh water to cross over the drain for agricultural use, strategically placed to enhance water distribution to nearby fields.</td></tr>
<tr><td>Implementing agency</td><td>Irrigation Department</td></tr>
</table>

Location Map	

Name	Pir Pathai Drain
District	Thatta
Type of Infrastructure	Drain
Components	The strengthening and improvement of the Outfall Regulator at RD 4+00 Stone pitching 4 RDs downstream of the Outfall Regulator The strengthening and improvement of IP and NIP sides Desilting of the Drain up to 1 to 1.5ft along 26 RDs Clearing of Weeds and Vegetation in 40 % of the length along the Drain Strengthening and Raising 40% of the length of Embankments along the drain Repair and improvement of one watercourse at RD 8 A new construction of a double box culvert is required at RD 19+500 Five new construction of culverts are needed between RD 20+00 and RD 26+00 26 Proposed new construction of inlets at different RDs
Current Situation	The Pir Pathai outfall drain begins near Buhara town in Taluka Mirpur Sakro, District Thatta, extending for approximately 26 RDs (7.25 kilometers) and draining the effluent of catchment area of 55 acres before discharging into a nearby creek. The design discharge of the drain is 16 cusecs, the drain has become severely silted and overgrown with weeds, drastically reducing its discharge capacity. To restore functionality, desilting of 1 to 1.5 feet is required along the entire 26 RDs length suggested by the field team with the irrigation department. **Detailed current situation of each component** The field team along with irrigation department visited the current condition of the Pir Pathai drain and observed that the drain and its associated structures presents several challenges. The structure of the existing outfall regulator is damaged, and gates are deteriorated which made regulator dysfunctional and requires rehabilitation, the banks in the downstream of the outfall regulator are eroded and required stone pitching to protect the outfall regulator and prevent erosion of banks. The inspection paths along the drain have significantly deteriorated and hinders the maintenance work of the drain which needs rehabilitation along the drain. Furthermore, the current inlets are inefficient because of blockage due to sedimentation, limiting their functionality also multiple inlets are needed at various points to drain agricultural land flows from the catchment area into the main drain to solve water logging problems. Current culverts are not enough for efficient passage of flow, so some additional culverts are required at critical points to allow the efficient passage of water beneath roads, embankments, or other obstacles, ensuring

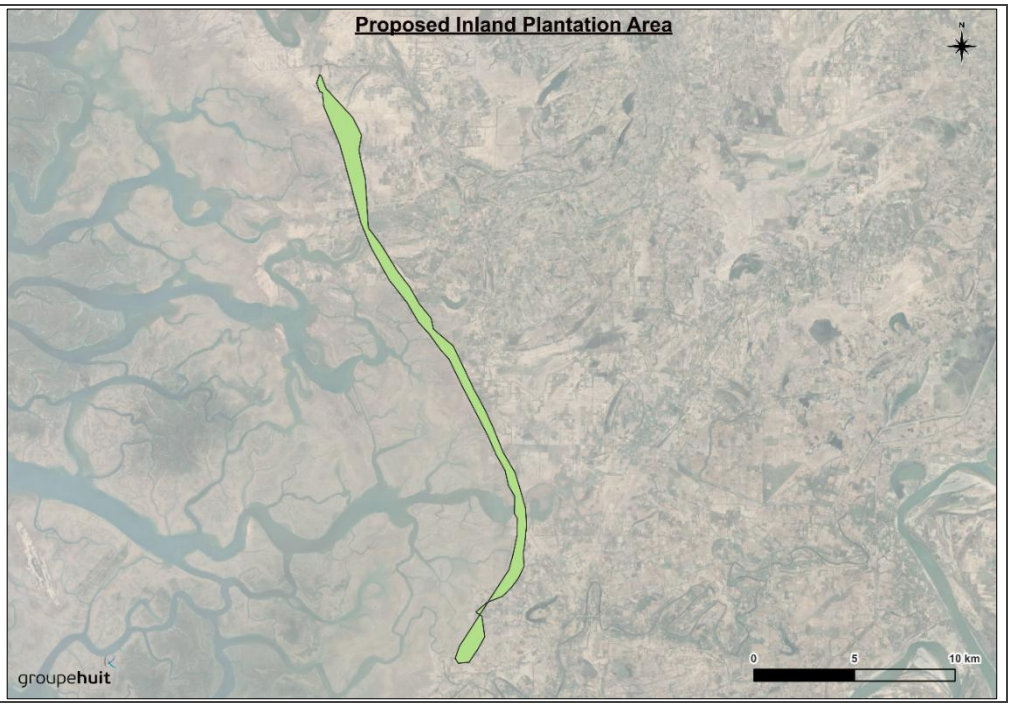
<table>
<tr><td></td><td colspan="2">proper drainage and preventing water from accumulating in unwanted areas. The embankment heights have proven to be not enough in previous events such as Floods 2022 also condition is deteriorated which needs to be elevated to ensure proper drainage and maintain structural stability.</td></tr>
<tr><td></td><td>  </td><td>  </td></tr>
<tr><td></td><td>Figure III-9 Regulator at RD 4+000</td><td>Figure III-10 Downstream of RD 4+000 requires stone pitching</td></tr>
<tr><td></td><td>  </td><td>  </td></tr>
<tr><td></td><td>Figure III-11 current condition of water course at RD 8+000</td><td>Figure III-12 current condition of inlets</td></tr>
<tr><td>Proposed Infrastructure</td><td colspan="2"><u>Strengthening and improvement WORKS</u>

• The strengthening and improvement (Extension) of the Outfall Regulator at RD 4+00 requires an extension, as the existing structure was designed for the original design discharge. However, due to the current increased discharge capacity of the drain, an extension of the regulator is necessary to accommodate the higher flow rates and ensure efficient operation.
• Stone pitching 4 RDs downstream of the Outfall Regulator is necessary to protect the drain embankments from erosion caused by the backflow of seawater during high tides. The high-velocity flows generated during tidal events contribute to significant scouring of the drain's bed and banks. Stone pitching will provide a protective layer, reducing erosion potential, and enhancing the long-term stability of the drain’s downstream section.
• The strengthening and improvement of IP and NIP sides is necessary to facilitate proper maintenance and monitoring of the drain. The IP provides easy access to maintenance and machinery, enabling regular inspections, desilting, and repair activities.
• Desilting of the Drain up to 1 to 1.5ft along 26 RDs is essential to restore and increase the drain's discharge capacity. Removing the excess sediment will improve the hydraulic performance, prevent waterlogging in adjacent areas, and reduce the risk of flooding.
• Clearing of Weeds and Vegetation in 40 % of the length along the Drain is essential to restore its full discharge capacity, as 40% of the drain area has overgrown plants that obstruct the flow, reducing the drain's efficiency. Additionally, excessive vegetation can lead to sediment accumulation, further decreasing the conveyance capacity and increasing the risk of waterlogging and flooding.
• Strengthening and Raising 40% of the length of Embankments along the drain is critical to enhance the structural stability and flood protection of the drainage system.
• Repair and improvement of one watercourse at RD 8 intersecting the drain are necessary to eliminate obstructions that impede drainage flow during high discharge events leading to localized flooding and inefficiencies in the drainage system.</td></tr>
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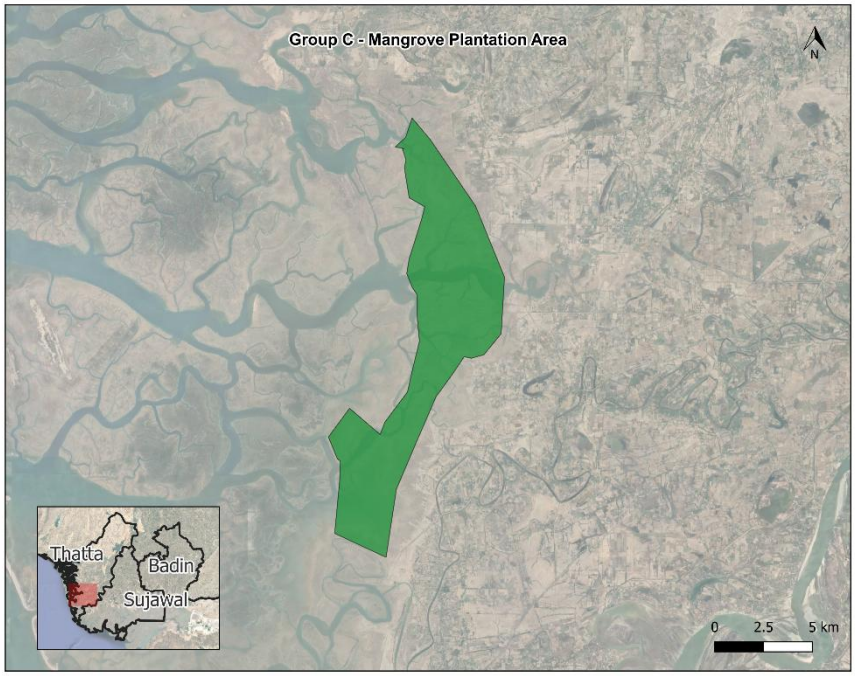
	NEW PROPOSED CONSTRUCTION • **A new construction of a double cell culvert is required at RD 19+500** to replace the existing culvert, which is heavily silted and completely damaged, rendering it incapable of passing upstream drainage flows. New culvert is critical to prevent flow blockages, mitigate the risk of upstream flooding, and restore the proper functioning of the drainage system. • **Five new construction of culverts are needed between RD 20+00 and RD 26+00** to facilitate access for the community to agricultural lands. These culverts will provide essential crossings over the drain, allowing farmers and residents to transport goods, equipment, and livestock without disruption. • **26 Proposed new construction of inlets at different RDs** will enhance the drainage network, ensuring the timely removal of surface water from the agriculture fields into the main drain.
Implementing agency	Irrigation Department
Location Map	

District	Thatta
Type of Infrastructure	Inland Plantation
Components	• Earthwork • Planting of Inland species • Restocking of Inland species • Raising of a nursery • Watch and Ward system • Engagement of local community in planting and seed as a food source for animals. • Establishment of Water storage tanks

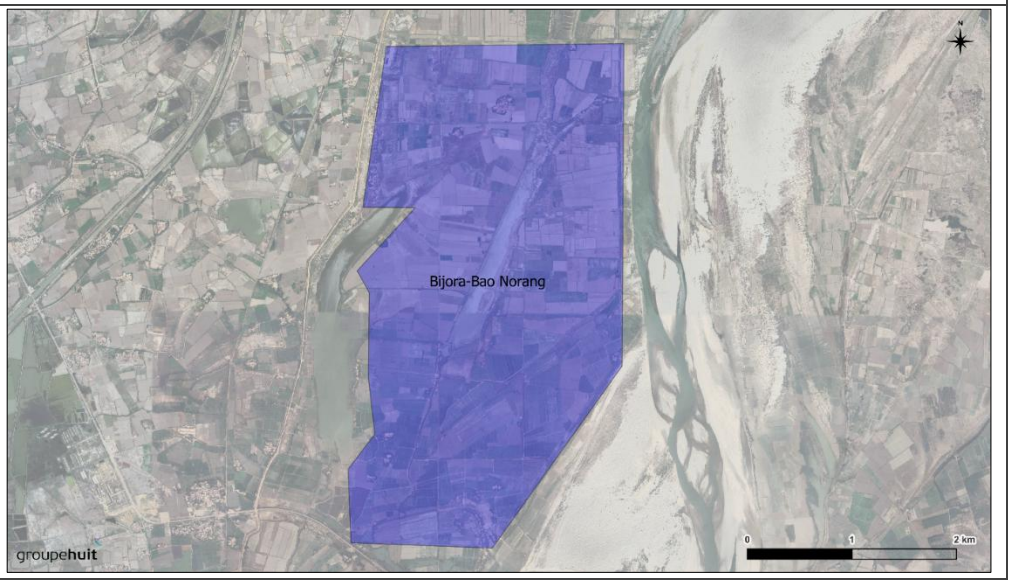
Current Situation	The project areas consist of barren, unattended saline lands situated beyond the intertidal zone. Historically, there has been no significant presence of mangroves or inland plantations in these regions, indicating a long-standing lack of vegetation. The soil type is predominantly saline and unproductive, contributing to the land's inability to support agricultural or natural plant growth. The absence of mangrove coverage or inland vegetation highlights the environmental degradation, and sea intrusion towards agricultural lands intensified by salinity and poor soil conditions have rendered the area ecologically dormant and challenging for productive use. Wave heights observed in these areas are typically low, given the distance from the more dynamic intertidal zones. **Proposed area for inland plantation**  
Proposed Infrastructure	New Plantation (Area = 1738 Hectares) with grid size 2m x 2m Restocking also after each year 1st year restocking in Plantation 30% 2nd year restocking in Plantation 20% 3rd year restocking in Plantation 10% The proposed inland tree species and Inland Shrubs will be: **INLAND TREE SPECIES** 1. Salvadora Persica 2. Salvadora oleoides. 3. Tamarix Aphylta 4. Prosopis Cineraria 5. Acacia Nilotica 6. Eucalyptus Camaldulensis 7. Conocarpus Eractus 8. Albizia Lebbeck 9. Parkinsonia Aculeate 10. Prosopis Juliflora 11. Casuarina Equisetifolia 12. Ber 13. Imli 14.Jungle Jalebi **INLAND SHRUBS** 1. Suaeda Fruticosa 2. Arthrocaulon Macrostachyum 3. Halopyrum Muconatum 4. Cressa Certica
Implementing agency	Forest Department

Location Map	

Name	Mangroves Plantation
District	Thatta
Type of Infrastructure	Mangroves
Components	• Earthwork • Planting of mangroves • Restocking of mangroves • Raising of a nursery • Watch and Ward system • Engagement of local community in planting, their wooden boats, seed as a food source for animals.
Current Situation	The project area is located in an intertidal zone and has not previously had mangrove plantations, leaving it exposed to environmental challenges. The soil in the region is primarily silty loam. This area is particularly vulnerable to sea intrusion, which has made agricultural lands unsuitable for farming. Additionally, coastal erosion and the threat of tsunamis pose significant risks to the local community, highlighting the urgent need for mangrove plantations to stabilize the coastline and enhance resilience against these natural hazards.
Proposed Infrastructure	New Plantation (Area = 2875 Hectares) with 2m x 2m grid side Restocking also after each year 1st year restocking in Plantation 30% 2nd year restocking in Plantation 20% 3rd year restocking in Plantation 10% **MANGROVE SPECIES** Mangrove plantation is carried out with four species: 1) Avicennia marina, 2) Rhizophora mucronata, 3) Ceriops tagal, and 4) Aegiceras corniculatum. The primary focus is on planting Avicennia Marina and Rhizophora mucronata, while the other two species are planted in suitable locations that receive fresh water from the delta.

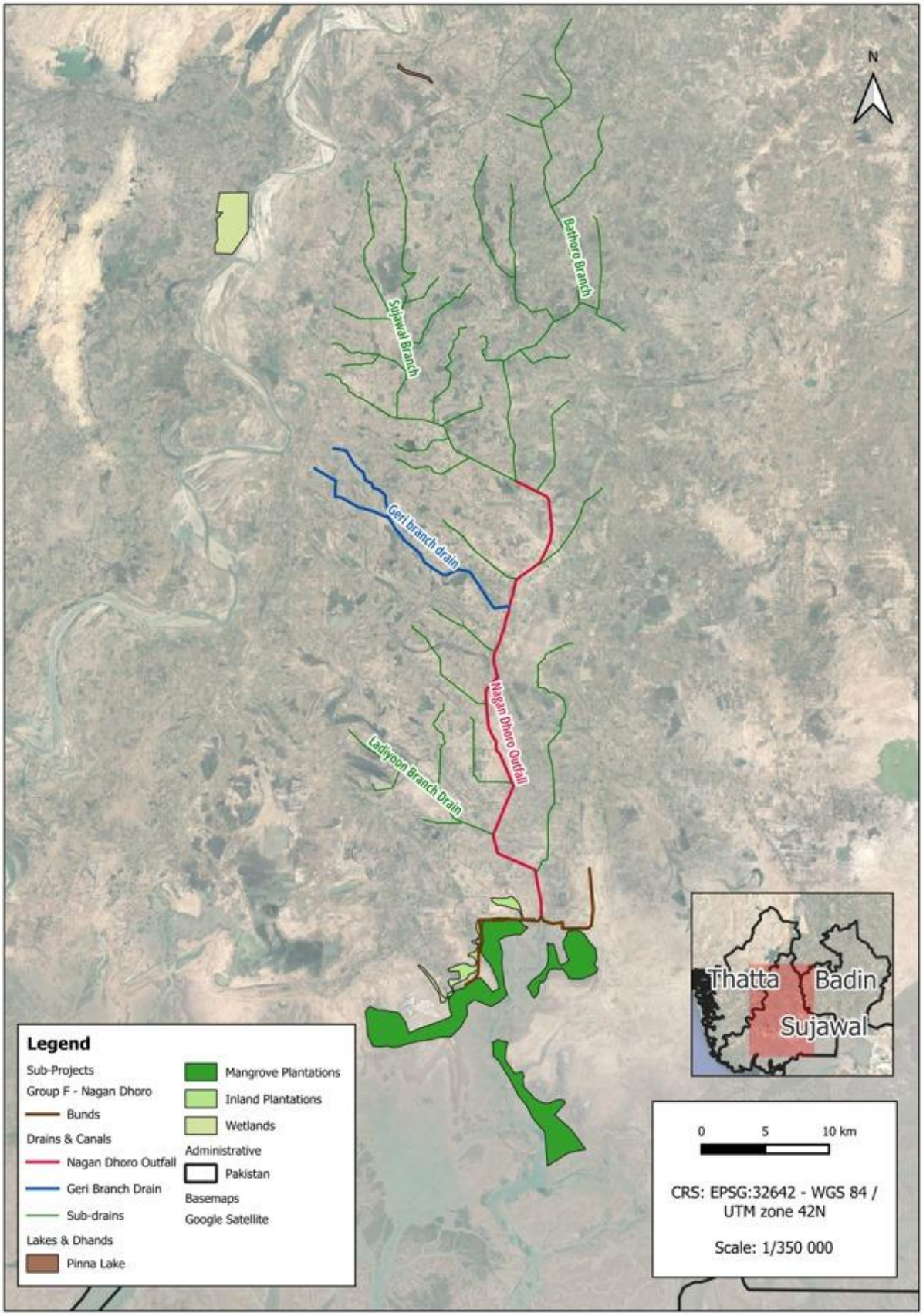
	Planting of Avicennia Marina and Rhizophora mucronata, the two most favorable species for the Indus Delta, takes place during the designated planting season. Restocking of Rhizophora is typically done alongside Avicennia, and restocking in Avicennia plantations is supplemented with other species like Rhizophora and Ceriops. Initially, a single species is planted at a location, depending on the availability of seeds or propagules and site conditions, with further plantation carried out accordingly.
Implementing agency	Forest Department
Location Map	

District	Thatta
Type of Infrastructure	Wetland/lake
Components	• Hydrological restoration • Water Quality Improvement • Earthwork for excavation and revamping • New Planting • Restocking in Plantation 30% • Maintenance of Plantation (Watering through lift pump) • Raising of Nursery Plants (Saline Resistant Species)
Current Situation	The Bijora Bao Norang wetland, located within the Bao Porandas Forest and Bijora Forest, is approximately 3 km from the Sujawal Bypass and Thatta City, and 100 km from Hyderabad. This wetland spans 4.95 km in length, 1,000 feet in width, and has a depth ranging from 10 to 15 feet. The wetland is primarily fed by scape gates, with water flowing out into the River Indus from the KB Feeder at RD-22. It is used for coconut plantation, lift irrigation covering 400-500 acres, and provides water for domestic use, including drinking and livestock. The area is culturally significant, hosting villages of the Mallah, Jakhro, and Shora tribes, as well as a temple, a Gurdwara, and the shrine of Bukhari Badshah. Vegetation includes Acacia nilotica, Prosopis glandulosa, Prosopis cineraria, Tamarix dioica, Saccharum spp, elephant grass, and coconut plantations. Despite the presence of sweet water suitable for agricultural use, the wetland faces challenges, particularly during high flood seasons when pathways are closed, leading to stagnant water conditions. These issues, coupled with damaged banks and weakened structural integrity, pose environmental risks. Nonetheless, the wetland remains a habitat for aquatic animals

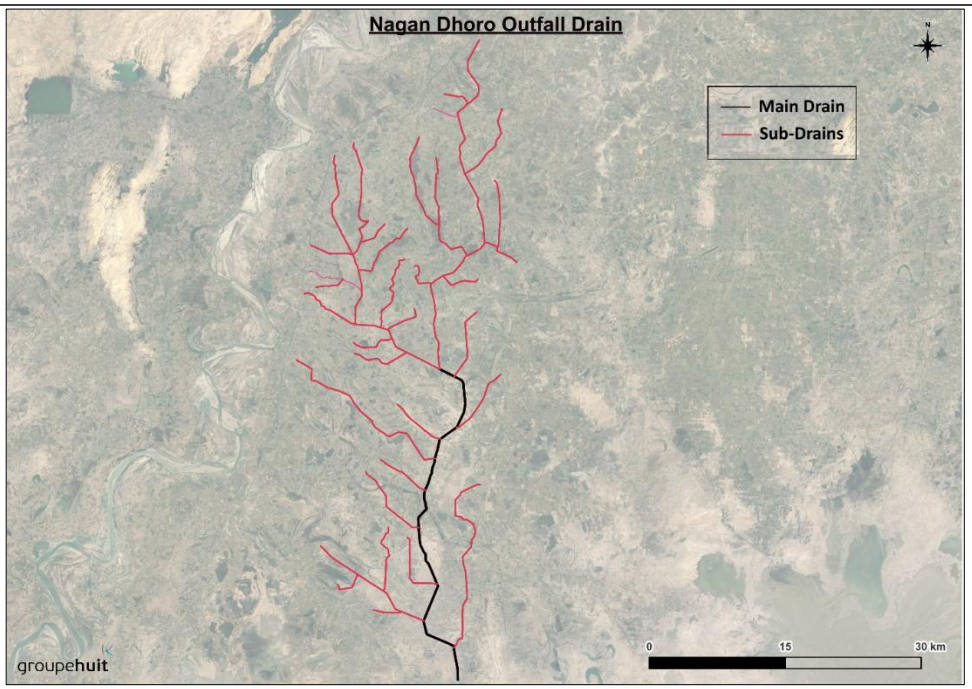
	and birds, including waterfowl, jackals, wild rabbits, fish eagles, and migratory birds that arrive during the winter season. **Current pictures of wetland**  Figure III-13 Passage made by Locals to cross the wetland
Proposed Infrastructure	• Earthwork for excavation and revamping for plantation as well as cleaning of inlets and outlets to receive more water. • New Planting includes Acacia nilotica, Prosopis glandulosa, Prosopis cineraria, Tamarix dioica, Saccharum spp, elephant grass, and coconut plantations are suitable for the area. • Restocking in Plantation 30% because, following planting, a 100% success rate is not always achieved. Factors such as soil conditions, terrain, and temperature fluctuations can cause plant mortality, with 20% to 30% of the plants failing to survive. This anticipated failure rate necessitates planning for a 30% restocking to ensure the plantation's success. • Maintenance of Plantation (Watering through lift pump) lift water from the river and wetland for plantation because some plantations are far from wetland and need a lift pump for watering. • Raising of Nursery Plants (Saline Resistant Species)
Implementing agency	Forest Department
Location Map	

2. Group F

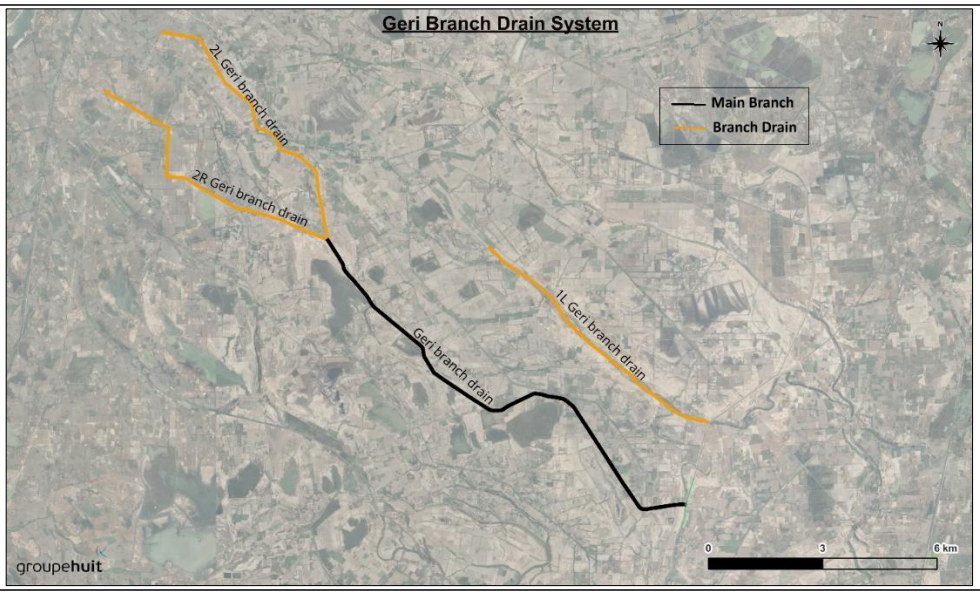
Map of Group F Sub-Projects



Name	Nagan Dhoro Outfall Drain
District	Sujawal
Type of Infrastructure	Drain
Components	• **Main Drain** • Reconstruction of Outfall Regulator at RD 2+00 • Proposed 70 new inlets (that drain agricultural lands) • Repair of VRB (Nos.6) RD 107+00, 89+20, 73+00, 80+00, 55+00, 38+00,a • Clearing of Weeds and Vegetation along the Drain RD 100 to 127 • Strengthening of Embankments 40% along the drain • Stone pitching at belly areas?? • Gated control structures at branch/sub drains outfall points??
Current Situation	The Nagan Dhoro Outfall Drain is a major drainage system in Sujawal district, starting from the village of Abral and discharging into the sea at Kalka Chhani. Spanning 134 RDs (approximately 80 km) with a design discharge capacity of 2,000 cfs, it serves a vast catchment area of 285,000 acres. The drainage network includes main, branch, sub, and link drains and is crucial for managing excess water in the region, preventing waterlogging and flooding in agricultural and residential areas. **Detailed current situation** The field team along with the irrigation department visited the current condition of the Nagan Dhoro Outfall drain and observed that the drain is in a deteriorated state, with several critical infrastructure issues. The outfall regulator at RD 2+00 is destroyed due to tidal action, severely impacting the drain's ability to manage water discharge. The banks along the main and branch drains are eroding, particularly where tidal influence is felt up to RD 78. The drain lacks sufficient inlets to effectively manage drainage from agricultural lands, with the proposed addition of 70 new inlets to address this issue. Several VRBs at different RDs are in disrepair and need repair and strengthening. Additionally, the drain is overgrown with dense weeds and vegetation from RD 100 to 127, which obstructs water flow and hampers maintenance efforts. The embankments are weak in several areas, heightening the risk of flooding during monsoon periods.
	 
	
	Figure III-14 Poor Regulator Condition of Nagan Dhoro Outfall Drain Figure III-15 Current condition of embankments
Proposed Infrastructure	**<u>Strengthening and improvement WORKS</u>** • **Reconstruction of the Outfall Regulator at RD 2+00** for properly controlled, safe, and efficient operations of outfall drainage into the creek.

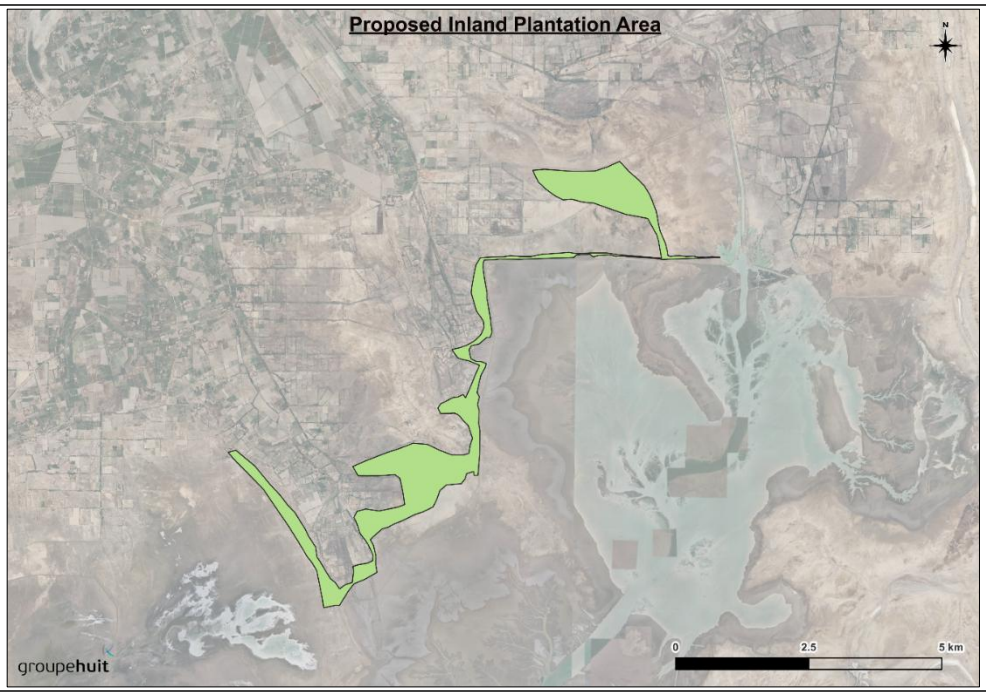
	• **Clearing of Weeds and Vegetation along the Drain from RD 100 to 127** is essential to restore its full discharge capacity, as the drain has overgrown plants that obstruct the flow, reducing the drain's efficiency. Additionally, excessive vegetation can lead to sediment accumulation, further decreasing the conveyance capacity and increasing the risk of waterlogging and flooding. • **Strengthening and Raising 40% of the length of Embankments along the drain** is critical to enhance the structural stability and flood protection of the drainage system. • **Rehabilitation of VRB (Nos.6) RD 107+00, 89+20, 73+00, 80+00, 55+00, 38+00** across the drain to facilitate access for the community. These bridges are deteriorated and create hindrances to crossings over the drain, allowing farmers and residents to transport goods, equipment, and livestock. • **Stone pitching at belly areas??** • **Gated control structures at branch/subdrains out falling points??** **NEW PROPOSED CONSTRUCTION** • **A new construction of 70 new inlets (that drain agricultural lands)** will enhance the drainage network, ensuring the timely removal of surface water from the agriculture fields into the main drain
Implementing agency	Irrigation Department
Location Map	

Name	Geri Branch Drain
District	Sujawal
Type of Infrastructure	Drain
Components	• Strengthening and Improvement of Embankment from RD 0+00 to 40+00 • Restoration of pipe inlets 16 Nos • Repair of Road Bridge 2 Nos • Repair of Village Road Bridge 6 Nos • Proposed new construction of 4 watercourses • Proposed stone pitching 1 RD
Current Situation	Geri Branch Drain is a tributary of the Nagan Dhoro Outfall Drain (NDOD), stretching over 40 RDs (12.2 km) which discharges into the NDOD. In its catchment area, heavy rainfall often leads to stormwater runoff, and due to the inadequate capacity of the branch drain

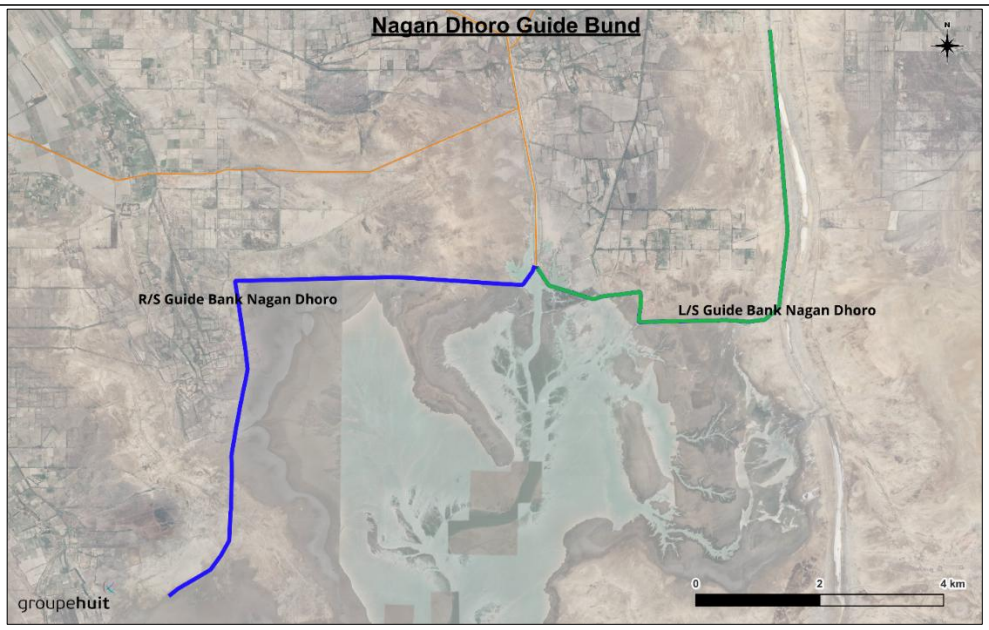
	and its weak banks, water overtops and flows back into the sub-drains and inlets. This backflow causes flooding, damaging agricultural lands, settlements, and infrastructure, and leading to loss of crops, livestock, and even human lives on both sides of the drain. The Geri Branch Drain is in a deteriorated state, as reported by the local community. The drain cannot and currently lacks the ability to effectively carry stormwater during the rainy season, resulting in prolonged inundation of the surrounding area. Inspection paths are limited, and most information regarding its condition has been gathered from local residents, who have expressed significant concern over its inability to function properly, making the area inaccessible during heavy rains.
Proposed Infrastructure	**<u>Strengthening and improvement WORKS</u>** • **Strengthening and Improvement of Embankment from RD 0+00 to 40+00** is critical to enhance the structural stability and flood protection of the drainage system. • **Restoration of pipe inlets 16 Nos IP and NIP side** is essential to effectively drain excess water from agricultural lands and reduce waterlogging issues. • **Repair of Road Bridge 2 Nos** for countering interruption in flow and ensuring connectivity of the area • **Repair of Village Road Bridge 6 Nos** to ensure safe and reliable access for residents while maintaining the structural integrity over the drain. **<u>NEW PROPOSED CONSTRUCTION</u>** • **Proposed new construction of 4 watercourses** to allow fresh water to cross over the drain for agricultural use, strategically placed to enhance water distribution to nearby fields. • **Proposed stone pitching 1 RD** to protect the embankment from erosion.
Implementing agency	Irrigation Department
Location Map	

Name	Inland Plantation
District	Sujawal
Type of Infrastructure	Inland Plantation
Components	• Earthwork • Planting of Inland species • Restocking of Inland species • Raising of a nursery • Watch and Ward system • Engagement of local community in planting and seed as a food source for animals.

	• Establishment of Water storage tanks
Current Situation	The project areas consist of barren, unattended saline lands situated beyond the intertidal zone. Historically, there has been no significant presence of mangroves or inland plantations in these regions, indicating a long-standing lack of vegetation. The soil type is predominantly saline and unproductive, contributing to the land's inability to support agricultural or natural plant growth. The absence of mangrove coverage or inland vegetation highlights the environmental degradation, and sea intrusion towards agricultural lands intensified by salinity and poor soil conditions have rendered the area ecologically dormant and challenging for productive use. Wave heights observed in these areas are typically low, given the distance from the more dynamic intertidal zones. **Pictures of the proposed area for an inland plantation**  
Proposed Infrastructure	New Plantation (Area = 536.3 Hectares) with 2m x 2m grid size Restocking also after each year 1st year restocking in Plantation 30% 2nd year restocking in Plantation 20% 3rd year restocking in Plantation 10% The proposed inland tree species and Inland Shrubs will be: **INLAND TREE SPECIES** 1. Salvadora Persica 2. Salvadora oleoides. 3. Tamarix Aphylta 4. Prosopis Cineraria 5. Acacia Nilotica 6. Eucalyptus Camaldulensis 7. Conocarpus Eractus 8. Albizia Lebbeck 9. Parkinsonia Aculeate 10. Prosopis Juliflora 11. Casuarina Equisetifolia 12. Ber 13. Imli 14.Jungle Jalebi **INLAND SHRUBS** 1. Suaeda Fruticosa 2. Arthrocaulon Macrostachyum 3. Halopyrum Muconatum 4. Cressa Certica

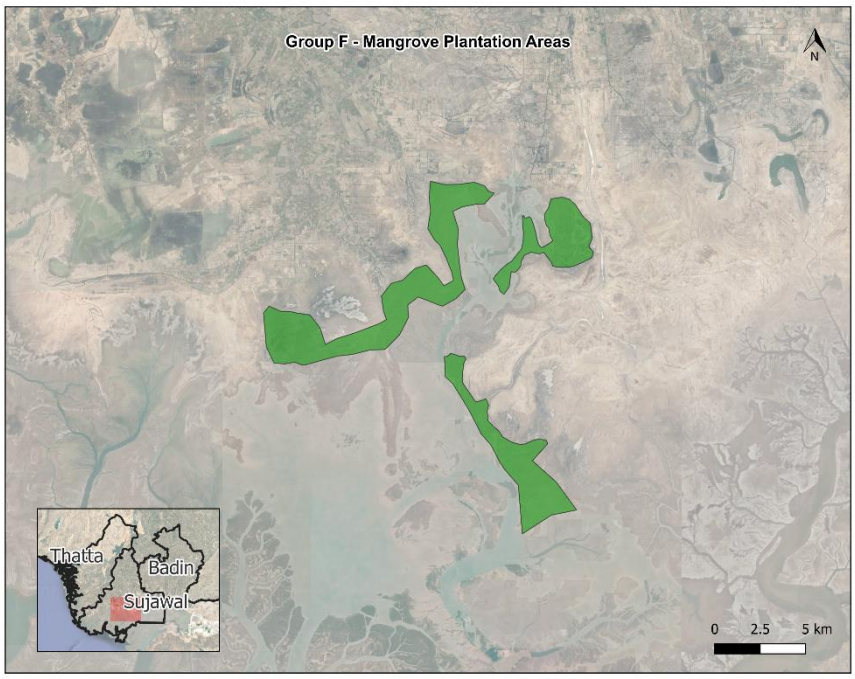
Implementing agency	Forest Department
Location Map	

Name	Left Side and Right-Side Guide Bund of Nagan Dhoro
District	Sujawal
Type of Infrastructure	Coastal Village bund
Components	• Strengthening and Rasing of Embankment • Stone Pitching along the seaside of the guide bank • Geo Membrane • Murum Flooring • Proposed 12 pipe inlets
Current Situation	This village protection bund is a critical sea-facing structure that safeguards more than 500 households living in the inland areas. Positioned on both the left and right sides of the Nagan Dhoro outfall, the bund acts as the first line of defense against encroaching seawater. It spans approximately 12.5 miles, with 5.8 miles on the left side and 6.7 miles on the right. Originally constructed between 2012 and 2013, the bund was designed to protect the local community from coastal flooding and seawater intrusion. Its primary purpose is to shield inland agricultural lands and residential areas from salinity, preserving the villagers' livelihoods and well-being. **Current Condition** Despite its crucial role in protecting the local community, the village protection bund is currently in a state of disrepair due to years of inadequate maintenance. Multiple breaches have occurred, allowing saline water to infiltrate inland areas, leading to increased soil salinity and environmental degradation. The bund's structural integrity has significantly weakened, and its current dimensions 5 feet in height and 8 feet in width are no longer sufficient to provide adequate protection against rising sea levels. The sea-facing side is particularly vulnerable, as it lacks proper stone pitching, making it prone to erosion and further damage during high tides and storms. Additionally, the absence of functional drainage inlets has caused waterlogging in several areas during rainfall.

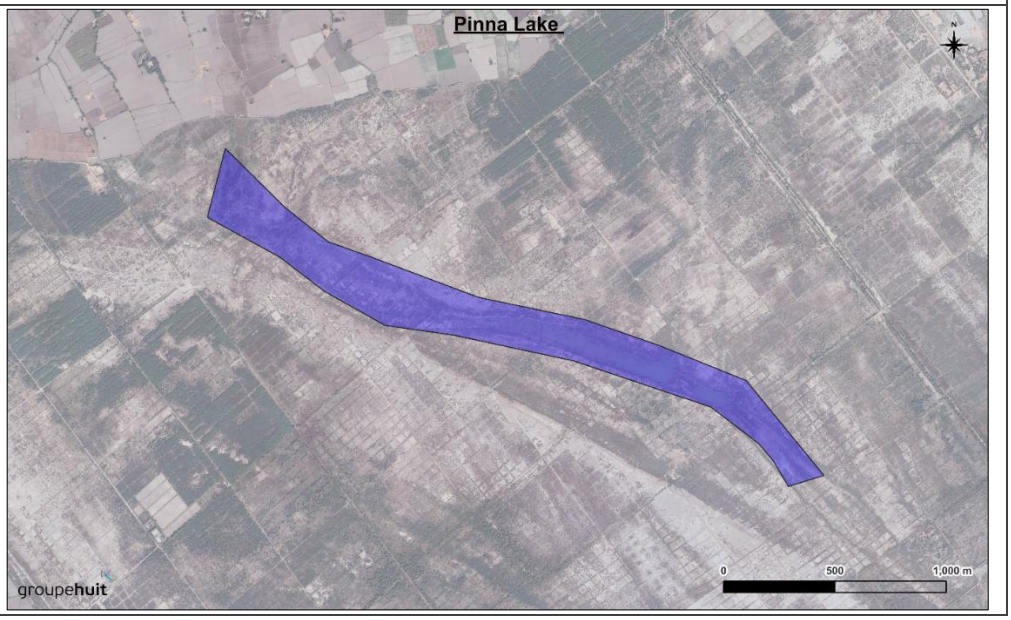
	 
Proposed Infrastructure	**Strengthening and improvement WORKS** • **Strengthening and Raising of Embankment** to raise the existing height of the bund from 5 feet to 10 feet and widen it from 8 feet to 15 feet, enhancing its capacity to withstand flooding and providing a more robust structure for the local community's protection. • **Stone Pitching along the seaside of the guide bank** to the seaward side of the bund with a thickness of 18 inches, provides a protective layer against erosion caused by tidal waves and enhances the overall stability of the embankment. • **Geo Membrane** needs to be installed to shield the underlying mud from being washed out due to tidal forces, thus ensuring the integrity of the embankment foundation and prolonging its lifespan. • **Murum flooring** on the top layer of the bund creates a stable and durable inspection pathway, facilitating easier maintenance access while ensuring safety for personnel during inspections. • **Proposed 12 pipe inlets** on both sides 6 inlets on the left side and 6 inlets on the right side need to be implemented on the community side of the bund to efficiently manage and drain excess water, preventing potential flooding and waterlogging in the surrounding areas.
Implementing agency	Irrigation Department
Location Map	

Name	Mangroves Plantation
District	Sujawal

Type of Infrastructure	Mangroves
Components	• Earthwork • Planting of mangroves • Restocking of mangroves • Raising of a nursery • Watch and Ward system • Engagement of local community in planting, their wooden boats, seed as a food source for animals.
Current Situation	The project area is located in an intertidal zone and has not previously had mangrove plantations, leaving it exposed to environmental challenges. The soil in the region is primarily silty loam. This area is particularly vulnerable to sea intrusion, which has made agricultural lands unsuitable for farming. Additionally, coastal erosion and the threat of tsunamis pose significant risks to the local community, highlighting the urgent need for mangrove plantations to stabilize the coastline and enhance resilience against these natural hazards. **Pictures of the proposed area for mangrove plantation**  
Proposed Infrastructure	New Plantation (Area = 2875 Hectares) with 2m x 2m grid side Restocking also after each year 1st year restocking in Plantation 30% 2nd year restocking in Plantation 20% 3rd year restocking in Plantation 10% **MANGROVE SPECIES** Mangrove plantation is carried out with four species: 1) Avicennia marina, 2) Rhizophora mucronata, 3) Ceriops tagal, and 4) Aegiceras corniculatum. The primary focus is on planting Avicennia Marina and Rhizophora mucronata, while the other two species are planted in suitable locations that receive fresh water from the delta. Planting of Avicennia Marina and Rhizophora mucronata, the two most favorable species for the Indus Delta, takes place during the designated planting season. Restocking of Rhizophora is typically done alongside Avicennia, and restocking in Avicennia plantations is supplemented with other species like Rhizophora and Ceriops. Initially, a single species is planted at a location, depending on the availability of seeds or propagules and site conditions, with further plantation carried out accordingly.
Implementing agency	Forest Department

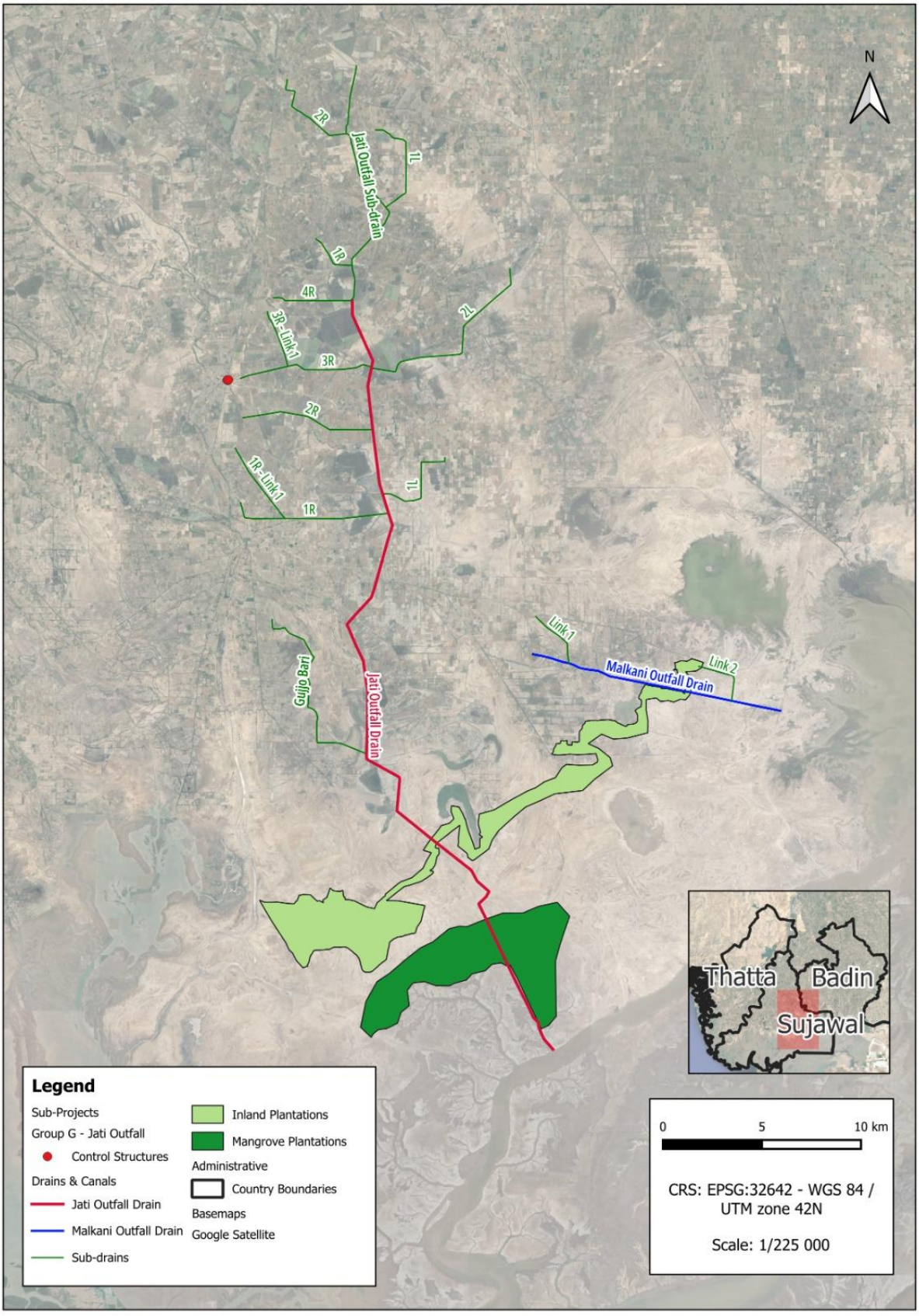
Location Map	

Name	Pinna Lake
District	Sujawal
Type of Infrastructure	lake
Components	• Propose new embankment • Desilting 1 to 1.5 ft • New Planting • Maintenance of Plantation • Raising of Nursery Plants • Proposed new inlet 10
Current Situation	Pinna Lake is a vital water body located within the Pinna Forest, an irrigated plantation forest reserve maintained by the Forest Department under the jurisdiction of Forest Division Sujawal. Covering approximately 150 to 200 acres, the lake is crucial for irrigating the surrounding 6,000 acres of land, half of which has already been planted by the Forest Department. The lake receives water through two canals, Shahwah and Rajwah, and has the potential to play a key role in the further development of the remaining 3,000 acres of unforested land, including the establishment of a nursery for diverse plant varieties. **Current Condition** The field team visited Pinna Lake and observed several critical issues hindering its full potential. Currently, the lake lacks proper embankments, with water depth fluctuating between 8 and 10 feet (2.5 to 3 meters). Damaged or insufficient banks contribute to water stagnation and poor water quality. Additionally, the absence of an adequate irrigation network prevents efficient water distribution to surrounding fields, especially in higher elevation areas that require water-lifting systems. The degraded lake environment also negatively affects local biodiversity, as the lack of vegetation and wildlife reflects poor ecological health.

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Figure III-16 : Current Water Situation in Pinna Lake</td></tr>
<tr><td>Proposed Infrastructure</td><td>Proposed New Components
Propose new embankment: Constructing new, stable embankments will enhance water retention, prevent breaching, and protect the surrounding land from flooding.
Desilting 1 to 1.5 ft: Removing 1 to 1.5 feet of silt will restore the lake's water-holding capacity and improve water flow, addressing the issue of stagnation.
New planting: Introducing native vegetation around the lake will stabilize soil, enhance water quality, and provide habitat for wildlife, promoting ecological balance.
Maintenance of plantation: Regular care of the planted vegetation will ensure healthy growth and support long-term ecological restoration efforts.
Raising of nursery plants: Developing a nursery will supply a continuous source of native plants for ongoing planting, ensuring sustained lake rehabilitation and ecosystem health.
Proposed new inlet 10: will improve water circulation in the lake, enhancing water quality and preventing stagnation. It will also provide efficient irrigation for surrounding agricultural fields and help manage excess runoff during heavy rainfall.</td></tr>
<tr><td>Implementing agency</td><td>Forest Department</td></tr>
<tr><td>Location Map</td><td> 
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3. Group G

Map of Group G Sub-projects



Name	Jati Outfall Drain
District	Sujawal
Type of Infrastructure	Drain
Components	**Main Jati Outfall Drain** Revamping of IP and NIP from RD 28 to RD 87 Strengthening and Improvement of banks and berms from RD 0 to RD 25 Rehabilitation and Extension of span of Road bridge at RD 35 Major Repairs and Extension of span of Road bridge at RD 86 Extension of spans of 3 Road bridges at RD 20, 60 and 73 Major Repairs of 5 Syphons Proposed new construction of 120 pipe inlets on the IP and NIP side Proposed new construction of 12 Gated inlets from RD 0 to 25 Proposed new construction of 5 control structures at out falling points of sub drains Proposed new construction of (10RDs right and 10 RDs left) guide banks with stone pitching Proposed new construction of Stone pitching from RD 0 to RD 25 Proposed new construction of outfall regulator structure with gates at RD 10 **Subdrains/ Link drains** Proposed 1 Sub drain of 12+776 RDs at RD 25 of main Jati outfall drain Revamping of IP/NIP of sub-drain 4R Provision of 25 inlets along sub drains Weed clearance of 1L and 1R Desilting of sub and link drains
Current Situation	The Jati Outfall Drain is located in Taluka Jati of District Sujawal, extending approximately 26.52 kilometers (87 RDs) with a catchment area of 90,336 acres and a design discharge capacity of 282 cusecs. It is associated with nine branches or sub-drains, along with their link drains, of varying lengths and discharges. The primary function of the Jati Outfall Drain is to manage stormwater and agricultural runoff from the surrounding catchment area. However, the drain is currently inadequate in handling the water volume during peak seasons, particularly the monsoon. As a result, large areas of agricultural land within the catchment suffer from waterlogging and increased soil salinity. On the right side of the Jati Outfall Drain, there are eight sub-drains, including their link drains, namely 1 R with 1 L of 1 R, 2 R, 3 R, and 4 R with Mulan link drain, Malhya, and Indo Mocharo sub-drains. On the left side, only one sub-drain, 2 L, discharges into the Jati Outfall Drain, and it has no preceding link drain. The outfall points of all these drains are open, without any control structures in place. **Current Situation** The Jati Outfall Drain is in extremely poor condition, with degraded banks, collapsed berms, and sections overgrown with weeds. Its road bridges are damaged, with spans too narrow to function efficiently. The drain lacks an adequate number of inlets and has no control structures at the outfall points of its sub-drains or at its main discharge into the creek. The initial 25 RDs are submerged in water, further impairing function. Branch and sub-drains suffer from similar issues, with insufficient berms, banks, and inlets, making them inefficient at draining surface water from surrounding lands. This leads to waterlogging and salinity, damaging soil fertility.

The site visit focused on the Jati Outfall Drain, accompanied by the irrigation staff responsible for its operations and maintenance. Due to accessibility issues, only 32 RDs of the total 87 RDs were inspected. Below are the key observations:

Earthwork

The Jati Outfall Drain consists of 87 RDs, but only the section from RD 60 to RD 28 was accessible. The remaining sections were either submerged (RD 0 to RD 25) or inaccessible due to poor conditions (RD 60 to RD 87). The 32 RDs visited were in poor condition, with almost no berms, and the banks were severely eroded. It was reported that the submerged section (RD 0 to RD 25) lacked banks entirely, requiring full restoration. Similarly, the section from RD 60 to RD 87 requires proper embankment work.

The current state of the banks is critical, especially since sea tides affect RD 35 during normal days, and the entire 87 RDs are exposed to tidal surges during the monsoon season. Desilting is urgently needed to restore the drain's capacity to handle surface water runoff.

Earthwork and Stone Pitching

The section from RD 0 to RD 25 is submerged due to monsoon rains and tidal surges. To prevent further erosion, it is essential to raise and strengthen the banks from RD 0 to RD 25, coupled with stone pitching on both sides of the banks.

Outfall Regulator and Guide Banks

The Jati Outfall Drain lacks an outfall regulator, leaving the system vulnerable to uncontrolled tidal surges, especially during the monsoon. The absence of a regulator has led to significant damage, particularly in the first 25 RDs. Guide banks with stone pitching and toe walls should be constructed on both sides to channel tidal surges toward the regulator, which needs to be installed once the area becomes accessible later in the year.

Branch/Sub Drains

The sub drains are in a critical state, with eroded banks and excessive weed growth impeding water flow. There are nine sub drains linked to the Jati Outfall Drain, all in need of revamping. Notably, the 4R sub drain has dangerously low banks, which need to be raised to 4-5 feet for safe operation. Weed removal and embankment repair are necessary for all sub drains, along with the installation of more inlets to improve drainage efficiency.

Inlets

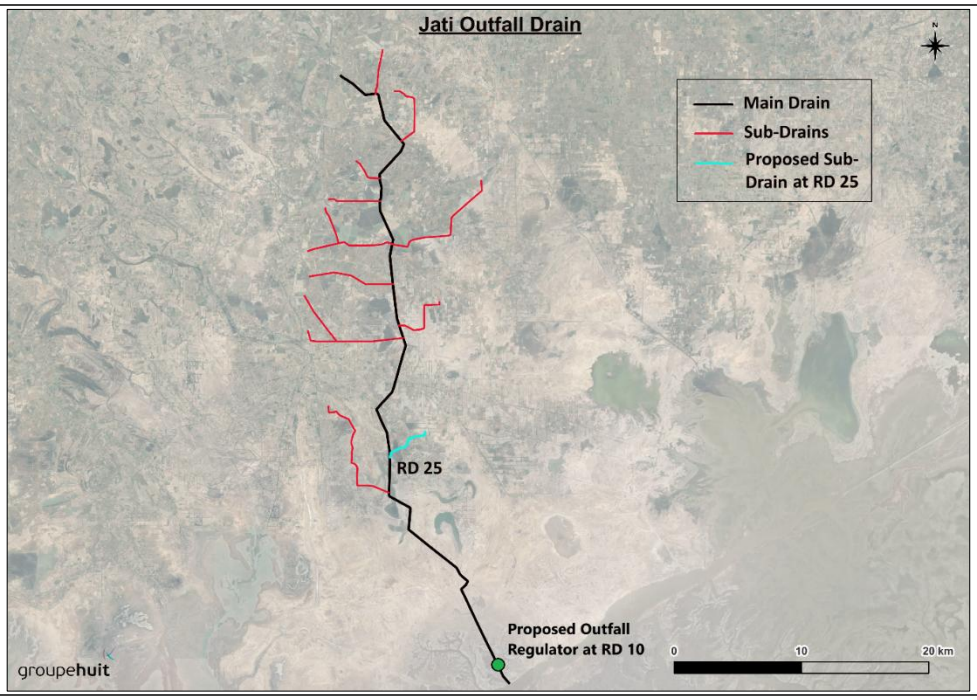
The Jati Outfall Drain and its sub drains have an insufficient number of inlets, severely limiting the system's capacity to drain water efficiently. The main outfall drains, with 87 RDs, has only six inlets, while the sub drains also lack an adequate number. Additional inlets are needed to improve water disposal and reduce negative impacts on soil conditions.

Desilting and Weed Clearance

Many sections of the Jati Outfall Drain are overgrown with weeds, obstructing the flow. The silt deposits throughout the 87 RDs are reported to be 1.5 to 2 feet deep, although no recent soundings have been conducted. Desilting up to 2 feet is recommended to restore the system's functionality.

Road Bridges, Syphons, and Aqueducts

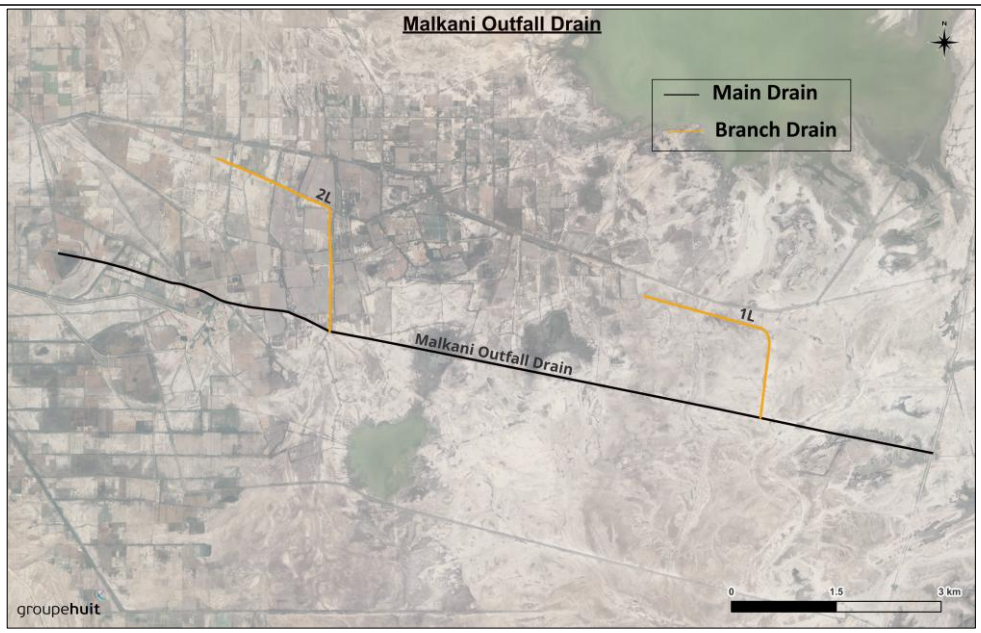
	The inspection covered road bridges from RD 60 to RD 28. The bridge at RD 38 was found in critical condition, requiring complete rehabilitation and an extension of its span. Other bridges (RD 20, RD 60, RD 73, RD 86) also need extensions to prevent flow obstruction, with the bridge at RD 86 requiring major repairs. Additionally, all three syphons along the drain need major repairs and span extensions.  
Proposed Infrastructure	**<u>Strengthening and improvement WORKS on the Main Drain</u>** • **Revamping of IP and NIP from RD 28 to RD 87:** To restore proper inspection and non-inspection paths for maintenance accessibility, ensuring the drain's operational longevity. These paths are essential for routine monitoring and quick repairs in case of issues. • **Strengthening and Improvement of banks and berms from RD 0 to RD 25:** Strengthening banks and berms improves flood resilience, preventing breaches and erosion. This ensures the stable discharge of water and protection of nearby lands. • **Rehabilitation and Extension of span of Road bridge at RD 35**: Extending the bridge span ensures it can accommodate the increased water flow, reducing the risk of flooding. Rehabilitation enhances structural safety for road users. • **Major Repairs and Extension of span of Road bridge at RD 86**: Necessary to handle increased water levels during peak flow and avoid damage to the bridge. Major repairs are vital for preventing collapse or restricted drainage. • **Extension of spans of 3 Road bridges at RD 20, 60 and 73**: Extending bridge spans increases water conveyance during high-flow conditions, preventing overflow onto roads. It also enhances flood safety for local communities. • **Major Repairs of 5 Syphons:** Essential to maintain the integrity of syphons, which ensure water continues to flow beneath structures without disruption. Repairs are necessary to prevent blockages and flooding. • Gated control structures **<u>NEW PROPOSED CONSTRUCTION</u>** • **Proposed new construction of 120 pipe inlets on the IP and NIP side**: To allow surface runoff to enter the main drain efficiently, reducing waterlogging and ensuring better drainage from surrounding lands. • **Proposed new construction of 12 Gated inlets from RD 0 to 25:** These gated inlets regulate water flow into the drain, preventing uncontrolled inflow during high tides or flood events. They offer better control over water levels. • **Proposed new construction of 5 control structures at out falling points of subdrains**: To regulate discharge from subdrains into the main drain, ensuring consistent flow and preventing water backflow. • **Proposed new construction of (10 RDs right and 10 RDs left) guide banks with stone pitching**: To protect the main drain banks from erosion, particularly during high flows, ensuring the structural integrity of the drain over time. • **Proposed new construction of Stone pitching from RD 0 to RD 25**: Stone pitching helps stabilize drain banks and reduces the risk of erosion. It is essential for maintaining the drain's capacity and preventing siltation.

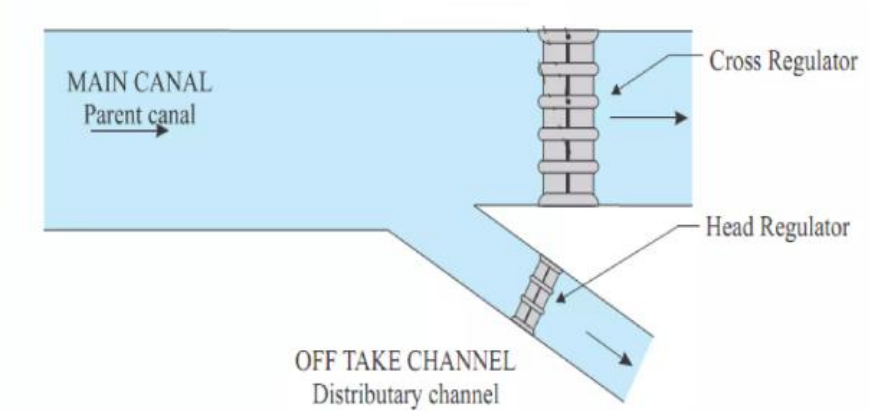
	• **Proposed new construction of outfall regulator structure with gates at RD 10**: The regulator with gates allows for better control of water discharges, protecting downstream areas from flooding and managing flow rates effectively. **Strengthening and improvement WORKS on Sub/Link drain** • **Proposed 1 Sub drain at 12+700 RDs at RD 25 of main Jati outfall drain**: To handle additional surface runoff and reduce pressure on the main drain, improving overall drainage efficiency in the region. • **Revamping of IP/NIP of subdrain 4R**: To ensure inspection access for maintenance of the subdrain, improving its operational reliability and facilitating monitoring. • **Weed clearance of 1L and 1R**: Weed growth obstructs water flow, reducing drain capacity. Clearing weeds ensures smooth water conveyance and minimizes flooding risks. • **Desilting of sub & link drains:** Silt buildup reduces the carrying capacity of drains. Desilting is necessary to restore the original discharge capacity and prevent water stagnation or overflow. **New Proposed Construction** • **Provision of 25 inlets along subdrains**: These inlets enhance drainage capacity by capturing local runoff, preventing waterlogging in adjacent lands, and improving agricultural productivity.
Implementing agency	Irrigation Department
Location map	

District	Sujawal
Type of Infrastructure	Malkani Outfall Drain
Components	• **Main Drain** • Strengthening and 3ft Raising of Embankment from RD 0 to 40 • Desilting along the drain 2ft • Clearing of Weeds and Vegetation along the Drain • Repair of Village Road Bridge 01 • Repair and improvement of Road Bridges 1 • Repair of watercourse 01

	• Proposed new construction of Village Road Bridge 03 • Proposed new construction of watercourse 08 • Proposed new pipe inlets 20 • Proposed new construction of 2 control structures at outfalling points of subdrains • Proposed new construction of outfall regulator structure with gates at RD 4 • Guide banks?? • **Subdrain 1L** • Repair of Village Road Bridge (VRB) 01 • Repair and Improvement of Road Bridges 01 • Restoration of Watercourse 03 • Desilting along the Drain (2ft) • Strengthening and Raising of Embankment by 3 ft • Proposed new pipe inlets 20
Current Situation	The Malkani Outfall Drain, spanning approximately 31 RDs, was originally designed to handle a discharge volume of 64 cusecs and serve a catchment area of 20,538 acres. Currently, the drain is in a critically deteriorated condition. The embankments have significantly settled, the berms have collapsed, and key infrastructure such as road bridges, watercourses, and culverts has suffered extensive damage. The number of inlets is insufficient to adequately drain the area, and the outfall points for the subdrains are missing essential control structures, severely limiting the drain's capacity to manage agricultural runoff and stormwater. 0 to 25 RDs are deluged?? Subdrain 1L, which is part of the Malkani Outfall Drain system, is overgrown with weeds, severely obstructing water flow and putting excessive pressure on the weakened and degraded banks. These banks lack berms, and the limited number of inlets is causing water stagnation in the fields for prolonged periods, exacerbating waterlogging and salinity issues in the surrounding farmland. **Current Pictures of Malkani Outfall Drain**  
Proposed Infrastructure	**STRENGTHENING AND IMPROVEMENT WORKS ON THE MAIN DRAIN** • **Strengthening and 3ft Raising of Embankment (RD 0 to 40)** height ensures enhanced flood protection, preventing overflow and minimizing the risk of bank failure during high water flows. • **Desilting along the Drain (2ft)** to increase the drain's discharge capacity by removing accumulated silt, which improves water flow and reduces the risk of waterlogging in adjacent lands. • **Clearing of Weeds and Vegetation along the Drain** to prevent blockages that restrict water flow, helping to maintain the drain's capacity and functionality. • **Repair of Village Road Bridge 01** to ensure safe and reliable access for residents while maintaining the structural integrity over the drain. • **Repair and Improvement of Road Bridges 01** to enhance transport connectivity and ensure that they can withstand increased water flow beneath them during heavy rainfall.

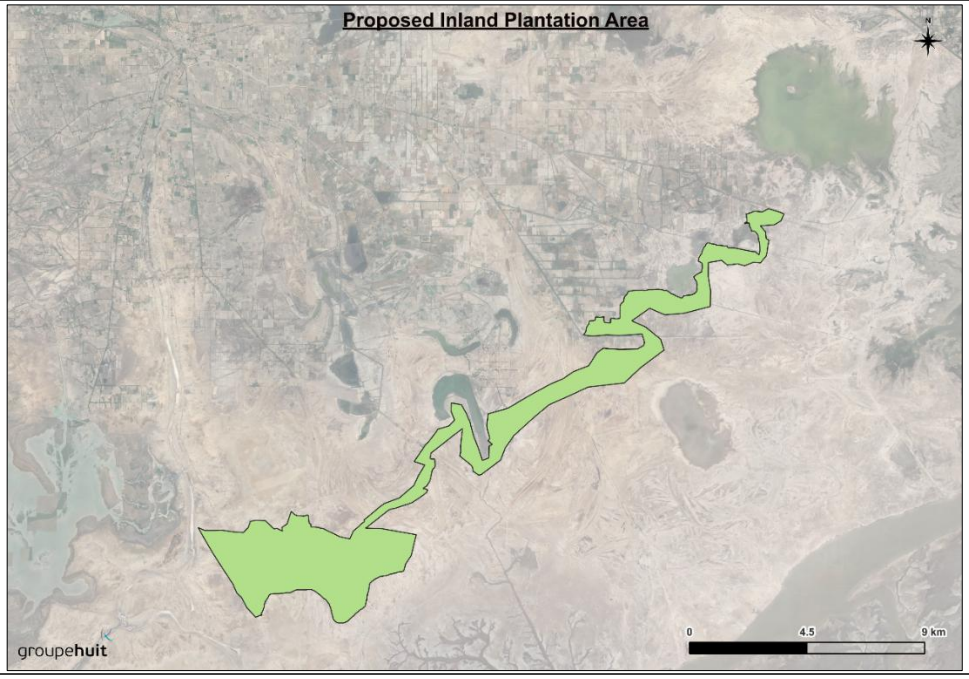
	• **Restoration of Watercourse 01** to ensure efficient water distribution for irrigation, preventing leakage, and ensuring better water management for agricultural purposes. • Guide banks?? • **Repair and Improvement of the Outfall Regulator** to ensure controlled water discharge, preventing backflow and ensuring efficient drainage during high flow conditions. **NEW PROPOSED CONSTRUCTION** • **Construction of 2 Road Bridges** will improve connectivity across the drain, ensuring safe passage for vehicles and people while accommodating drainage flow underneath during heavy rains. • **Construction of 20 Pipe Inlets** will enhance the drain's ability to collect and channel surface water from surrounding areas, reducing waterlogging and improving overall drainage efficiency. • **Construction of Watercourse 01** will provide efficient irrigation delivery to nearby agricultural lands, enhancing water management and boosting crop productivity. • **Construction of a New Double Box Culvert** will allow smooth water flow beneath roads or embankments, preventing road flooding and ensuring efficient drainage under high water conditions. • **Proposed new construction of 2 control structures at outfalling points of subdrains:** to regulate discharge from subdrains into the main drain, ensuring consistent flow and preventing water backflow. • **Proposed new construction of outfall regulator structure with gates at RD 4:** The regulator with gates allows for better control of water discharges, protecting downstream areas from flooding and managing flow rates effectively. **STRENGTHENING AND IMPROVEMENT WORKS ON SUB DRAIN 1L** • **Repair of Village Road Bridge (VRB) 01** to ensure safe and reliable access for residents while maintaining the structural integrity over the drain. • **Repair and Improvement of Road Bridges 01** to enhance transport connectivity and ensure that they can withstand increased water flow beneath them during heavy rainfall. • **Restoration of Watercourse 03** to ensure efficient water distribution for irrigation, preventing leakage, and ensuring better water management for agricultural purposes. • **Desilting along the Drain (2ft)** to increase the drain's discharge capacity by removing accumulated silt, which improves water flow and reduces the risk of waterlogging in adjacent lands. • **Strengthening and Raising of Embankment by 3 ft** height ensures enhanced flood protection, preventing overflow and minimizing the risk of bank failure during high water flows. **NEW PROPOSED CONSTRUCTION** • **Construction of 20 Pipe Inlets** will enhance the drain's ability to collect and channel surface water from surrounding areas, reducing waterlogging and improving overall drainage efficiency.
Implementing agency	Irrigation Department

Location Map	

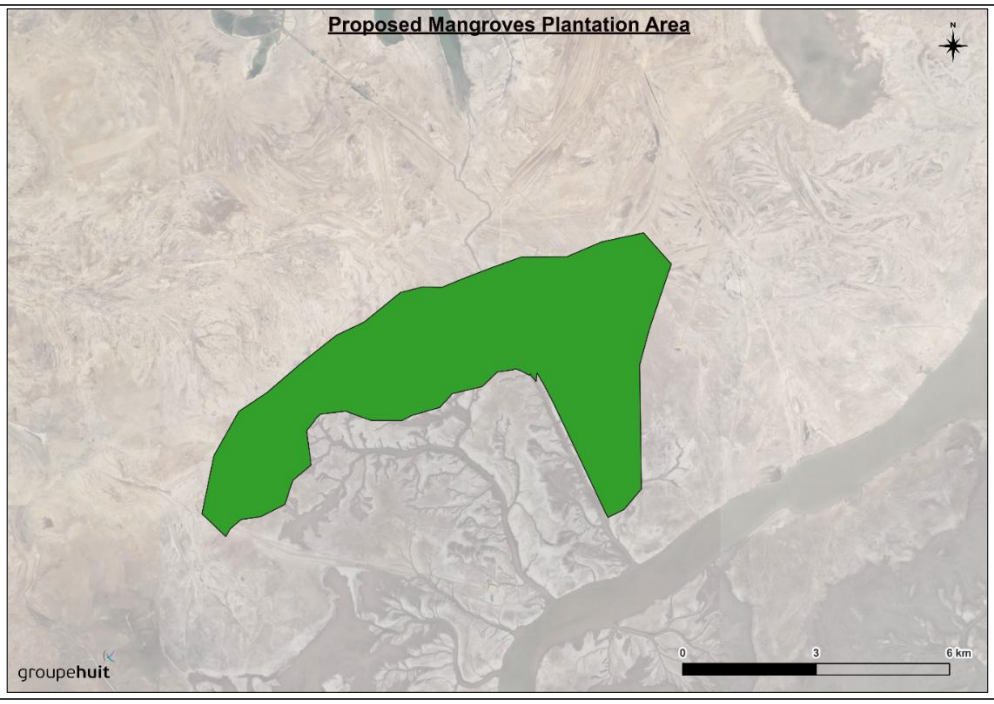
District	Sujawal
Type of Infrastructure	Pinyari Group of Control Structure
Components	• Repair of Pinyari cross Regulator • Repair of Tambo minor Head Regulator • Repair of Amerji Head Regulator • Repair Begna Head Regulator
Current Situation	The Pinyari Canal serves as a crucial water supply route for the agricultural area through its downstream distributaries and minors, including the Tambo Minor, Amirji Distributary, and Begna Branch. This canal features three head regulators, one each on the Amirji and Begna distributaries, and the Tambo Minor as well as a cross regulator on the Pinyari branch canal. These regulators operate manually and are designed to manage and control the distribution of water effectively, ensuring that irrigation demands are met for the surrounding agricultural lands.  **Current condition** The current condition of the Pinyari group of regulators remains critical, with the need to repair, the Pinyari cross regulator, along with the head regulators for Tambo Minor, Amirji Distributary, and Begna Branch, which are in a severely deteriorated state. All hydraulic structures exhibit significant cracks and mechanical failures, which undermine their ability to effectively manage water distribution. The manual operation of these regulators complicates their functionality, as operators struggle to maintain precise flow control amid

	the structural damage. Furthermore, the ongoing siltation in the main canal continues to limit water flow to the off-taking distributaries and minors, resulting in inadequate irrigation supply for surrounding agricultural lands. Immediate repair actions for the Pinyari cross regulator and each head regulator are essential to restore their operational capacity and ensure effective water management in the area.
	
	Figure 1 Current Condition of Pinyari Cross Regulator
	
	Figure III-17 Current Condition of Tambo Minor Head Regulator
Proposed Infrastructure	**Repair works of Control Structures** • **Repair of Pinyari Cross Regulator:** To restore its structural integrity and functionality, ensuring effective flow control and distribution of water. • **Repair of Tambo Minor Head Regulator**: To improve water delivery efficiency to the Tambo Minor, thereby enhancing irrigation supply for agricultural lands reliant on this distributary. • **Repair of Amerji Head Regulator:** To facilitate reliable water management for crops served by the Amerji Distributary. • **Repair of Begna Head Regulator**: To reinstate operational capability, ensuring equitable water distribution to agricultural lands depends on this distributary.
Implementing agency	Irrigation Department
Location Map	

District	Sujawal
Type of Infrastructure	Inland Plantation
Components	• Earth work • Planting of Inland species • Restocking of Inland species • Raising of a nursery • Watch and Ward system • Engagement of local community in planting and seed as a food source for animals. • Establishment of Water storage tanks
Current Situation	The project areas consist of barren, unattended saline lands situated beyond the intertidal zone. Historically, there has been no significant presence of mangroves or inland plantations in these regions, indicating a long-standing lack of vegetation. The soil type is predominantly saline and unproductive, contributing to the land's inability to support agricultural or natural plant growth. The absence of mangrove coverage or inland vegetation highlights the environmental degradation, and sea intrusion towards agricultural lands intensified by salinity and poor soil conditions have rendered the area ecologically dormant and challenging for productive use. Wave heights observed in these areas are typically low, given the distance from the more dynamic intertidal zones. **Pictures of the proposed area for an inland plantation**  
Proposed Infrastructure	New Plantation (Area = 3726 Hectares) with 2m x 2m grid size Restocking also after each year 1st year restocking in Plantation 30% 2nd year restocking in Plantation 20% 3rd year restocking in Plantation 10% The proposed inland tree species and Inland Shrubs will be: **INLAND TREE SPECIES** 1. Salvadora Persica 2. Salvadora oleoides. 3. Tamarix Aphylta 4. Prosopis Cineraria 5. Acacia Nilotica 6. Eucalyptus Camaldulensis 7. Conocarpus Eractus 8. Albizia Lebbeck 9. Parkinsonia Aculeate 10. Prosopis Juliflora 11. Casuarina Equisetifolia 12. Ber

	13. Imli 14.Jungle Jalebi **INLAND SHRUBS** 1. Suaeda Fruticosa 2. Arthrocaulon Macrostachyum 3. Halopyrum Muconatum 4. Cressa Certica
Implementing agency	Forest Department
Location Map	

District	Sujawal
Type of Infrastructure	Mangroves
Components	• Earth work • Planting of mangroves • Restocking of mangroves • Raising of a nursery • Watch and Ward system • Engagement of local community in planting, their wooden boats, seed as food source for animals.
Current Situation	The project area is located in an intertidal zone and has not previously had mangrove plantations, leaving it exposed to environmental challenges. The soil in the region is primarily silty loam. This area is particularly vulnerable to sea intrusion, which has made agricultural lands unsuitable for farming. Additionally, coastal erosion and the threat of tsunamis pose significant risks to the local community, highlighting the urgent need for mangrove plantations to stabilize the coastline and enhance resilience against these natural hazards. **Pictures of the proposed area of mangrove plantation**

	 
Proposed Infrastructure	New Plantation (Area = 3010 Hectares) with 2m x 2m grid side Restocking also after each year 1st year restocking in Plantation 30% 2nd year restocking in Plantation 20% 3rd year restocking in Plantation 10% **MANGROVE SPECIES** Mangrove plantation is carried out with four species: 1) Avicennia marina, 2) Rhizophora Mucronata, 3) Ceriops Tagal, and 4) Aegiceras Corniculatum. The primary focus is on planting Avicennia Marina and Rhizophora Mucronata, while the other two species are planted in suitable locations that receive fresh water from the delta. Planting of Avicennia Marina and Rhizophora Mucronata, the two most favorable species for the Indus Delta, takes place during the designated planting season. Restocking of Rhizophora is typically done alongside Avicennia, and restocking in Avicennia plantations is supplemented with other species like Rhizophora and Ceriops. Initially, a single species is planted at a location, depending on the availability of seeds or propagules and site conditions, with further plantation carried out accordingly.
Implementing agency	Forest Department
Location Map	

E. Construction Methodology for Rehabilitation of Drains

59. All the drains under SCRP are part of the broader Kotri Surface Drainage Scheme which were originally constructed by the Sindh Irrigation Department in 1970s. The initial designs aimed to manage a drainable surplus for limited agricultural area as the agriculture land was limited in that time due to inadequate canal system. However, between 2000 and 2003, this design was updated under the National Drainage Program, increasing the drainage capacity to better accommodate changing water/pluvial management.

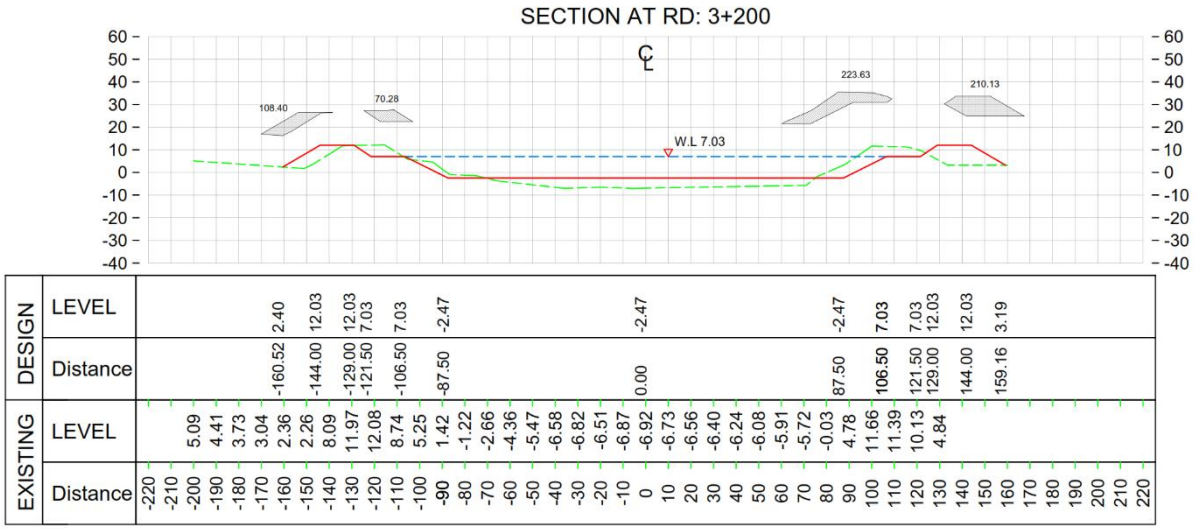
60. Recent climate change impacts, particularly extraordinary rainfall events in 2010, 2011, and 2022, have placed significant stress on this drainage network. These events have revealed that the existing infrastructure is inadequate for effectively and timely draining surplus runoff, leading to heightened hydraulic stresses within the system. Consequently, accurate hydrological computations are now deemed essential for the adequate redesign of these drainage systems to ensure they can handle current and future demands effectively.

61. Given the critical importance of ensuring the project's long-term sustainability and supporting the anticipated evolution of agricultural practices in the region, it has been deemed necessary to adopt a more forward-looking approach. This approach involves planning and designing the system to withstand more extreme conditions and longer time horizons. For overall project considerations, a 20-year return period has been proposed as the standard for capacity evaluation. This will involve the re-sectioning of the existing main drains according to proposed design. This timeframe accounts for expected increases in water flow due to changes in land use, crop patterns, and rainfall intensities over two decades.

62. Furthermore, for the hydraulic design of outfall structures, which are key components of the drainage system, even more stringent criteria are recommended. Specifically, the parameters used will correspond to a 50-year return period. This ensures that the structures are designed to handle rare but highly impactful events, providing a significant margin of safety against potential failures caused by extreme weather or flooding. By adopting these more rigorous design standards, the project aims to deliver a resilient and reliable drainage system capable of meeting future challenges, thereby safeguarding agricultural productivity and infrastructure in the region.

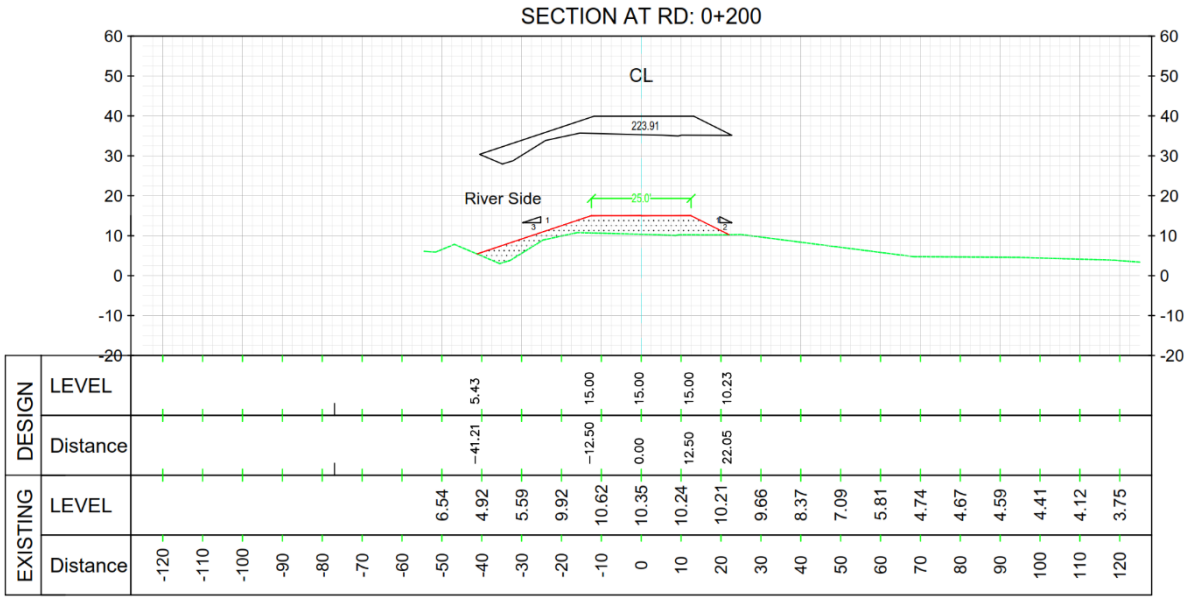
F. Typical Cross-Sections of Proposed Drainage Sections

1. Nagan Dhoro Outfall Drain

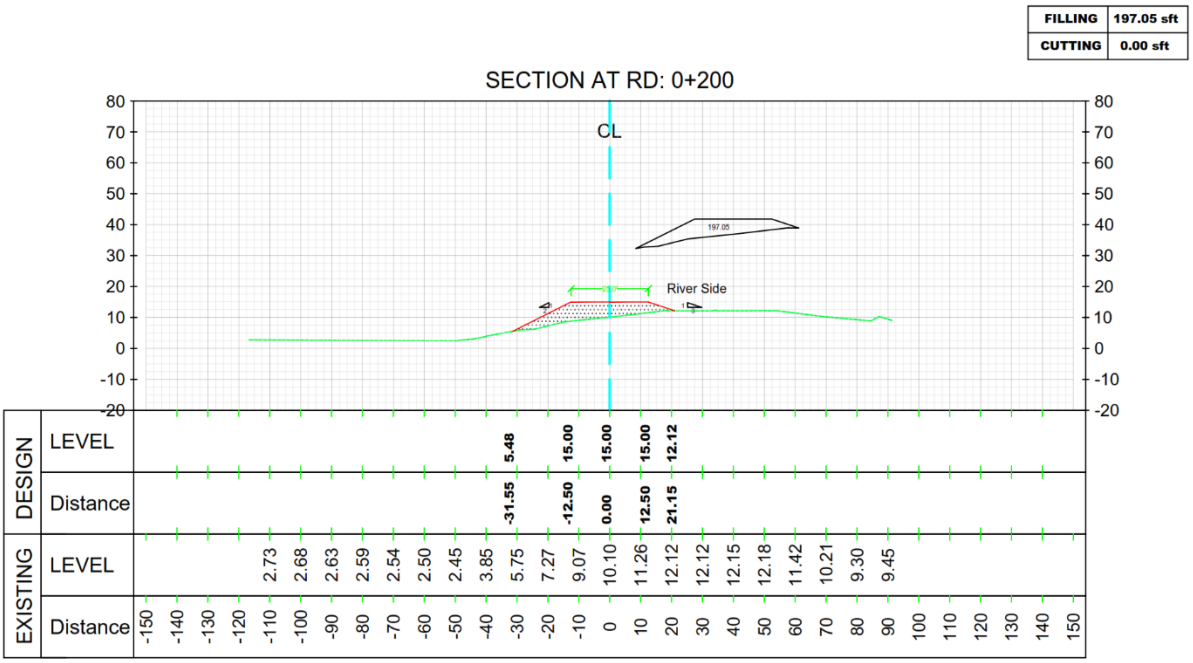


2. Nagan Dhoro Left Guide Bank

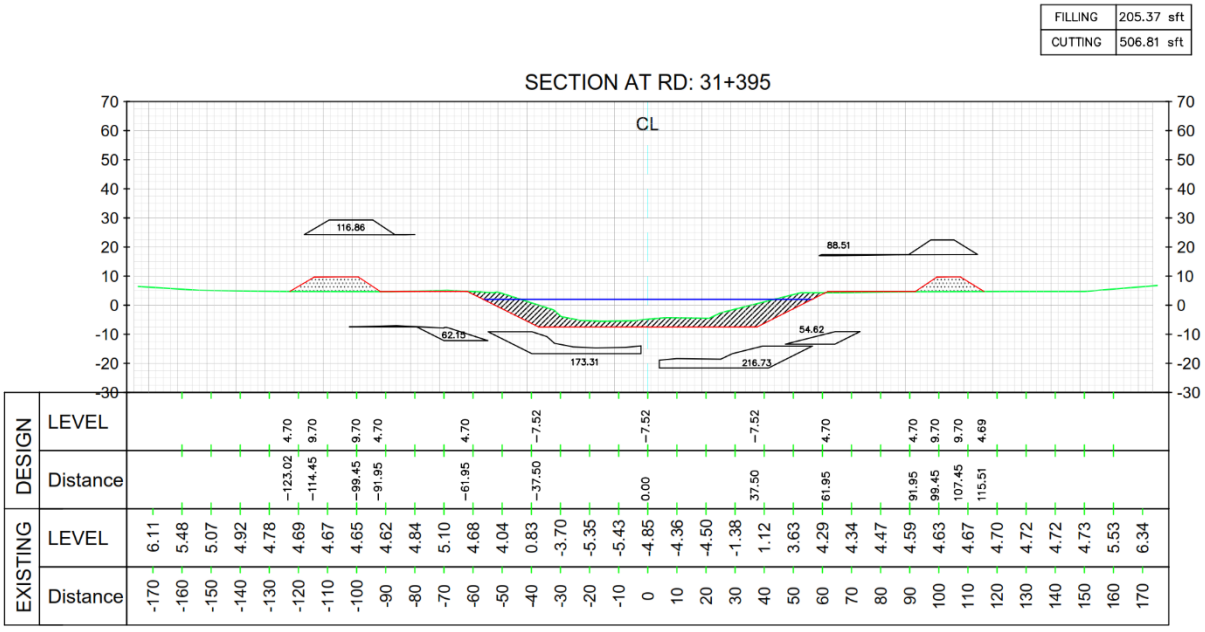
FILLING	223.91 sft
CUTTING	0.00 sft



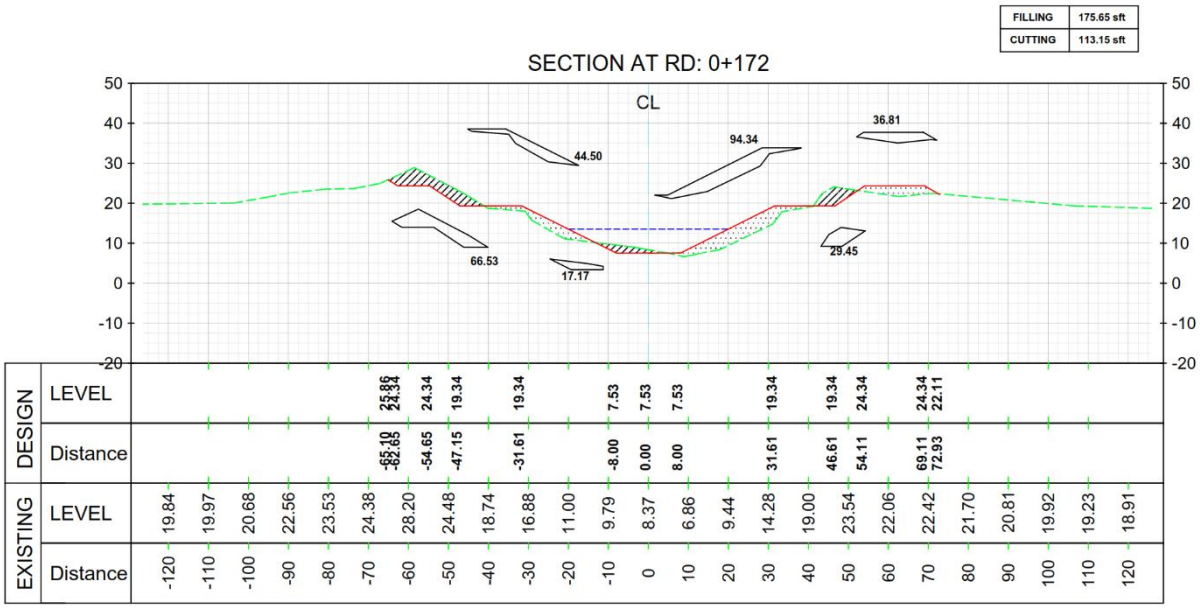
3. Nagan Dhoro Right Guide bank



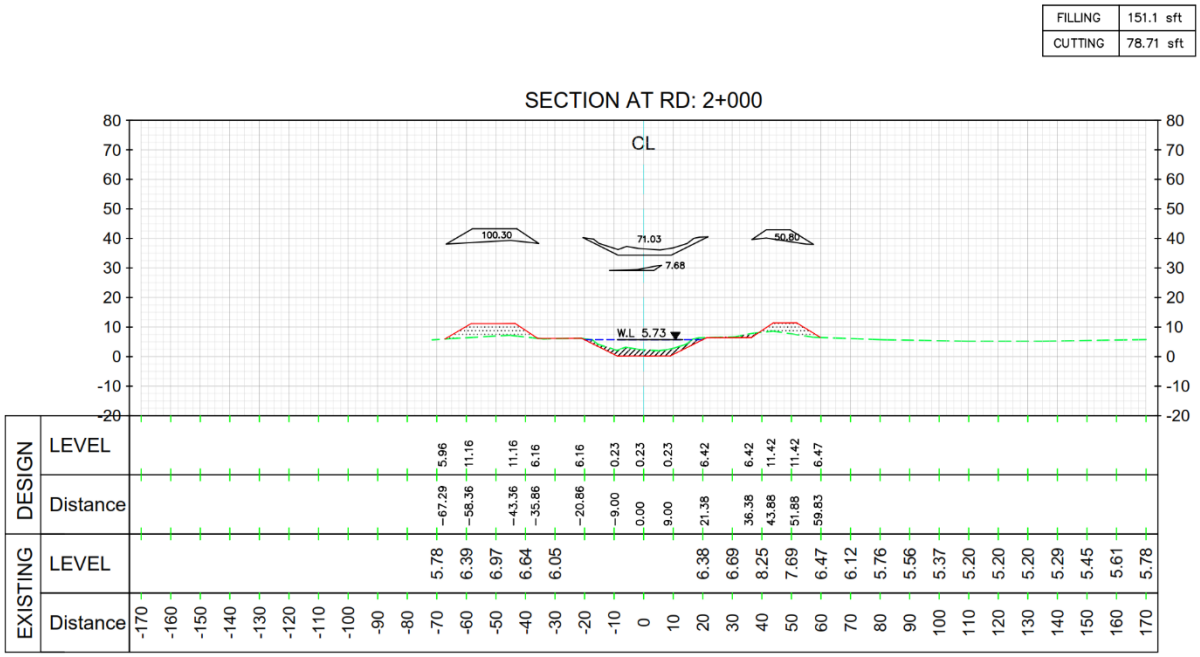
4. Jati Outfall Drain



5. Geri Branch Drain



6. Malkani Outfall Drain



G. Project Cost

63. The total project cost is Rs. 44,845,366,406/- as per PC-1 document.

IV. DESCRIPTION OF ENVIRONMENT

64. **General**

65. Since the subprojects as presented in Table III-1 are planned in the 02 districts of southern Sindh Province i.e., Thatta and Sujawal, the description of the general environmental conditions at district level are discussed in this section.

66. Below are some of the selected pictures of immediate environment of the subprojects captured during reconnaissance.



Typical agriculture environment along the drains with local bridge to cross



Typical road bridge over the drains to cross vehicles



Fishnets are installed by locals to capture small catch in the drains



Clear signs of bank erosion in most of the drains



Extensive weed and native vegetation in some parts of the drains



Some sections of the drains located along degraded plains with no agriculture and land is affected with salinity and wild shrubs



Existing outfall structures in some of the drains



Some sections of the drains are covered with water hycinth (weed)



Some sections of the drains are covered with Typha (which provides shelter to local fish and birds)



Some of the villages are located close to the subprojects



Inlets are made to drain the water effectively in some sections



The outfall of some of the drains is into the delta from where local fisherman venture open seas



Typical inspection path, some are paved, some are in deteriorated conditions along the drains



Local fishermen Jetty is made on some of the drains near their outfall



Typical x-section of a drain covered with weeds



Endemic birds were observed during the site visits



One of the guide bunds located at the outfall of the drain, which is part of subproject development.



Part of Indus delta where no vegetaiton is observed



Lifting of drain water in some sections of drains to cater the irrigation needs



Some of the wetlands are also part of subprojects. The wetlands are rich in native flora and fauna

A. Physical Environment

67. The physical environment of the project area has been described in this study with respect to the airshed, watershed, geology and seismicity. The airshed describes the meteorological and climatic conditions and quality of air in the microenvironment characterizes it in terms of level of pollution. The watershed describes the hydrology and quality of surface and groundwater in the microenvironment.

1. Geography and Topography

68. Sindh can be divided into four distinct parts topographically: Kirthar range on the west, a central alluvial plain bisected by the Indus River in the middle, a desert belt in the east and south-east, and the Indus delta in the south[9].

69. The fertile central plain constitutes the valley of the Indus River. This plain is about 580 kilometers long and about 51,800 square kilometers in area and gradually slopes downward from north to south. The lower part of this plain, which starts from Hyderabad is predominantly covered with flood silt. There are also a few depressions and lakes in this plain[10].

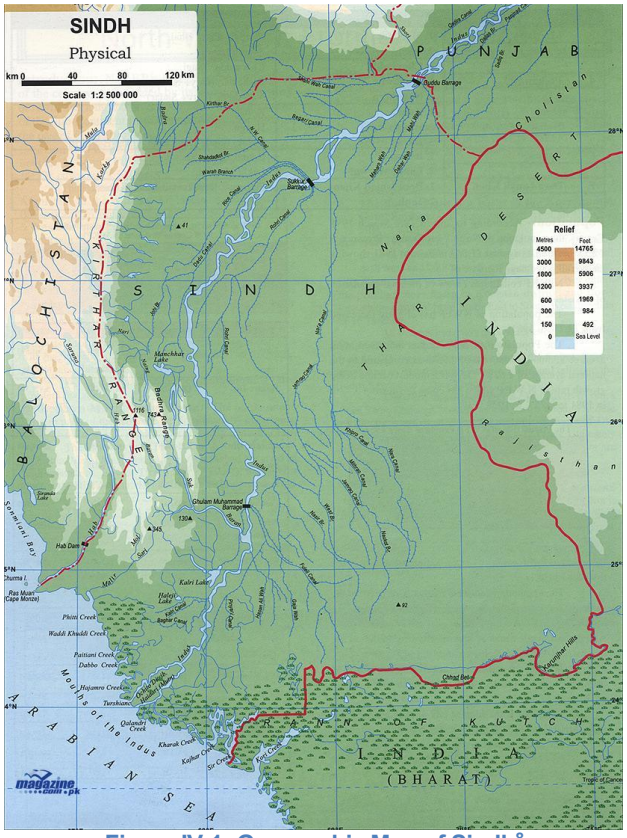


Figure IV-1: Geographic Map of Sindh[8]

70. Lying between 23° 43' to 25° 26' north latitude and 67° 05' to 68° 45' east longitude, Thatta is one of the southern and border districts of Pakistan. It is bounded by District Jamshoro in North, Karachi in North West, Hyderabad and Tando Muhammad Khan in North East, Badin in East, Arabian Sea in the South and Rann of Kutch in South East. District Thatta spreads over a vast area of 17,355 square kilometers and is the second largest district of the Sindh province following District Tharparkar[11].

71. River Indus bisecting the district from north to southwest, Kohistan or hill zone in the north and north west, areas put under year-round cultivation along river Indus through canals and tube wells, and coastal belt and delta area, are four broader topographical divisions of Thatta. Keenjhar lake is another important physical feature and surface water resource of the district.

72. District Sujawal lies on the Left bank of river Indus. This district is bounded by Thatta district on the West, district T.M Khan and Badin on the North and West, Arabian Sea on the South and India on the East and South east. Indus river is the boundary between district Thatta and district Sujawal. Sujawal district has four (04) talukas namely Sujawal, Jati, Mirpur Bathoro and Shah Bander. Taluka Sujawal is the DHQ of Sujawal district[12].

73. The topography within 3 kilometers of Sujawal is essentially flat, with a maximum elevation change of 23 meters and an average elevation above sea level of 11 meters. Within 16 kilometers is essentially flat (75 meters). Within 80 kilometers contains only modest variations in elevation (467 meters)[13].

74. The land structure of district Thatta can be divided into four regions. The northwestern part that comprises of taluka Makli is hilly and barren with no irrigation and agriculture. The southwestern

[8] http://www.magazine.com.pk/travel/Pakistan/maps/
[9] https://en.wikipedia.org/wiki/Sindh
[10] Ibid.
[11] https://en.wikipedia.org/wiki/Thatta_District
[12] https://en.wikipedia.org/wiki/Sujawal_District
[13] https://weatherspark.com/y/106548/Average-Weather-in-J%C4%81ti-Pakistan-Year-Round

part, due to the long coastal line of 107 kilometers as well as shortage of river Indus water, is saline and sea-affected. This area is suitable for fish production and its export. While the southern portion, adjoining the Run of Kachh, on the border of India, is desert like sandy area, the northern part of this district consists of small hills and torrents that are extended till the Kirthar range of mountains. The irrigated and productive area lies only in the middle of the district. Though agricultural land is very limited, yet the available cultivable land is very productive in this region[14].

2. Geology and Geomorphology

75. The geology of Sindh is divisible in three main regions, the mountain ranges of Kirthar, Pab containing a chain of minor hills in the west and in east it is covered by the Thar Desert and part of Indian Platform where the main exposure is of Karonjhar Mountains, which is famous for Nagarparkar Granite. In the north Sindh is enquired by rocks of Laki range extending to Suleiman range and its southern most part is encircled by the Arabian Sea. The rocks exposed in this area belong to upper Cretaceous which is recent in age. The sub-surface rocks are about 20,000 feet thick and belong to Cretaceous and Pre-Cretaceous periods. Mostly the rocks are of sedimentary origin of clastic and non-clastic nature and belong to marine, partly marine and fluviatile depositional environments[15].

76. Basin wise Sindh lies in the lower Indus Basin and its main tectonic features are the platform and fore deep areas. Thick sequences of Pab sandstone of Upper Cretaceous, Ranikot Group (Khadro, Bara, Lakhra) of Paleocene, Laki, Tiyon, and Kirthar of Eocene age, Nari Formation of Oligocene, Gaj Formation of Lower to Middle Miocene, Manchar of Upper Miocene to Pliocene, Dada Conglomerate of Pleistocene are present in various areas of Sindh. Limestone and sandstones are the most dominant sedimentary rocks in the area[16].

77. The large sediment load of the Indus River from the western Himalayas during Holocene led to the formation of Indus deltaic plain (150 km wide in average) in the lower basin between the hills of Kirthar range in the west and sand dunes of Thar desert in the east (Giosan et al., 2006).

78. Agriculture, followed by the forestry, is the main land use in the central alluvial plains. Although more than 50 per cent of the total geographic area is cultivable, only 26 per cent of it is actually located in the central plain. The land inside the Indus embankments is almost equally employed by agriculture and forestry, while that outside the embankments is more extensively utilized for agriculture in the form of sparsely distributed irrigated plantation.

79. Geologically, Thatta is formed of volcanic and sedimentary rocks of quaternary and tertiary types and has the same composition as that of the Indus plain and the eastern desert zone of Pakistan containing the deserts of Cholistan, Nara and Thar. The soils are silty, clayey wet and saline.

80. The deltaic plain is characterized by meandering belt deposits of the tributaries of the Indus, which have silted with levees (Kazmi and Jan, 1997). The Indus deltaic plain consists of large quantities of highly fertile alluvium which was deposited during the last glacial period and the Holocene since 20 ka (Giosan et al., 2006; Ansari and Vink, 2007). The lithological succession is dominated by medium to fine sand and clay representing channel facies and predominantly fine-grained sediments representing the over bank facies and exhibiting a fining upward character like the Ganges and Brahmaputra delta.

[14] https://rsu-sindh.gov.pk/contents/SELECT/ESMP/ESMP-Thatta.pdf
[15] https://pdma.gos.pk/Documents/District_Management_Plans/Provincial%20Disaster%20Management%20Plan.pdf
[16] Ibid.

81. Geologically, Sujawal is formed of volcanic and sedimentary rocks of quaternary and tertiary period and has the same composition as that of the Indus plain and the eastern desert zone of Pakistan comprising the deserts of Cholistan, Nara and Thar. The soils are silty clayey wet and saline[17].

82. As regards the physiographic features, district Sujawal can be characterized as the piedmont colluvial fans. The district is covered with un-differentiated piedmont and sub-piedmont deposits consisting of loosely packed boulders, cobbles, pebbles and coarse to fine stand[18].

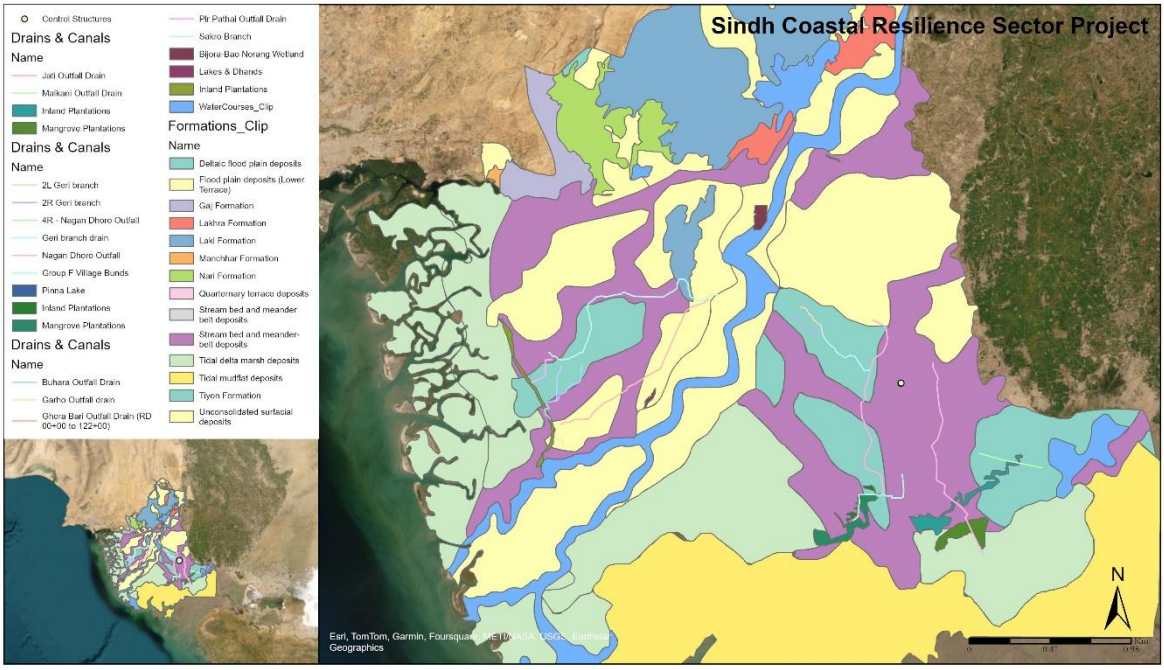


Figure IV-2: Geological map of Project Area[19]

3. Seismicity

83. The major active faults in the southern province are as under:

Table IV-1: List of Major Active Faults in Southern Sindh[20]

Fault Name	Trending	Features	Maximum magnitude on Richter Scale
Pab Fault	NN-W	The fault is located in the eastern part of Pab range	
Jhimpir Fault	N-W	A number of epicenters are located on the fault	M=5.6
Rann of Kutch	E-W	Recent studies have revealed that this fault traverses the Karachi Metropolitan Area.	M=7.6

84. According to the map provided below, subproject sites fall in Zone 2A which corresponds to peak ground acceleration (PGA(g)) of 0.08-0.16[21] and a possibility of no to minor seismic hazards.

[17] https://www.adb.org/sites/default/files/project-documents/51126/51126-002-iee-en_0.pdf
[18] Ibid
[19] Developed from Geological Survey of Pakistan (GSP) data
[20] Sarwar, Ghulam. (2013). Riding the mobile Karachi arc, Pakistan: Understanding tectonic threats. Journal of Himalayan Earth Sciences. Vol.46(2).
[21] Siddique, Muhammad Shahid & Schwarz, Jochen. (2014). Elaboration of Multi-Hazard Zoning and Qualitative Risk Maps of Pakistan. Earthquake Spectra. 31. 141208072728004. 10.1193/042913EQS114M.

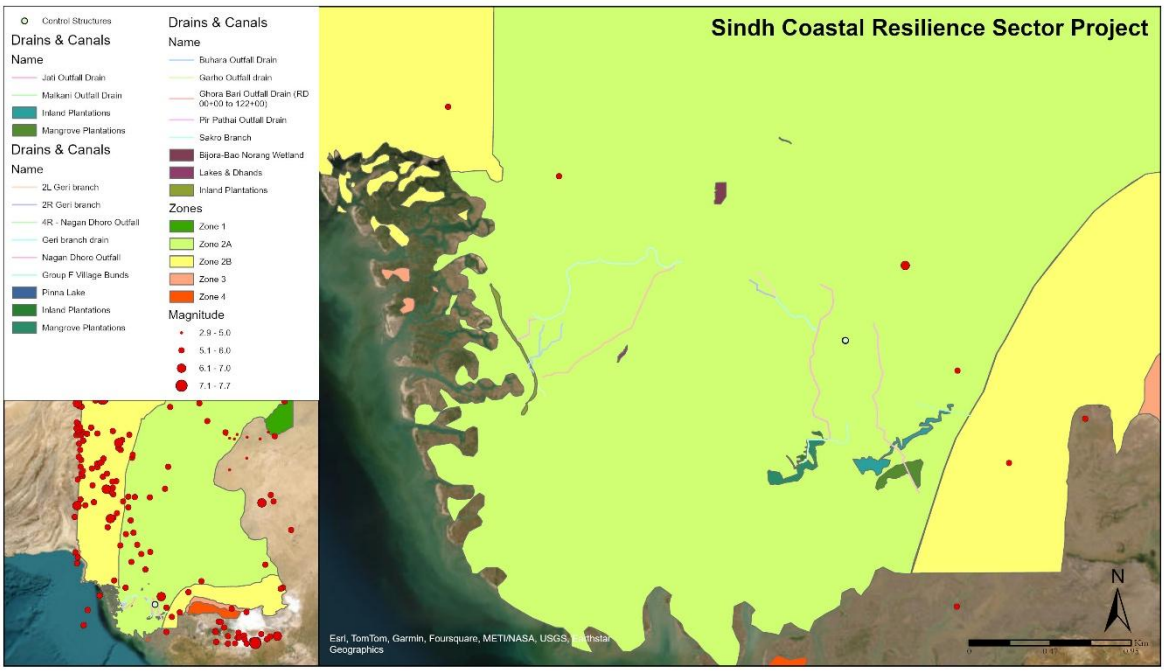


Figure IV-3: Seismic Zoning Map of Subprojects

4. Meteorology and Climate

85. Sindh lies in a dry Subtropical Climate zone, characterized by hot summers and mild winters. From April onwards, the summer season continues usually up to the middle of October after which it becomes cool and the day temperature also begins to decline. May, June and July are the hottest months. The months of August and September are stuffy and suffocating due to higher humidity levels. The winter months are December, January and February.

86. Sindh is divided into three climatic regions: Siro (the upper region, centered on Jacobabad), Wicholo (the middle region, centered on Hyderabad), and Lar (the lower region, centered on Karachi). The thermal equator passes through upper Sindh, where the air is generally very dry. Central Sindh's temperatures are generally lower than those of upper Sindh but higher than those of lower Sindh. Dry hot days and cool nights are typical during the summer. Central Sindh's maximum temperature typically reaches 43–44 °C (109–111°F). Lower Sindh has a damper and humid maritime climate affected by the southwestern winds in summer and northeastern winds in winter, with lower rainfall than Central Sindh. Lower Sindh's maximum temperature reaches about 35–38 °C (95–100 F)[22].

87. Sindh receives two monsoon seasons, the southwest monsoon from the Indian Ocean and the northeast or retreating monsoon deflected toward Sindh by the Himalayan Mountains, but largely escapes the influence of both, resulting in a rainfall of only 150 to 180 mm per year.

88. For the description of the meteorological and climatological profile of the project area comprising two districts i.e., Thatta and Sujawal; the recent data, including the minimum and maximum temperature, precipitation, relative humidity wind speed and wind direction, is taken from the nearest Pakistan Meteorological Department's observatory located in Thatta City. Observations of climatological data are given in Table IV-2-7.

[22] https://en.wikipedia.org/wiki/Climate_of_Sindh

89. The maximum temperature remains high during May and June and annual maximum temperature ranges from 32.5°C to 33.5°C in Thatta. Minimum temperature usually fluctuates from 19.9°C to 21.4°C in Thatta.

Table IV-2: Mean Monthly Maximum Temperature (°C)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MEAN MONTHLY MAXIMUM TEMPERATURE (MEAN DAILY MAXIMUM TEMPERATURE) (°C)													
2014	23.6	27.7	31.5	36.5	36.8	36.8	34.6	34.0	33.8	35.8	32.1	26.8	32.5
2015	24.9	28.7	31.7	36.1	36.9	37.8	34.2	32.6	34.5	35.7	31.2	27.0	32.6
2016	27.0	27.7	33.6	35.5	36.0	35.7	34.6	32.8	32.9	34.3	32.8	29.9	32.7
2017	23.7	29.3	33.2	36.6	36.9	37.1	33.4	33.8	33.9	36.9	31.6	26.4	32.7
2018	27.0	30.1	34.9	37.4	39.1	36.3	34.2	32.8	33.0	36.8	32.9	27.1	33.5
2019	25.4	26.1	31.4	36.5	36.9	37.7	35.3	32.8	35.5	35.4	30.1	25.0	32.3
2020	22.8	29.1	31.4	37.2	37.2	37.6	37.3	35.2	34.9	35.8	30.1	26.2	32.9
2021	24.8	30.7	34.7	37.9	37.7	36.6	34.8	32.8	35.5	34.3	32.2	25.8	33.1

Table IV-3: Mean Monthly Minimum Temperature (°C)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MEAN MONTHLY MINIMUM TEMPERATURE (MEAN DAILY MINIMUM TEMPERATURE) (°C)													
2014	8.7	11.9	17.3	22.2	24.8	26.0	26.5	25.1	24.4	22.1	18.1	11.1	19.9
2015	10.4	14.6	16.7	22.9	25.4	26.8	26.1	24.8	23.7	22.7	16.8	10.5	20.1
2016	12.2	13.0	19.1	21.5	25.1	25.8	25.9	24.5	23.4	22.2	17.7	15.5	20.5
2017	11.5	14.2	19.1	22.9	26.5	28.0	26.2	25.7	24.9	23.6	17.0	11.9	21.0
2018	11.7	15.4	19.8	23.1	25.9	27.1	26.6	25.1	24.0	22.5	18.8	12.9	21.1
2019	11.9	13.4	18.5	23.4	26.0	27.8	27.5	25.9	27.0	24.2	18.4	12.5	21.4
2020	10.0	14.4	18.4	23.8	26.6	28.7	28.4	27.7	26.9	23.9	16.3	11.9	21.4
2021	8.6	14.9	20.5	23.9	27.1	27.9	27.3	25.8	26.0	23.0	17.8	12.1	21.2

90. Trend of annual precipitation in Thatta from 2014-2021 is shown below. 2014 and 2018 are considered as dry years in which low rainfall was recorded as compared to last 8 years. Mean annual precipitation is significantly declined from 2015 and only about 32.6mm of mean annual precipitation received by Thatta district in 2018. However, since last 3 years, significant rainfall is recorded in Thatta District with the highest of 539.0 mm - mean annual precipitation. July is characterized with highest mean monthly precipitation amount.

Table IV-4: Monthly Amount of Precipitation (mm)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MONTHLY AMOUNT OF PRECIPITATION (mm)													
2014	0.0	0.0	0.0	0.0	0.0	0.0	7.0	13.9	8.8	0.0	10.1	0.0	39.8
2015	0.0	0.0	3.8	0.0	15.8	10.7	93.6	0.0	41.0	0.0	0.0	0.0	164.9
2016	0.0	0.0	0.0	0.0	0.0	6.3	1.2	123.8	0.0	0.0	0.0	0.0	131.3
2017	2.8	TRACE	0.0	0.0	0.0	48.4	79.8	85.3	15.0	0.0	0.0	0.0	231.3
2018	0.0	0.0	0.0	0.0	0.0	24.7	5.9	2.0	0.0	0.0	0.0	0.0	32.6
2019	8.0	1.3	7.0	0.0	0.0	0.0	192.2	267.8	40.7	0.0	18.0	4.0	539.0
2020	0.0	TRACE	0.0	0.0	0.0	0.0	47.1	261.8	25.0	0.0	0.0	0.0	333.9
2021	0.0	0.0	0.0	0.0	0.0	0.0	66.0	0.0	120.0	9.0	0.0	13.0	208.0

91. Relative humidity in Thatta normally ranges from 41.3% to 45.5% of relative humidity was observed during 2014-2021. Following are the monthly and annual observations of relative humidity in Thatta.

Table IV-5: Mean Monthly Relative Humidity at 1200 UTC (%)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MEAN MONTHLY RELATIVE HUMIDITY (MEAN) AT 1200 UTC (%)													
2014	28.0	25.0	30.0	37.0	49.0	57.0	59.0	60.0	58.0	33.0	36.0	28.0	41.7
2015	37.0	38.0	31.0	41.0	53.0	51.0	66.0	65.0	53.0	41.0	30.0	26.0	44.3
2016	40.0	20.0	24.0	44.0	54.0	56.0	61.0	71.0	60.0	53.0	29.0	34.0	45.5
2017	36.0	25.0	29.0	35.0	50.0	55.0	68.0	65.0	60.0	38.0	28.0	26.0	42.9
2018	28.0	31.0	27.0	35.0	41.0	57.0	61.0	64.0	59.0	33.0	29.0	31.0	41.3
2019	34.1	32.1	29.5	37.3	45.4	51.0	60.5	70.9	63.1	41.1	41.2	33.9	45.0
2020	34.0	28.0	32.0	33.0	49.0	53.0	57.0	69.0	60.0	38.0	32.0	30.0	42.9
2021	29.8	30.4	33.4	34.6	45.4	54.5	63.8	62.4	66.2	43.9	27.5	34.1	43.8

92. Wind speed and direction in Thatta is listed below:

Table IV-6: Mean Monthly Wind Speed at 1200 UTC (Knots)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MEAN MONTHLY WIND SPEED AT 1200 UTC (Knots)													
2014	0.3	3.3	3.4	0.5	0.7	0.8	0.7	0.6	0.7	3.1	2.5	2.0	1.6
2015	0.3	4.5	0.4	6.0	8.0	6.3	10.0	8.0	6.4	4.9	3.0	2.2	5.0
2016	3.1	3.1	5.0	7.5	10.5	8.9	9.8	7.5	10.0	5.0	2.4	2.5	6.3
2017	4.4	4.1	5.1	8.5	10.4	7.3	0.8	6.7	5.5	4.4	2.9	4.5	5.4
2018	0.3	0.3	4.9	0.6	0.8	7.9	8.1	7.3	7.3	3.3	2.7	2.9	3.9
2019	3.5	4.4	4.1	8.0	8.6	7.3	9.0	5.8	4.3	3.2	4.1	4.1	5.5
2020	3.9	2.6	4.8	6.4	7.7	6.6	5.5	5.0	4.4	2.7	2.8	2.6	4.6
2021	2.5	2.4	4.3	4.6	6.8	6.9	7.4	7.4	3.9	3.4	2.7	3.3	4.6

Table IV-7: Mean Monthly Wind Direction at 1200 UTC (Knots)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MEAN MONTHLY WIND DIRECTION AT 1200 UTC													
2014	N45E	N27E	N45W	S32W	S46W	S45W	S65W	S42W	S60W	S27W	N11E	N60E	----
2015	N18E	N45W	S72W	S43W	S49W	S41W	S63W	S46W	S47W	S62W	N43E	N47E	----
2016	S45W	N60E	S41W	S60W	S34W	S45W	S70W	S76W	S68W	S56W	S45W	N3E	----
2017	N43E	N27E	S62W	S53W	S63W	S40W	S70W	S59W	S54W	S43W	N5E	N36E	----
2018	N53E	N55E	S76W	S56W	S65W	S40W	S52W	S54W	S56W	S41W	N21E	N51E	----
2019	N50E	N42E	S73W	S62W	S59W	S53W	S53W	S52W	S39W	S19E	N43E	N33E	----
2020	N30E	N34E	S70W	S56W	S65W	S57W	S67W	S63W	S47W	S45W	N37E	N45E	----
2021	N40E	S63W	S47W	S55W	S50W	S47W	S55W	S46W	S66W	S43W	N50E	N25E	----

5. Ambient Air Quality

93. There are no major industrial or mobile sources of air pollution in the vicinity of the subprojects, except for occasional movement of vehicles along unpaved roads, which generates dust. Air quality in most of the project area appears good based on observation during the study period. Most of the subproject sites are located in rural areas and the human activity is primarily related to agriculture.

94. Ambient air quality monitoring was conducted at fourteen (14) recommended sampling locations for 24-hours duration in Thatta, Badin and Sujawal, districts to assess the concentration of SEQS required pollutants (Carbon monoxide, Oxides of Nitrogen (NOx), Sulphur dioxide (SO2), PM2.5 and PM10, SPM and Ozone). Selection of monitoring locations were based on the environmental factors including wind direction on the particular day and amount of turbulence in the air etc.

95. The graphical representation of all the results of air quality is presented below.

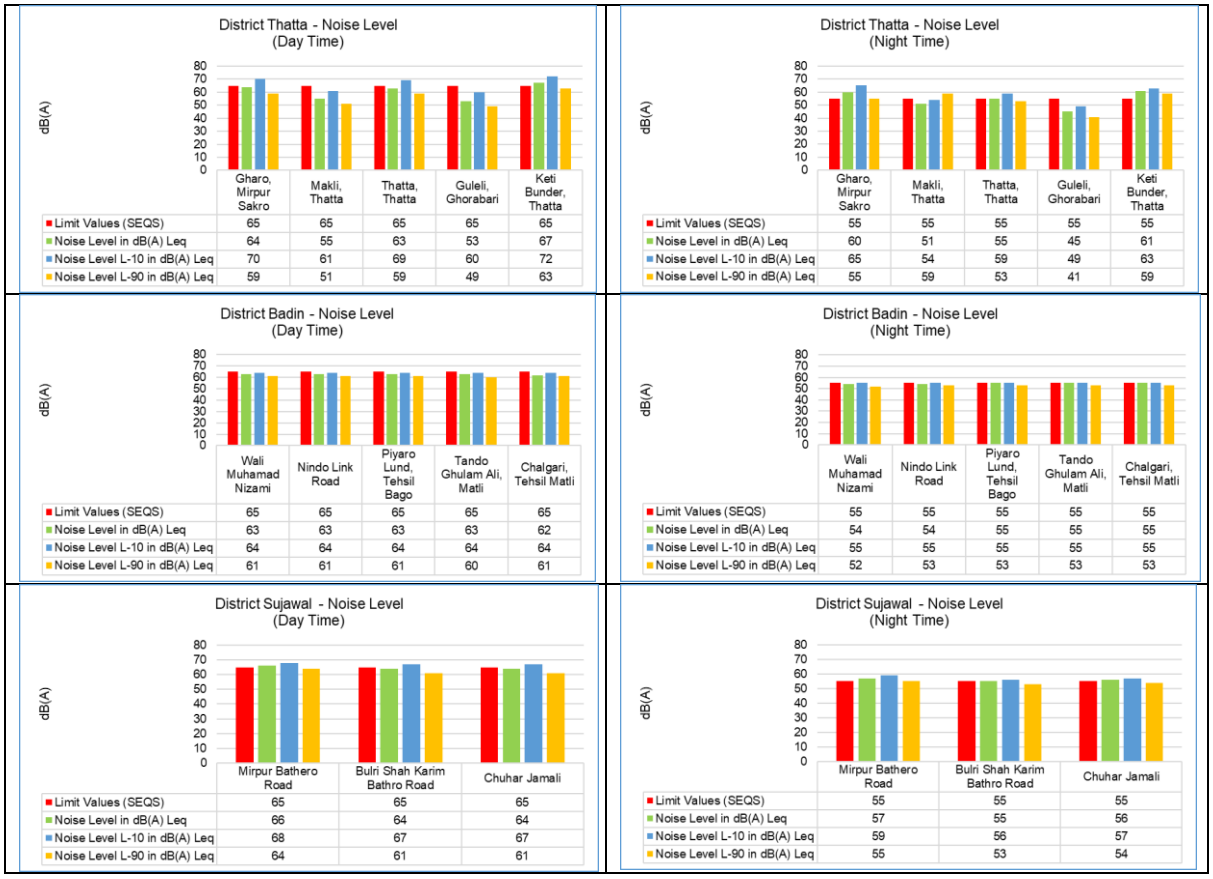


6. Noise

96. Noise in most of the project area appears within the permissible limit of SEQS based on observation during the study period. Presently, the major source of noise for the subproject locations is from vehicles, however, that is intermittent.

97. As the baseline survey for noise monitoring was also planned based on cluster sampling, therefore, the noise was monitored approximately from the same point where the air equipment was installed. Noise level was monitored for 24-hours duration as per SEQS requirements.

98. The graphical representation of all the results of noise level is presented below.



7. Discussion on Ambient Air Quality and Noise

a. District Thatta

99. Ambient air was analyzed at five (03) locations. All SEQS tested parameters were found within respective threshold level.

100. Noise values were measured at five (03) locations. Day time Leq noise value exceeded limits at one point whereas night time limit value for Leq noise exceeded at two locations. All other measured noise values were within SEQS limits set for commercial area.

101. Exceeding limits of noise may be caused by the locations in the vicinity of roadways. Intermittent traffic on roads causes sharp peaks in noise values. This pattern causes the average value to shift higher resulting in noise limit value being exceeded. This condition is noticeable in especially those locations where heavy traffic noise is aggravated by noisy horns. Night time limits are more vulnerable because of lower threshold of exceedance.

8. Surface Hydrology

102. The Kotri Barrage is the last control structure on the Indus, and the Indus empties into the Arabian Sea below Kotri. Water availability at Kotri d/s (in addition to environmental flows) has been studied in Water Balance Study by NESPAK (2023), and the analyses of flows at Kotri barrage (Figure IV-4) suggest that the water has always been plentiful during the summer flood period starting from July to September, with flows reducing during the recession towards end of the year with expected occasional small rise near April. Irrigation water demand at Kotri Barrage is far greater than Karachi's requirements, so the total water requirement at Kotri is very seasonal. Historic data at Kotri shows that that plentiful amount of water is available with average annual volume of around 25 MAF. Whereas, the actual water requirement downstream Kotri is far leaser. As per

recommendations of International Panel of Experts (IPOE)[23] in 2004; water flow of 5,000 cusecs throughout the year should be ensured below Kotri Barrage to minimize the impact of seawater intrusion and meet the environmental flow required for downstream ecosystem. Also, a total volume of 25 MAF in five years (equivalent to 5 MAF annually) be released below Kotri barrage as flood flows (Kharif period).

103. IUCN (2004a) has recommended an essential release of 27 MAF per year for the continued well-being of the deltaic ecosystem. Another recommendation, although not scientifically robust, widely accepted or implemented, has suggested a continuous environmental flow below Kotri Barrage of 0.35 MAF per day (5,000 cubic meters per second)[24].

104. The monthly distribution of flows downstream of Kotri suggests the availability of ample flows meeting e-flows requirements from April-I to October-III. Whereas, during the remaining time the downstream riparian suffers shortages of flows. The grey lines in bars in the below chart shows the total availability at Kotri downstream, blue bars present water that is available for diversion after meeting e-flows requirements and red bars show the deficit in the e-flows i.e., the magnitude and time where e-flows requirements have not been met with.

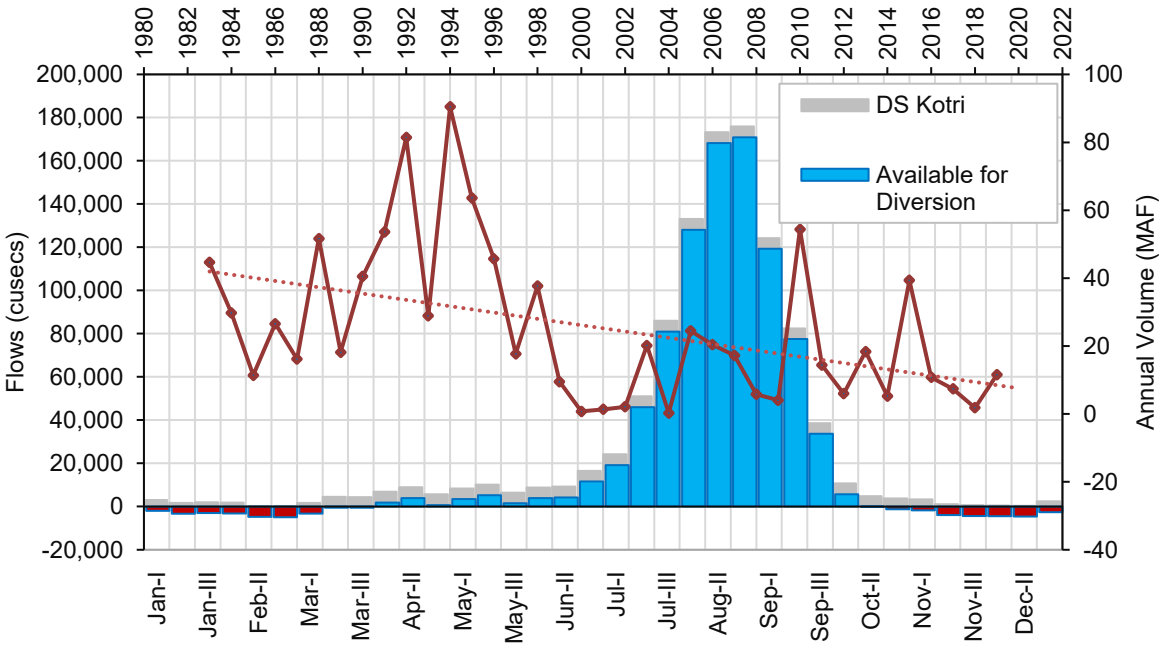


Figure IV-4: Flows Availability at Upstream and Downstream of Kotri Barrage

105. The decline in river flow is evident from Figure IV-5, which illustrates the water decline trend in post-dam conditions. The sediment load in the delta has also decreased. The region has been classified as arid because annual precipitation is less than 250 mm per year, and this amount of precipitation has occurred only once in the past 60 years. Due to a lack of freshwater in the river system, agricultural land in the Indus Delta declined dramatically from 1998 to 2018 (Mahar and Zaigham, 2019[25]), from 116,928 to 48,787 acres.

[23] Fernando J Gonzalez, Dr. Bart Schultz, Thinus Basson (2005), Final Report of IPOE For Review Of Studies On Water Escapages Below Kotri Barrage
[24] Young, William J., Arif Anwar, Tousif Bhatti, Edoardo Borgomeo, Stephen Davies, William R. Garthwaite III, E. Michael Gilmont, Christina Leb, Lucy Lytton, Ian Makin, and Basharat Saeed. 2019. "Pakistan: Getting More from Water." Water Security Diagnostic. World Bank, Washington, DC.
[25] Mahar, Gohar & Zaigham, Nayyer. (2019). Spatio-temporal assessment of agriculture & mangroves and its impact on socioeconomy of people in indus delta. Pakistan Journal of Botany. 51. 10.30848/PJB2019-1(38).

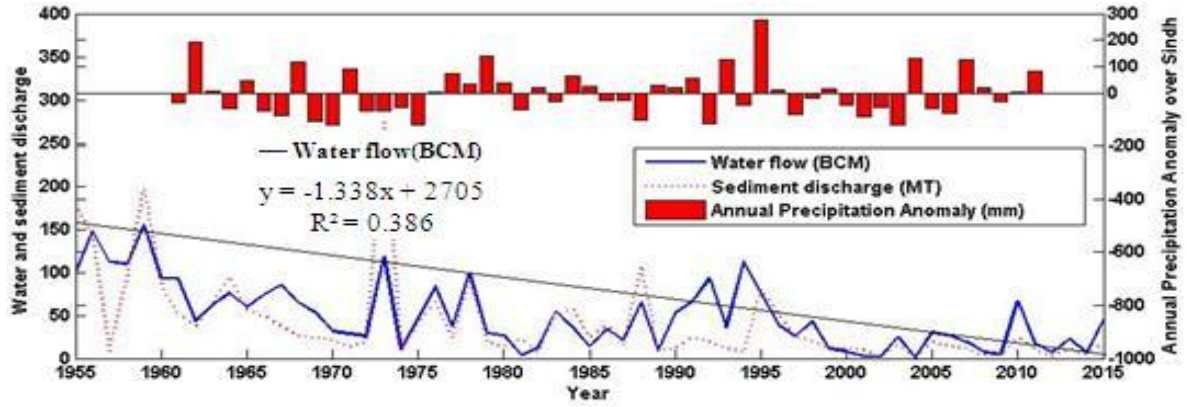


Figure IV-5: Yearly water and sediment discharge below the Kotri Barrage and annual precipitation anomalies over Sindh showing flood and drought

9. Discussion on Water Quality

106. Water sampling and laboratory analyses covered in this section were conducted in January 2025, during the dry season, therefore, corresponding to a period of low water levels and operation of sugar mills.

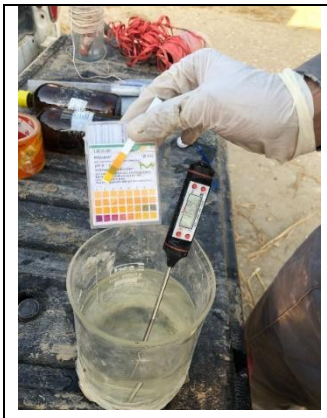




Figure IV-6: Illustration of sampling collection – January 025

107. The collection of samples and analysis were carried out in the 3 target districts of the project: (i) Thatta, (ii) Sujawal, and (iii) Badin. In total, 26 sites were analyzed, including 5 where a full analysis was conducted and 21 where a simplified analysis was performed.

108. Samples were collected from 13 drains and 1 canal. For some of these drains/canal, multiple samples at different location were taken to allow, if possible, a comparative analysis of the water quality upstream /downstream. The field and laboratory tests were prepared by the SGS laboratory.

109. The overall location of the sites is illustrated on the following map:

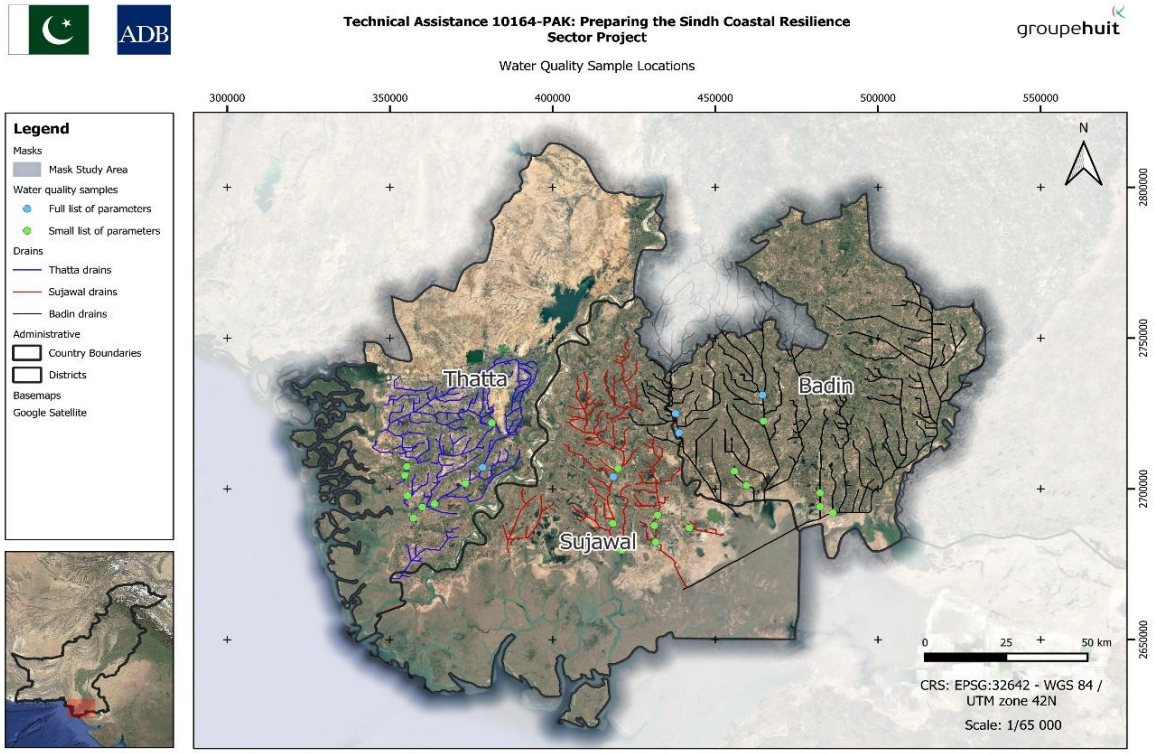
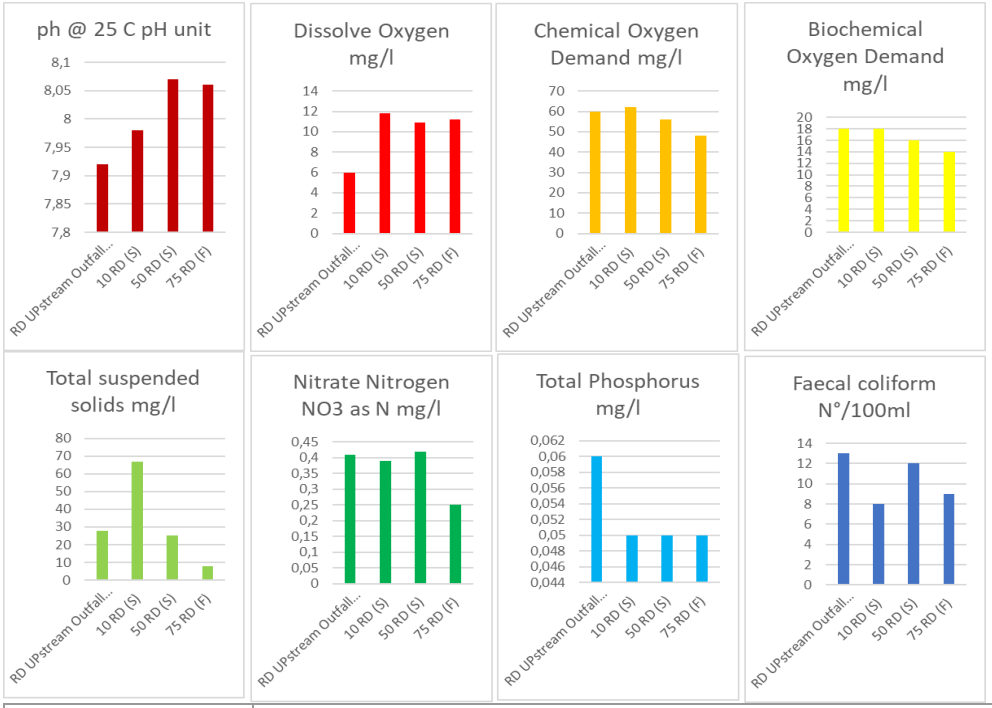


Figure IV-7: Location of the sampling sites

a. Thatta District: Ghorabari Outfall drain

110. The following figure summarizes the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).

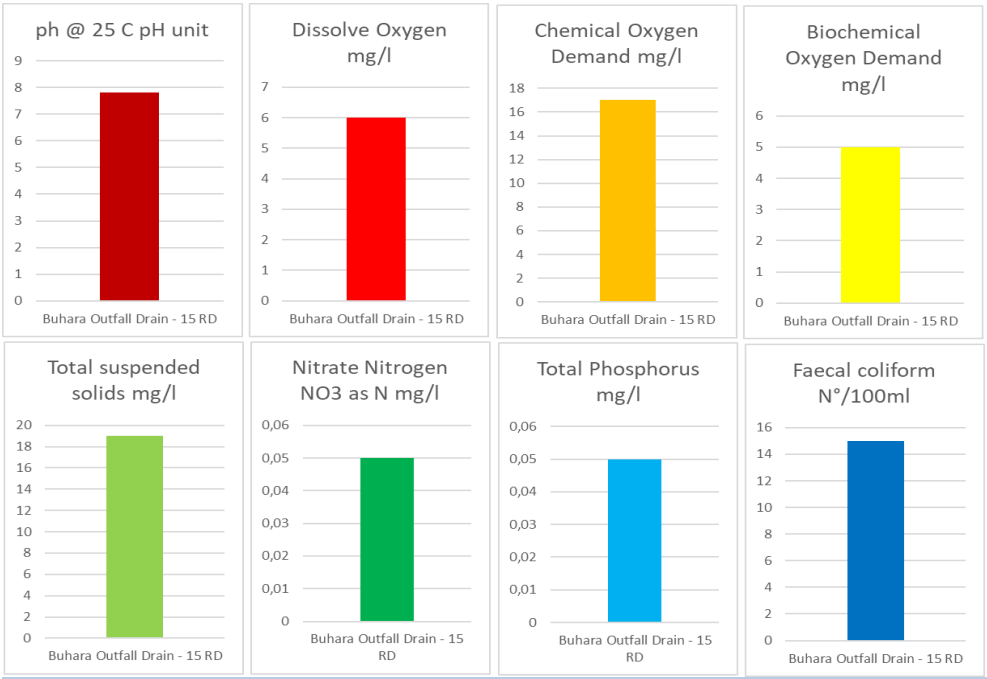


Parameter	Sample 1: Ghorabari Drain - RD Upstream Outfall Regulator (S) Sample 2: Ghorabari Drain - 10 RD (S) Sample 3: Ghorabari Outfall Drain - 50 RD (S) Sample 4: Ghorabari Outfall Drain - 75 RD (F)

pH	pH levels are consistently slightly alkaline (🟢), which is ideal for most freshwater organisms.
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) values are generally good across the sites, with one site (RD Upstream Outfall Regulator (S)) showing a moderate level of 6 mg/L (🟡), while the others have high levels (🟢).
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) is a major concern across all sites, particularly at RD Upstream Outfall Regulator (S) (🔴) and 10 RD (S) (🔴), indicating high organic pollution that could lead to oxygen depletion and ecological stress.
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) is moderate across all sites (🟡), indicating significant organic material but not critical levels.
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is concerning at 10 RD (S) (🔴), with high turbidity and sedimentation, potentially impacting aquatic life and water clarity. The other sites are in a moderate to good range.
Nitrate Nitrogen (NO3 as N)	Nitrate Nitrogen (NO3) concentrations are moderate across the sites (🟡), and although not immediately harmful, they should be monitored to prevent nutrient pollution.
Total Phosphorus	Total Phosphorus is low at all sites (🟢), which helps prevent nutrient-induced problems like algal blooms.
Fecal Coliform	faucal Coliform levels are generally moderate (🟡) at most sites, indicating potential fecal contamination but not at alarmingly high levels.

b. Thatta District: Buhara Outfall Drain

111. The following figure summarizes the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).:

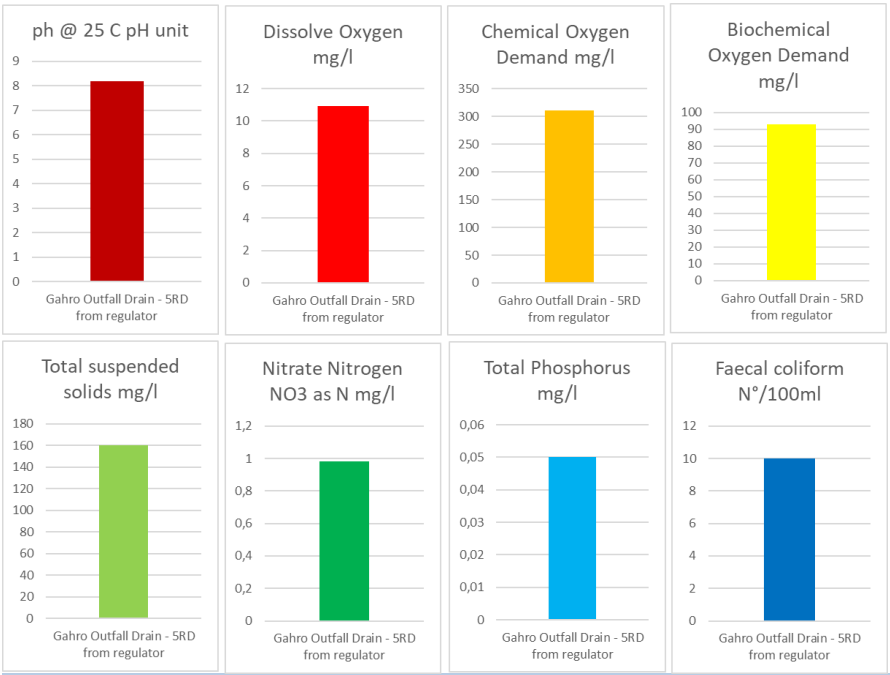


Parameter	Buhara Outfall Drain 15RD
pH	pH is 7.8, which is slightly alkaline and falls within the ideal range for most aquatic organisms (🟢)
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) is at 6 mg/L, which is on the lower end of the acceptable range, indicating some potential stress on aquatic life, though it is still suitable for many species (🟡)
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) is 17 mg/L, which is moderate. It indicates a moderate level of organic pollution, though it is not alarmingly high (🟡)
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) is 5 mg/L, which is good, indicating a lower concentration of biodegradable organic matter (🟢)

Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is 19 mg/L, which is moderate. It suggests some turbidity and sedimentation, which could affect aquatic habitats and water clarity (🟡)
Nitrate Nitrogen (NO3 as N)	Nitrate Nitrogen (NO3 as N) is 0.05 mg/L, which is very low, indicating a minimal risk of nutrient pollution (🟢)
Total Phosphorus	Total Phosphorus is 0.05 mg/L, which is also low, suggesting no significant risk of eutrophication or algal blooms (🟢)
fecal Coliform	fecal Coliform is 15 N°/100ml, which is on the higher end of acceptable levels. While not critically high, it still suggests some fecal contamination, and further monitoring is recommended (🟡)

c. Thatta District: Garho Outfall Drain

112. The following table and figure summarize the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).

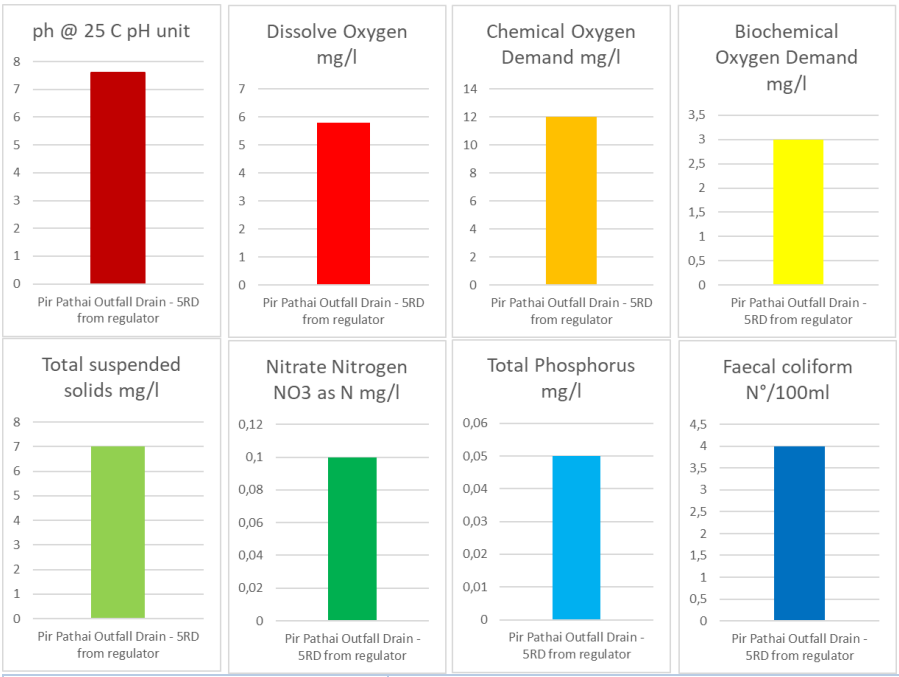


Parameter	Gahro Outfall Drain – 5RD from regulator
pH	pH is 8.19, which is slightly alkaline, but still within the acceptable range for most aquatic organisms (🟢)
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) is 10.9 mg/L, which is ideal and indicates good water quality for supporting aquatic life (🟢)
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) is very high at 310 mg/L, indicating significant organic pollution. This value is a major concern as it can lead to oxygen depletion and environmental stress (🔴)
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) is 93 mg/L, also a very high value, which further reflects high levels of organic matter and potential water quality problems (🔴)
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is 160 mg/L, which is extremely high, suggesting severe turbidity, sedimentation, and possible habitat degradation (🔴)
Nitrate Nitrogen (NO3 as N)	Nitrate Nitrogen (NO3 as N) is 0.98 mg/L, which is moderate and may indicate nutrient pollution, though it's not at harmful levels yet (🟡)
Total Phosphorus	Total Phosphorus is low at 0.05 mg/L, which is good as it minimizes the risk of eutrophication (🟢)

Fecal Coliform	fecal Coliform is 10 N°/100ml, which is moderate and suggests some level of fecal contamination, though not critically high (🟡)

d. Thatta District: Pir Pathai Outfall Drain

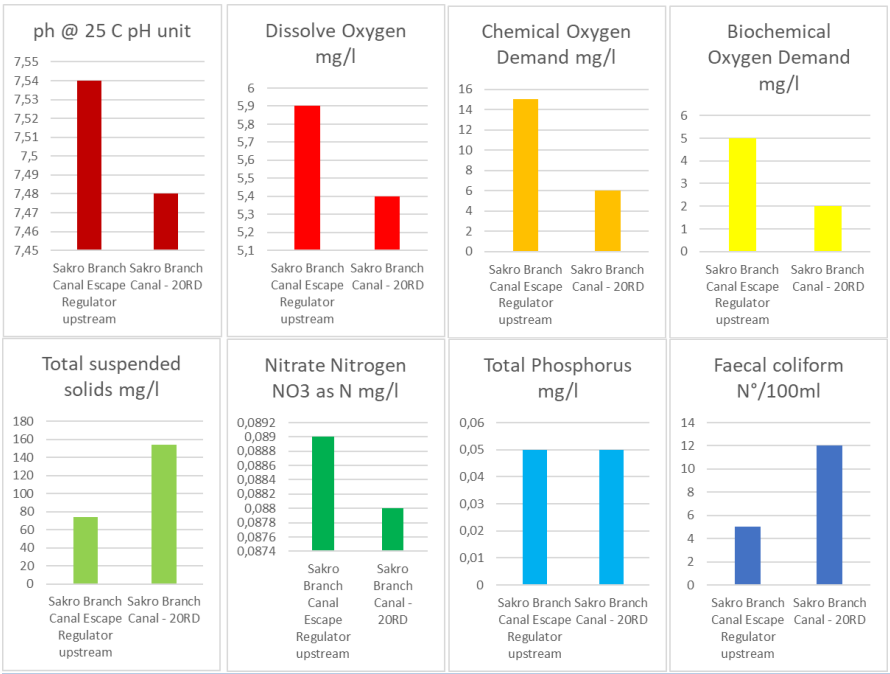
113. The following table and figure summarize the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).



Parameter	Pir Pathai Outfall Drain 5RD from regulator
pH	pH is 7.61, which is within the ideal range for aquatic organisms (🟢)
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) is 5.8 mg/L, which is on the lower end of the acceptable range, but still generally suitable for many aquatic species (🟡)
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) is 12 mg/L, which indicates moderate organic pollution but is not at alarmingly high levels (🟡)
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) is 3 mg/L, which is low and indicates minimal biodegradable organic matter (🟢)
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is 7 mg/L, which is low and indicates good water clarity (🟢)
Nitrate Nitrogen (NO3 as N)	Nitrate Nitrogen (NO3 as N) is 0.1 mg/L, which is low and does not pose a risk of nutrient pollution (🟢)
Total Phosphorus	Total Phosphorus is 0.05 mg/L, which is also low and helps minimize the risk of eutrophication (🟢)
fecal Coliform	fecal Coliform is 4 N°/100ml, which is low, suggesting minimal fecal contamination (🟢)

e. Thatta District: Sakro Branch Canal

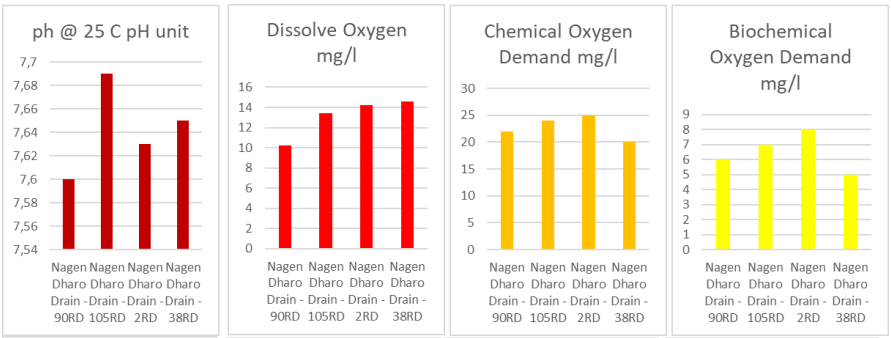
114. The following table and figure summarize the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).

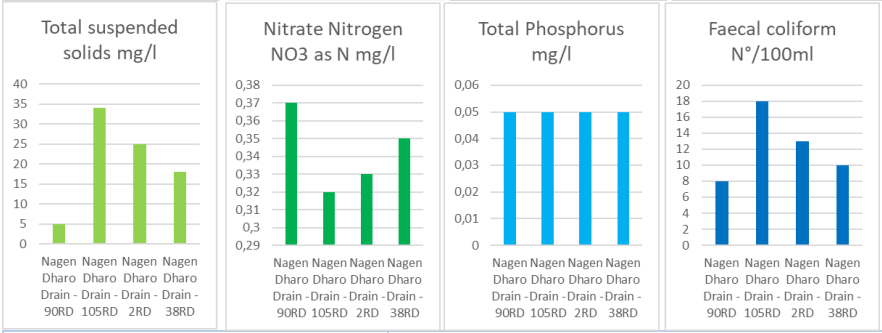


Parameter	Sample 1: Sakro Branch Canal Escape Regulator upstream Sample 2: Sakro Branch Canal - 20RD
pH	pH values are slightly alkaline but fall within the ideal range for most aquatic organisms ( ).
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) is moderately low at 5.9 mg/L for Sample 1 and 5.4 mg/L for Sample 2, which might indicate some stress on aquatic life, but it is still within an acceptable range ( ).
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) is 15 mg/L for Sample 1 ( ), indicating moderate organic pollution, while Sample 2 is lower at 6 mg/L ( ).
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) is moderate at 5 mg/L for Sample 1 ( ) and lower at 2 mg/L for Sample 2 ( ), suggesting moderate organic material in the water.
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is high in Sample 1 (74 mg/L) and extremely high in Sample 2 (154 mg/L), which indicates significant turbidity and sedimentation problems, especially in Sample 2 (for Sample 1, for Sample 2).
Nitrate Nitrogen (NO_3 as N)	Nitrate Nitrogen (NO3 as N) is low and poses no risk of nutrient pollution in both samples ( ).
Total Phosphorus	Total Phosphorus is low and indicates minimal risk for eutrophication in both samples ( ).
fecal Coliform	fecal Coliform is relatively low at 5 N°/100ml for Sample 1 ( ), but higher at 12 N°/100ml for Sample 2 ( ), suggesting moderate contamination.

f. Sujawal District: Nagin Dharo Outfall Drain

115. The following table and figure summarize the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).

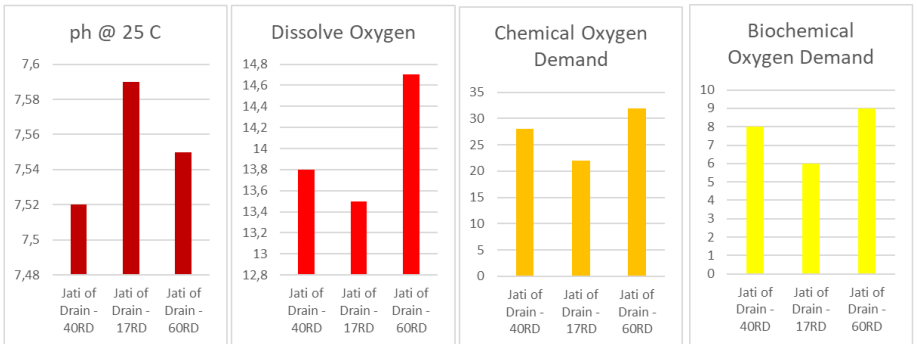


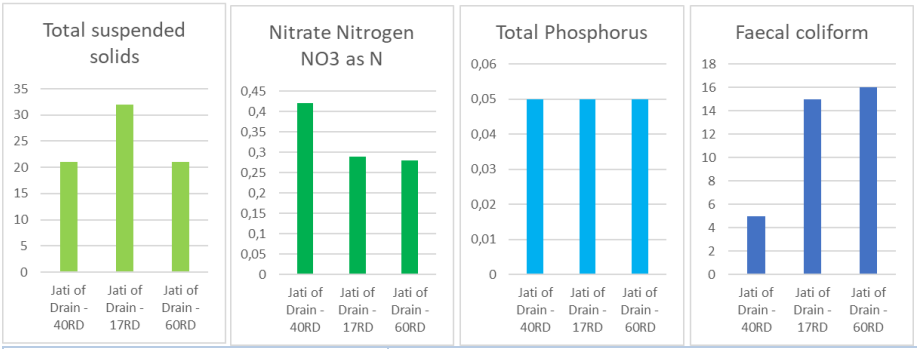


Parameter	**Sample 1 : Nagen Dharo Drain - 90RD** **Sample 2 : Nagen Dharo Drain – 105RD** **Sample 3 : Nagen Dharo Drain – 20RD** **Sample 4 : Nagen Dharo Drain – 38RD**
pH	pH values across all locations are within the ideal range ( )
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) is moderate at Nagen Dharo Drain - 90RD (10.2 mg/L,), but good at other locations ( )
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) are moderate across all locations ( ), indicating some organic pollution
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) are moderate across all locations ( ), indicating some organic pollution
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is low ( ) at 90RD, but moderate ( ) at other locations.
Nitrate Nitrogen (NO3 as N)	Nitrate Nitrogen (NO3 as N) is moderate across all locations ( ), suggesting some nutrient pollution.
Total Phosphorus	Total Phosphorus is within the ideal range across all locations ( ).
fecal Coliform	fecal Coliform is low ( ) at 90RD and 38RD, but moderate ( ) at 105RD and 20RD, indicating some bacterial contamination.

g. Sujawal District: Jati Outfall Drain

116. The following table and figure summarize the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).

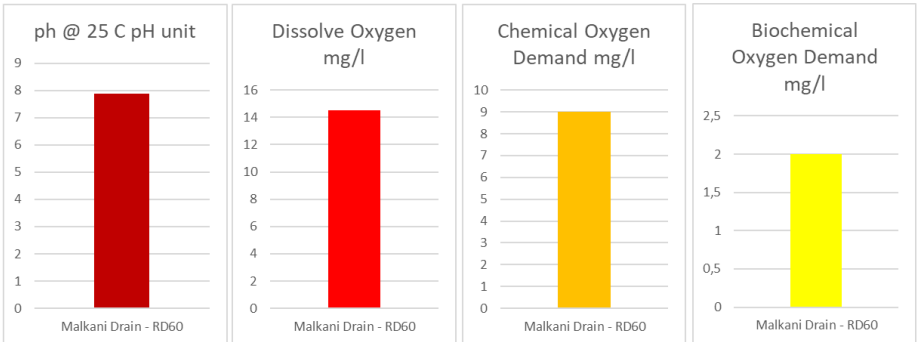


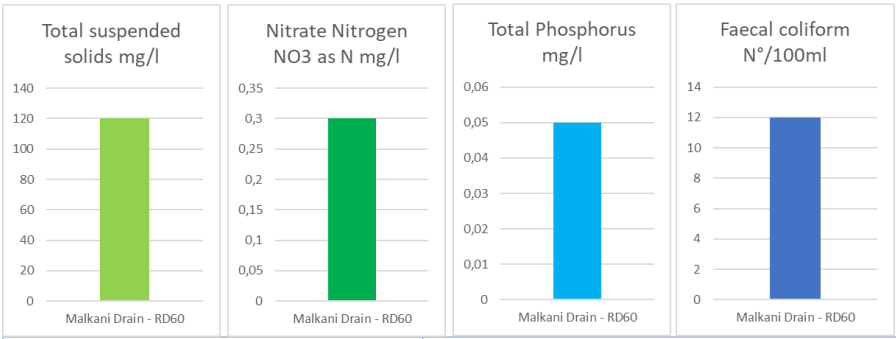


Parameter	Sample 1 : Jati Of Drain 40RD Sample 2 : Jati Of Drain 17RD Sample 3 : Jati Of Drain 60RD
pH	pH values for all three samples are slightly alkaline, but still fall within the ideal range for most aquatic organisms (🟢)
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) is excellent in all samples, ranging from 13.5 mg/L to 14.7 mg/L, which supports a healthy aquatic ecosystem (🟢)
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) is moderate, ranging from 22 mg/L to 32 mg/L. While these values are not alarmingly high, they indicate moderate organic pollution (🟡)
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) is moderate as well, ranging from 6 mg/L to 9 mg/L, which suggests the presence of biodegradable organic matter (🟡)
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is moderate, ranging from 21 mg/L to 32 mg/L, indicating some turbidity and sedimentation in the water (🟡)
Nitrate Nitrogen (NO3 as N)	Nitrate Nitrogen (NO3 as N) is higher in 40RD at 0.42 mg/L, which may suggest a slight nutrient pollution risk. However, 17RD and 60RD are within the ideal range (🟡 for 40RD, 🟢 for 17RD and 60RD)
Total Phosphorus	Total Phosphorus is low across all samples (🟢), minimizing the risk of eutrophication.
Faecal Coliform	Faecal Coliform is 5 N°/100ml in 17RD (🟢), but higher in 40RD and 60RD at 15 and 16 N°/100ml, respectively, suggesting moderate contamination in these two samples (🟡)

h. Sujawal District: Malkani Drain

117. The following table and figure summarize the analysis results for the 8 main parameters and graphs displaying water quality data at each sampling station located along the drain/canal, allowing for a comparison of values along its course (when several samples were taken on the same branch).





Parameter	Malkani Drain – RD60
pH	pH is 7.89, which is slightly alkaline but within the ideal range for most aquatic organisms ( ).
Dissolved Oxygen (DO)	Dissolved Oxygen (DO) is 14.5 mg/L, which is excellent and supports healthy aquatic life ( ).
Chemical Oxygen Demand (COD)	Chemical Oxygen Demand (COD) is 9 mg/L, which is low and indicates minimal organic pollution ( ).
Biochemical Oxygen Demand (BOD)	Biochemical Oxygen Demand (BOD) is 2 mg/L, which is also low, suggesting minimal biodegradable organic matter ( ).
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is 120 mg/L, which is moderately high, indicating turbidity and sedimentation concerns ( ).
Nitrate Nitrogen (NO3 as N)	Nitrate Nitrogen (NO3 as N) is 0.3 mg/L, which is moderate and could indicate some nutrient pollution ( )
Total Phosphorus	Total Phosphorus is 0.05 mg/L, which is low and minimizes the risk of eutrophication ( )
Faecal Coliform	Faecal Coliform is 12 N°/100ml, which is moderate and indicates some fecal contamination ( )

B. Subsurface Hydrology

118. The available groundwater resource in Sindh is approximately 6.2 BCM and holds ample potential for irrigation. However, the utilization of groundwater is relatively lower (4.3 BCM) than surface water due to two primary reasons, first, there is a large area where groundwater is saline; and second, there is a high surface irrigation supply to most of the canal commands, e.g., average annual supply to rice command is 1723 mm, close to the annual reference crop evapotranspiration for the area, while there is an additional annual rainfall of about 200 mm[26]. About 35% of Sindh's total area have water table within 1.5 m, resulting in significant waterlogging issues (Steenbergen, 2020). In 2013, the average annual depth to the water table ranged from 0.2 to 3.0 m, covering approximately 98% area. Out of this, about 51% area experienced waterlogging conditions with a depth to water table (DTW) less than or equal to 1.5 m (Iqbal et al., 2020). Due to these challenges, the development of private tubewells in Sindh remained limited, and groundwater fluctuations are less noticed compared to other regions. This constraint can be attributed to the restricted exploitation of groundwater due to the reasons explained above[27].

119. Depth to Water Table (DTW) is classified into five classes, ranging from <2 m to greater than 16 m (Figure IV-8). The DTW analysis reveals that the most significant seasonal variation occurs immediately after monsoon season. The average water-table depth in pre-monsoon season is 4.6 m, whereas in the post-monsoon season, it decreases to 2.4 m.

[26] Van Steenbergen, F., Basharat, M., & Lashari, B. K. (2015). Key Challenges and Opportunities for Conjunctive Management of Surface and Groundwater in Mega-Irrigation Systems: Lower Indus, Pakistan. Resources, 4(4), 831-856. https://doi.org/10.3390/resources4040831
[27] Abdul Salam et al. (2023), Exploring Groundwater Dynamics: A Comprehensive Investigation and Spatial Mapping in Canal Command Areas of Sindh, Pakistan Council of Research in Water Resources (PCRWR)

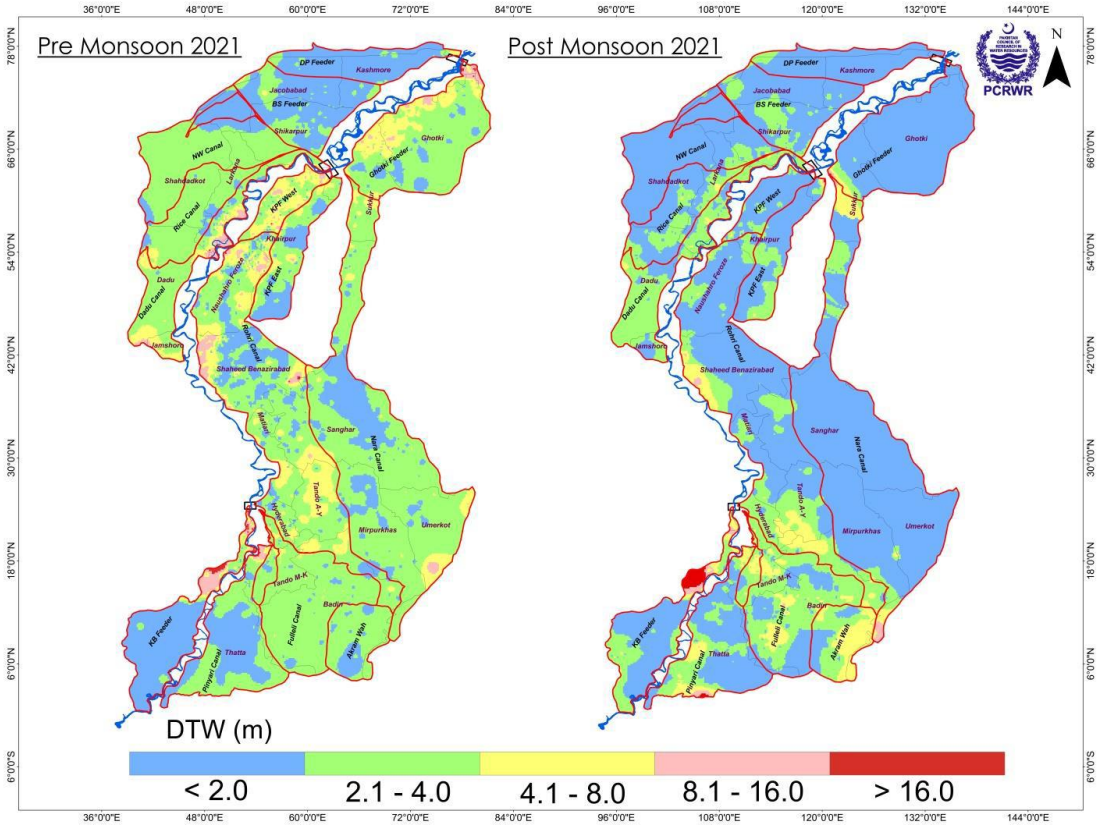


Figure IV-8: Pre-monsoon and post-monsoon DTW in 2021 (Source: Abdul Salam et al. (2023), Exploring Groundwater Dynamics: A Comprehensive Investigation and Spatial Mapping in Canal Command Areas of Sindh, Pakistan Council of Research in Water Resources (PCRWR))

120. The quality of groundwater in terms of electrical conductivity (EC) was measured by Pakistan Council of Research on Water Resources (PCRWR) in 2021 and divided into four water quality zones (Table IV-8).

Table IV-8: Water quality zoning

Water Quality Zones	EC (dS/m)
Fresh	< 1.5
Marginal	1.5 – 2.5
Saline	2.6 – 4.0
Highly Saline	> 4.0

Source: Iqbal et al., (2020).

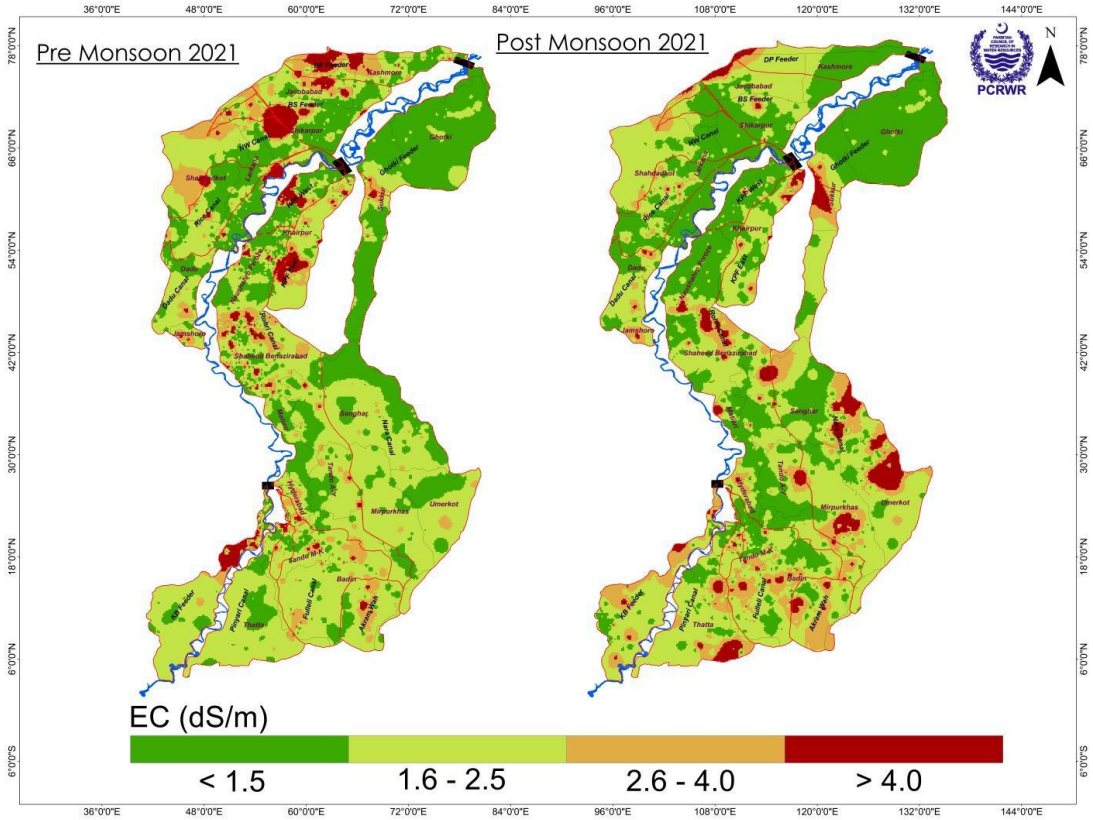


Figure IV-9: Pre-monsoon and post-monsoon EC variations at varying depths in 2021 (Source: Abdul Salam et al. (2023), Exploring Groundwater Dynamics: A Comprehensive Investigation and Spatial Mapping in Canal Command Areas of Sindh, Pakistan Council of Research in Water Resources (PCRWR))

121. Figure IV-10 illustrates that 52% of the area falls under marginal groundwater quality, 34% area falls under fresh groundwater quality, and remaining 14% of the area falls under saline to highly saline groundwater. The groundwater of fresh quality was found in shallow pockets up to 16 m in Ghotki, Khairpur West, Begari Sindh, North West, Rice canal and downstream Rohri canal commands in the Districts of Ghotki, Khairpur, Shikarpur, Larkana, Matiari and Tando Allahyar.

122. The reason for fresh groundwater quality at shallow depth may be recharge from river and canal irrigation network as well as cropping pattern. During the post-monsoon, fresh groundwater quality (<1.5 dS/m) is improved by 4%. It shows that in post monsoon, due to recharge from rainfall and high flows in canals, the groundwater quality was improved.

123. The spatial variation of groundwater quality evaluated through ERS is given in Figure IV-10.

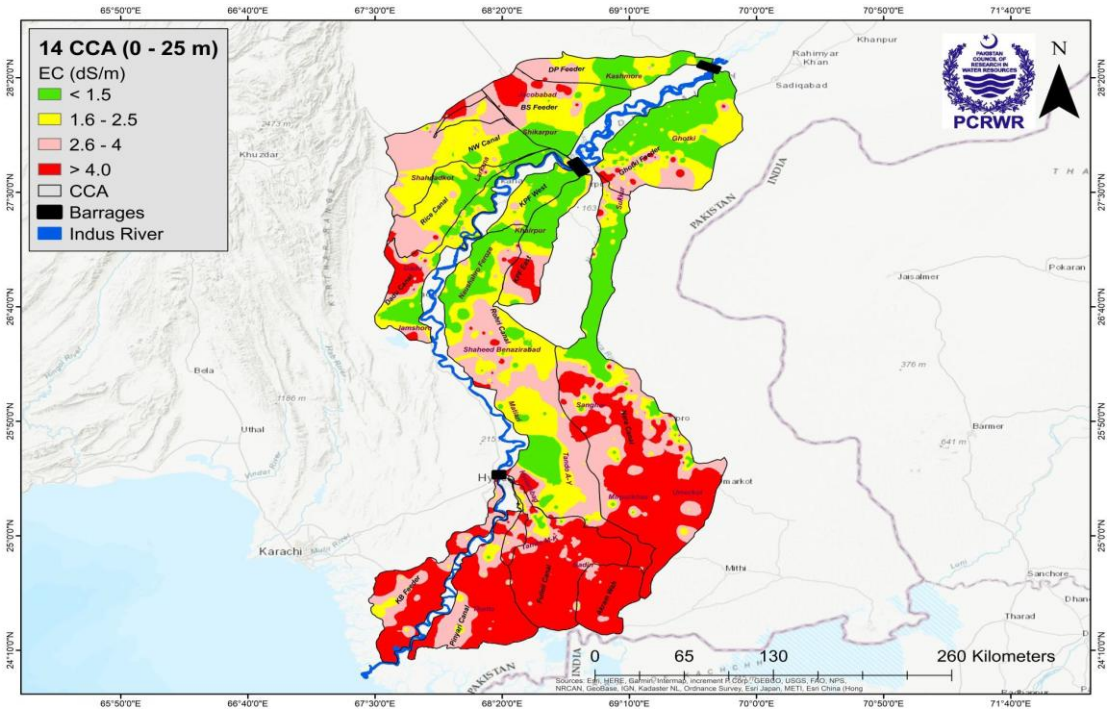


Figure IV-10: Spatial variation of groundwater quality at 25 m depth (Source: Abdul Salam et al. (2023), Exploring Groundwater Dynamics: A Comprehensive Investigation and Spatial Mapping in Canal Command Areas of Sindh, Pakistan Council of Research in Water Resources

124. Sindh Water Policy, 2023 highlights that groundwater rights have not yet been introduced in the province. The Policy proposed reforms in the associated institutions for the restructuring of Sindh Irrigation Department and Sindh Irrigation and Drainage Authority into Sindh Water Resources Management Department. Under this department, Groundwater, Drainage and Water Quality Directorate will be established dealing with the policy, planning, allocation, regulation, operation and maintenance of vital parts of the system.

1. Groundwater Quality Analysis

125. It is recommended that as part of the Site-Specific Environmental Management Plan (SSEMP), the contract will undertake site-specific groundwater quality analysis on following tentative locations (see **Table IV-11**) before commencement of the construction activities. The results of these tests for each subproject must be submitted to the Engineer for review and approval.

Table IV-9: Tentative locations are proposed below for Groundwater Quality sampling

ref	Component	Area / Land mark	Sample Code	Tentative Locations	
				Latitude	Longitude
1.	Ghorabari Outfall drain	Var Town	GW1	24°33'11.40"N	67°50'32.98"E
2.	Sakro Branch	Ghulamullah Town	GW2	24°36'1.35"N	67°49'15.94"E
3.	Pir Pithai Drain	Buhara Town	GW3	24°27'40.28"N	67°34'41.00"E
4.	Garho Drain	Garho Town	GW4	24°18'37.05"N	67°36'4.36"E
5.	Bao Bijora Naurang	Bao Bijora wetland	GW5	24°43'56.20"N	67°58'59.35"E

126. Following description pertains to the secondary data referred here to develop the baseline at macro level – district level, which will be complemented by the primary data of groundwater quality specific to the site to be collected in Phase 2 of the subproject.

a. Secondary Data Analysis

127. The results of seventeen (17) groundwater samples analyzed[28] for SEQS/WHO parameters for drinking water were compared with SEQS/WHO limit values. Some water samples were found to contain TDS, chlorides, total hardness, turbidity, coliform organisms / E. coli and boron, in excess of SEQS/WHO limits set forth for Drinking Water. In four (04) samples, Total Dissolved Solids (TDS) parameter exceeded limit values. Chloride and Total Hardness (as CaCO3) value exceeded in four (04) samples; one (01) sample was found having turbidity value exceeding SEQS/WHO limit value whereas E. coli / Fecal coliforms were found in nine (09) samples; Phenolic compounds (as phenols) value exceeded from WHO limit in ten (10) samples. Out of seventeen (17) tested samples, four (04) groundwater samples were found exceeding SEQS/WHO limits in respect of at least three (03) test parameters. Overall, eleven (11) samples were found non-compliant to SEQS/WHO in some respect.

128. Excessive solids and hardness in water may be caused by salinity in soils from where such water is abstracted. However, coliform organisms are likely caused by anthropogenic activities as agricultural runoff, abstraction of water from shallow depths and fecal contamination of groundwater sources by domestic waste. Presence of phenolic compounds in exceedance of WHO limits may be due to the excessive use of pesticides in agriculture. Groundwater quality was also undertaken recently in Thatta District[29] at 24°43'57.96"N 67°37'38.02"E near Gharo Town. The graphical representation of all the results of groundwater quality is presented below.

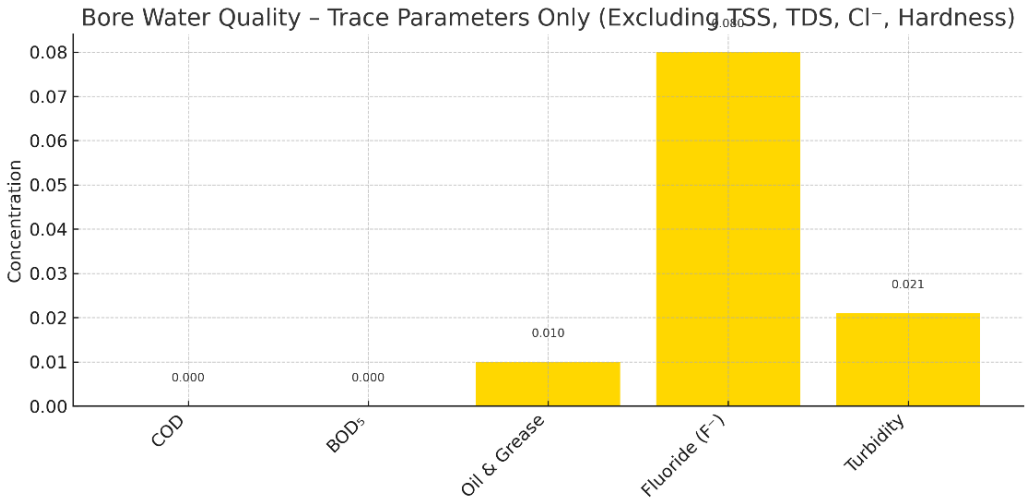


Figure IV-11: Groundwater Quality

[28] Sampling and analysis of groundwater quality was conducted by Team in December 2021 under Sindh Secondary Education Improvement Project (SSEIP) – A Sindh Government Project funded by ADB.
[29] Sampling and analysis of Groundwater Quality conducted by EMC Pakistan Pvt. Ltd for EIA of Risesince Steel Mills Gharo Sindh in 2025.

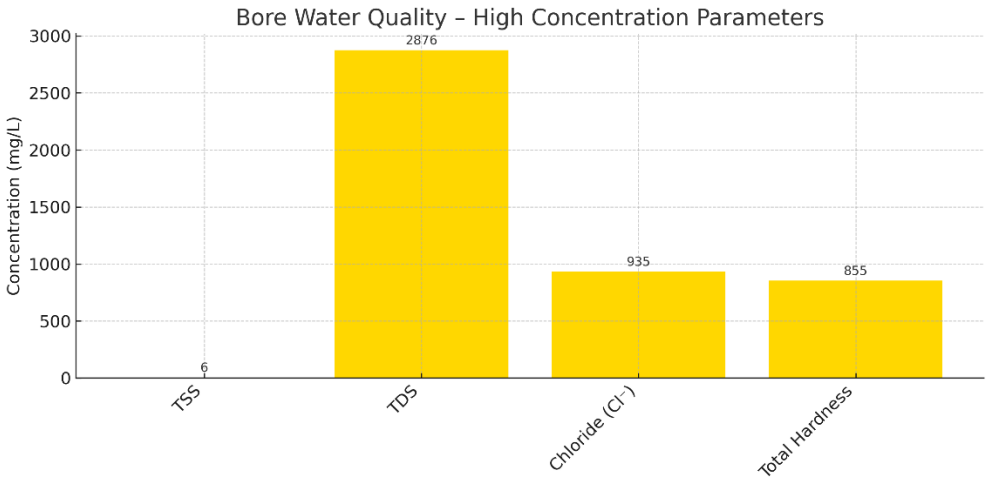


Figure IV-12: Groundwater Quality analysis under EIA of Risesince Steel Mills Gharo

129. The bore water quality analysis for Risesince Steel Mills, Gharo, reveals a generally low organic and microbial load, with both COD and BOD_5 values reported below detection limits, indicating the absence of significant biodegradable or chemical pollutants. Total Suspended Solids (TSS) is also low at 6 mg/L, suggesting minimal particulate matter in the water column.

130. However, the Total Dissolved Solids (TDS) concentration is notably high at 2876 mg/L, which exceeds the typical acceptable range for drinking water and may affect taste, hardness, and scaling potential. Similarly, Chloride and Total Hardness levels are elevated, recorded at 935 mg/L and 855 mg/L, respectively. These values point toward mineral-rich groundwater, possibly influenced by geological formations or saline intrusion.

C. Ecological Resources

131. Sindh is unique in its biodiversity due to its diverse range of landscapes and ecosystems and its location on the flyway of Central Asia, giving it the opportunity to host a multitude of migratory species. The variety of ecosystems is evident as Sindh is home to riverine, scrub, and mangrove forests, deserts, coastal areas, wetlands, and agri-ecosystems. The province is also rich in diverse species of flora and fauna. Plant species play an integral role in the biodiversity of the province, are a source of fodder, and an important source of raw material. Sindh also has a variety of medicinal plants, which are used in healthcare products, traditional medications, dyeing, as culinary spices, and in natural cosmetics and perfumes.

132. Wildlife species diversity is also apparent throughout Sindh. Migrating birds from the South Asian subcontinent, East Africa, Europe, and much of Asia use the wetlands as wintering grounds. Some fly in to stay for the winter and breed here, while the rest fly through. Therefore, besides Sindh's endemic species, these migrating birds also depend on these important wildlife habitats over the course of a year. Some significant wildlife species, which have come under threat due to loss of habitat, expansion of human settlements, lack of water supplies, and unregulated hunting, include the Houbara bustard, the Sindh urial, the Sindh ibex, the Indus blind dolphin, the marsh crocodile, the Indian cobra and python, and the Oliver Ridley turtles (*Lepydochelys olivacea*), to name just a few[30].

1. Flora

133. District Thatta and Sujawal are located at the tail end of the River Indus where the water flow in the river is very little. In addition to this, due to hot weather and sporadic rainfall the flora cannot

[30] Sindh Strategy for Sustainable Development - IUCN

be expected to be very rich and diverse. Also, because of growing population and increasing agricultural activity, most of the natural vegetation in the macro-environment has been replaced by agricultural fields. Major crops in the area include Wheat, rice, cotton, sugar cane, pulses and maize. Most of the plant species present in the site are cultivated.

134. Riverine Belt of Sindh which comprises Thatta and Sujawal is rich in different plant species as listed below:

Table IV-10: Plant Species of Riverine Belt[31]

S No	Scientific name	Common name
1.	*Tamarindus indica*	Imli
2.	*Indigophorapaucifolia*	Neel
3.	*Prosopis cineraria*	Kandi
4.	*Alhagimaurorum*	Kandero
5.	*Albiziz lebbek*	Sirehn
6.	*Prosopis glandulosa*	Mesquite
7.	*Prosopis juliflora*	Mesquite
8.	*Calotropis procera*	Ak
9.	*Capparis aphyla*	Kirir
10.	*Leptadeniaspartium (Khip)*	Khip
11.	*Tamarix articulate*	Asri Lawo
12.	*Tamarixdioca*	Lai
13.	*Populus euphratica*	Bahan
14.	*Salvadoraoleoides*	Jar
15.	*Salvadora persica*	Khabar
16.	*Phyllanthus reuticulatus*	Kamo
17.	*Salvia spp.*	Kinro
18.	*Salsola foetida*	Lani
19.	*Cardia mixa*	Geduro
20.	*Zizyphus jujube*	Ber
21.	*Gynandrpsis pentaphylla*	Kinro
22.	*Desmostachyabipinnata*	Dubh
23.	*Saccharum spontaneum*	Kanh
24.	*Sacchrummunja*	Munj
25.	*Sacchrumarundinaceum*	Sar

135. Agricultural and Horticultural Crop Species of Canal Irrigated plains of project districts are listed below:

Table IV-11: Agricultural and Horticultural Crop Species of Canal Irrigated plains[32]

S No.	Botanical Name	Local Name
	Cultivated Crops	
1.	*Triticum vulgare*	Wheat
2.	*Gossypium harbaccium*	Cotton
3.	*Oryza sativa*	Rice
4.	*Saccharum officianarum*	Sugarcane
5.	*Andropogon sorghum*	Sorghum, Jowar
6.	*Pennisetum typhoides*	Millet-Bajra
7.	*Hordeum vulgar*	Barley
8.	*Zea mays*	Maize

[31] https://documents.worldbank.org/en/publication/documents-reports/documentdetail/376071484725445516/addendum-to-environmental-and-social-management-framework-final-report
[32] https://documents.worldbank.org/en/publication/documents-reports/documentdetail/376071484725445516/addendum-to-environmental-and-social-management-framework-final-report

	Vegetables	
9.	*Cucurbita pepo*	Pumpkin – Kadu
10.	*Spinacea oleracea*	Spinach
11.	*Lycopersicum esculentum*	Tomato
12.	*Lagennaria vulgaris*	Bottle gourd -Kadu
13.	*Cucumis sativum*	Cucumber – Kheera
14.	*Cucumis melo*	Musk melon
15.	*Coriandrum sativum*	Corriander
16.	*Allium cepa*	Onion
17.	*Allium sativum*	Lasan
18.	*Capsicum annum*	Chilly
19.	*Brassica capitata*	Cabbage
20.	*Colocassia esculentum*	Kachaloo
21.	*Daucus carota*	Carrot
22.	*Hibiscus esculentus*	Ladies finger
23.	*Raphanus sativus*	Radish- Mooli
	Fodder	**Lucern**
24.	*Medicago sativa*	Lucern
25.	*Trifolium alexandrinum*	Clover- barseem
	Pulses	
26.	*Phasiolus mungo*	Moong
27.	*Phasiolustrilobus*	Moth
28.	*Phasiolusaconitifolia*	Kidney bean (Dal moth)
29.	*Phasioluslunata*	Kidney beam Lobia
30.	*Pisum sativum*	Pea
31.	*Cicer arietinum*	Chick pea
	Oil seeds	
32.	*Brassica junceae*	Rape seed
33.	*Brassica campestris*	Mustard
34.	*Eruca sativa*	Black mustard Jambho
35.	*Helianthus annus*	Sun flower
	Fruit Trees	
36.	*Musa sapientum*	Banana
37.	*Phoenix dactylifera*	Date palm
38.	*Scyzigiumcumini*	Jaman
39.	*Carica papaya*	Papaya

136. The coastal strips and the creeks abound in semiaquatic and aquatic plants, and inshore deltaic islands have mangrove forests of Timmar (*Avicennia marina*) trees. Avicennia marina is the most common mangrove species found in the area and also naturally growing immature plants were observed along the bunds. There is a proper SFD planted mangrove plantation observed in the creek area along the bunds. The mangrove tree is itself protected under Sindh Forest Act, 1927 (Amendment 1994). Water lilies grow in abundance in the numerous lakes and ponds, particularly in the Lower Sindh region33.

137. In addition to the mangrove trees, other primary producers in mangrove communities and adjacent areas include microscopic and macroscopic algae. Microscopic algae are found in the plankton (phytoplankton), on mangrove roots (periphyton) and other substrates (epibenthic), and within the tissues of sea anemones, ascidians, sponges, and other animals (endobionts).

[33] Ibid

2. Fauna

a. Wildlife

138. As a result of shift in land use from a previously uncultivated land to presently extensively cultivated area, the wildlife has noticeably reduced. Due to human intervention, most of the endemic wildlife has either left or become locally extinct. The animals that are now found are common species that are highly adaptable and able to coexist with people. Cape hare, fox, Asiatic jackal and porcupine constitute the dominant wildlife species in the district. Cape hare is also sighted during the day which indicates that predators are not common in the area. The number and frequency of visits by other animals into the area is reported by the locals to have substantially reduced in recent period.

b. Birds

139. The most common birds found in the district are sparrows, robins and doves. Characteristic bird species that have adapted to the environment and are still found in the area include the Indian grey partridge (*Francolinus pondicerianus-LC*[34]), chest-nut-bellied sand grouse (*pterocles exustus-LC*), rock dove (*Columba* **livia** *domestica*), Indian little button quail (*turnix sylvatica-LC*) and Eurasian roller (***Coracias*** garrulus-LC). Kites and vultures, the high-flying birds are also spotted. Other birds reported in the area include the Houbara Bustard (*Chlamydotis undulata -VU*), Houbara Bustard (*Tetrax tetrax-NT*).; Grey Parttridge (*Francolinus pondicerianus also known as* Ortygornis pondicerianus-LC); Indian Sand grouse (*Pterocles exustus-LC*); Painted Sand grouse (*Pterocles indicus-LC*); Saker Falcon (*Falco cherrug-EN*) (Extremely rare); Indian Griffon Vulture (*Gyps fulvus-LC*); Partridge (*Ammoperdix griseogularis-LC*); Common Quail (*Coturnix coturnix-LC*); Eurasian Wryneck (*Jynx torquilla-LC*); Sindh Woodpecker (*Dendrocopos assimilis-LC*); Common Hoopoe (*Upupa epops-LC*); Indian Roller (*Coracias benghalensis-LC*); Asian Koel (*Eudynamys scolopacea-LC*); Rose-ringed Parakeet (*Psittacula krameria-LC*); Spotted Owlet (*Athene brama-LC*); Rock Pigeon (*Columba livia-LC*); Indian Collared Dove (*Streptopelia decaocto-LC*); Common Crane (*Grus grus-LC*); Tawny Eagle (*Aquila rapax-VU*), , Common Myna (*Acridotheres tristis-LC*); Pale Crag-martin (*Hirundo obsolete-LC*); House Sparrow (*Passer domesticus-LC*).

c. Reptiles

140. The spiny-tailed lizard (*Uromastyx hardwickii-VU*) is highly abundant in this area. Most of the sand mounds in the district were found to have its burrows. The species are included in Appendix III of the CITES. The abundance of this lizard gives an indication about the absence of birds of prey in the area.

141. Other reptiles are getting rare because of aridity which has in general reduced the biodiversity of the area. Indian Monitor lizard (*Varanus bengalensis-NT*) (reported but not spotted)

142. Other reptiles reported in the area include Yellow-headed Agama (*Laudakia nupta-LC* (spotted during the survey), Indian Garden Lizard (*Calotes versicolor-LC*), Long-tailed Desert Lacerta (*Eremias guttulata watsonana-LC*) (reported but not spotted), Sindh Sand Gecko (*Crossobamon orientalis-LC*) (reported but not spotted).

d. Mammals

143. Indian Pangolin (Scaly Anteater) (*Manis crassicaudata-EN*) is; Jackal (*Canis aureus-LC*); Ratel (Honey Badger) (*Mellivora capensis-LC*); Small Indian Mongoose (*Herpestes javanicus-LC*);

[34] LC=Least Concern, VU=Vulnerable as per IUCN redlist.

Black-naped Hare *Lepus nigricollis-LC*); Grey Spiny Mouse (*Mus Saxicola-LC*) are reported in the area.

e. Livestock

144. Locals rear herds of livestock for source of food and additional income. Sheep (*Ovis aries*), Goat (*Capra aegagrus hircus*), Camel (*Camelus*), Horse (*Equus caballus*), Ass (*Equus asinus*) and mule are the main livestock of the districts. People prefer keeping cattle rather than goats or sheep. However, during drought condition Livestock in the districts suffers in particular from shortage of high-quality feed and fodder crops as a result of the overall shortage of water[35].

f. Aquatic Fauna

145. A total of 38 finfish species, 21 shellfish (shrimps, gastropods and bivalves) were identified at different locations in the Indus Delta. *Liza subviridis-LC* of the family Mugilidae, was found to be the dominant species making 14.36% of the total, whereas two other species of the family Sciaenidae, *Johnius carouna-LC* and *Otolithes ruber-LC*, were at 9.41% and 9.94%, respectively[36]. Different species of fish found in abundance in the wetlands and lakes namely Gulfam (Cyprinus carpio - LC), Morakhi (Cirrhinus cirrhosis - VU), Theli (Labeo catla - LC), Singhari (Sperata seenghala – LC), Jirko, and Dayyo (Oreochromis niloticus – LC).

3. Ecologically Protected Areas

146. There is no notified protected areas directly falling along the drains and canal alignment or in close vicinity (Subprojects proposed under Output 1). Subprojects proposed under Output 2 including Bijora Bao Norang Wetland, which is one of the wetland subprojects is located close to a wildlife sanctuary namely **Bijoro Chach**. The wildlife sanctuary is known for important breeding area for Water Fowl. However, development of wetland and improved water retention and periphery tree cover will enhance the ecological character of the wetland.

147. Under output 2, one of the subprojects namely Mangroves Plantation (Ghorabari) will be undertaken in Indus Delta which is a Ramsar Site as well as it is 02 km away from Marho Kotri Wildlife Wildlife Sanctuary, but the purpose is to plant mangrove and improves ecological characteristics and forest cover.

148. Mangroves Plantation (Nagan Dhoro) will be undertaken in Indus Delta which is a Ramsar Site as well as a close to Keti Bundar wildlife sanctuary, but the purpose is to plant mangrove and improves ecological character and forest cover. Inland Plantation (Jati) will be undertaken in Indus Delta which is a Ramsar Site as well as a close to Keti Bundar wildlife sanctuary, but the purpose is to plant trees and improves ecological character and forest cover.

149. The Bijora Bao Norang Wetland and Pinnah Lake is located inside the reserved forests Called Bijora Forest and Pinnah Forest respectively designated by forest department. The land use around the wetland is encroached upon with cultivation by locals and no forest land use was observed. However, development of wetland and improves water retention and periphery tree cover will enhance the ecological characteristics of the wetland.

[35] Pakistan Emergency Situational Analysis, District Thatta, 2014
[36] Project Document - Delta Blue Carbon – 1, March 2021

a. Important Bird Areas (IBAs) / Ramsar Sites[37]

150. There are nineteen Ramsar sites, covering an area of 1,343,627 hectares (3,320,170 acres) in Pakistan, out of which, 5 sites are located in Thatta, Sujawal and Badin districts. Only Indus Delta is located close to the subproject sites.

151. There are 08 IBAs in Thatta, Sujawal and Badin. Most of these IBAs have been selected as IBAs for supporting some threatened species of birds as well as large populations of congregator birds. Only Outer Indus Delta and Keti Bundar North Wildlife Sanctuary are located close to the subproject sites.

152. Indus Delta is a designated Ramsar site (number 1,284) as per Annotated List of Wetlands of International Importance. A large number of species are supported by the Delta, of birds (including the threatened Dalmatian pelican), of fish and shrimps, and of dolphins (Plumbeous dolphin, Finless porpoise, and Bottlenose dolphin), humpback whale, and reptiles. Only mangrove plantation is proposed in the Indus Delta.

4. Floral Survey of Ghora Bari Catchment

153. Vegetation monitoring under the Sindh Coastal Resilience Project (SCRP) was carried out along the Ghorabari, Jati, Pif Pathai, Sakro, Nagan Dhoro drains and adjacent wetlands and canals. This exercise documented the presence, condition, and ecological role of key plant species, with a focus on understanding their relationship to the drainage infrastructure and the wider resilience objectives of the project. The baseline flora includes a blend of native halophytes, xerophytes, riparian grasses, mangroves and, in some stretches, aggressive invasive species. Together, they define the ecological character and bank stability potential of these drain corridors.

154. Some of the mature trees located alongside of the existing drains and canals are planted by Irrigation Department, in which Babbur (*Acacia nilotica*) and Nim (*Azadirachta inidica*) and Sufaida (*Eucalyptus*) species are dominant. The objective for the plantation of trees alongside banks of water channels is to prevent soil erosion and stability of banks. However, most of the sections of drains and canals are covered extensively with wild and invasive shrubs. Undergrowth may include small bushes of *Tamarix spp.*, and *Prosopis juliflora*, *Calotropis procera* and *Saccharum sp*. and *Halocnemum strobilaceum*. The water column in some sections of the channels is covered with aquatic weeds. During rehabilitation activities, in addition to shrubs and weed clearing, some of the mature trees need to be cut down. Below is the plant species observed along the drain during floral survey.



Acacia nilotica



Prosopis juliflora

[37] Review of the Distribution, Status and Conservation of the Wildlife of Sindh, Canadian Journal of Pure and Applied Sciences Vol. 12, No. 2, pp. 4519-4533, June 2018



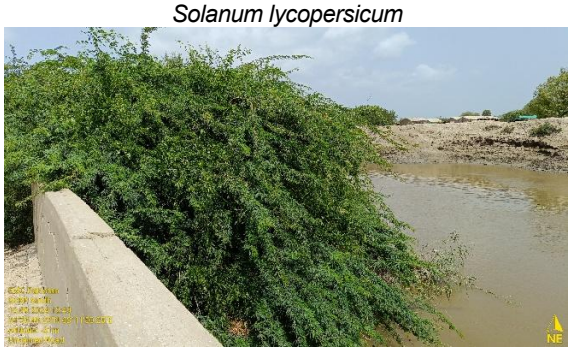
Calotropis procera



Solanum lycopersicum



Saccharum sp.



Prosopis juliflora



Moringa oleifera



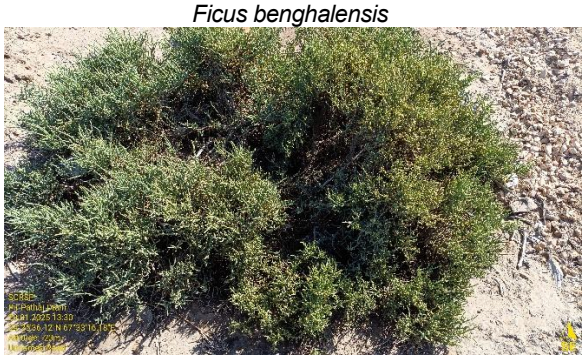
Typha angustifolia & Ipomoea spp.



Ficus benghalensis



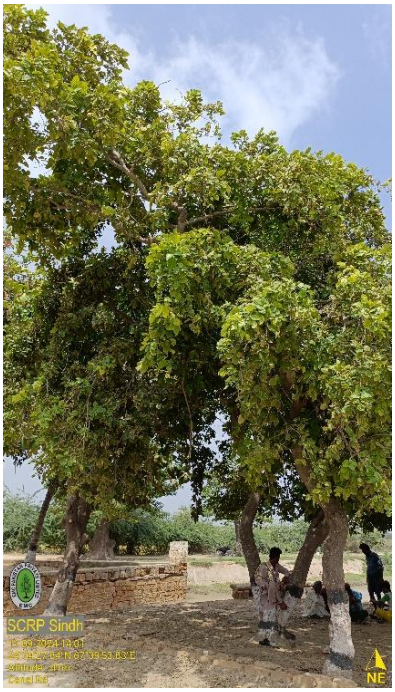
Phoenix dactylifera



Haloxylon stocksii



Avicennia marina



Ficus religiosa



Eichhornia crassipes



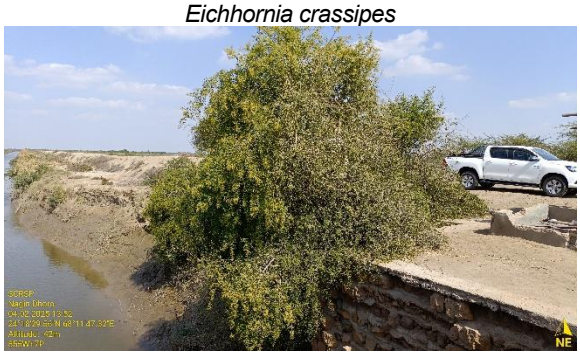
Polygonum glabrum



Eichhornia crassipes



Avicennia marina



Salvadora oleoides



Tamarix indica



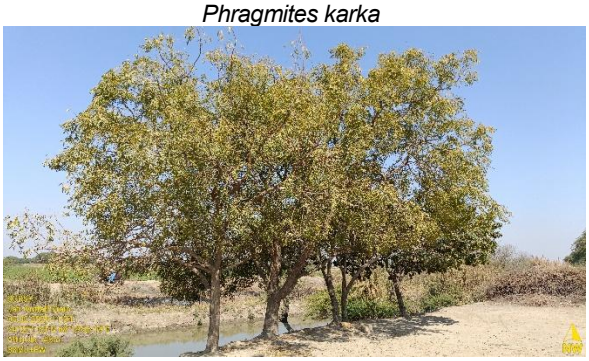
Halocnemum strobilaceum



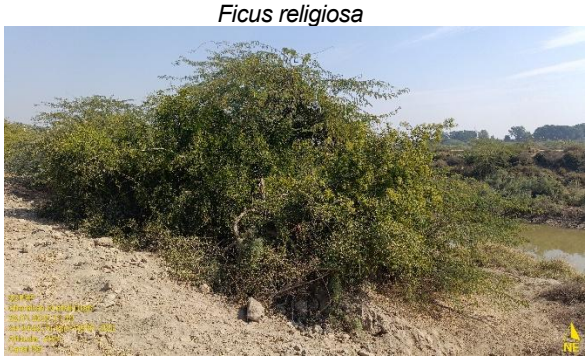
Phragmites karka



Ficus religiosa



Azadirachta indica



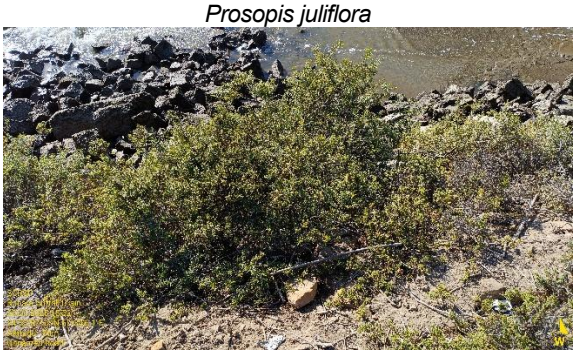
Capparis decidua



Prosopis juliflora



Typha domingensis



Atriplex crassifolia



Prosopis juliflora



View of Jamdari Dhand



Large stand of phragmites support fish and birds in Jamdari Dhand

Figure IV-13: Pictures of Observed Floral Species Along the subproject AoI

Table IV-12: List of Floral Species Identified During Survey

ref	Scientific Name	Local Name	IUCN Category
1	*Tamarix dioica*	Lai	Least Concern
2	*Salvadora persica*	Pilu	Least Concern
3	*Phragmites karka*	Reed	Least Concern
4	*Prosopis juliflora*	Mesquite	Least Concern
5	*Azadirachta indica*	Neem	Least Concern
6	*Ficus religiosa*	Peepal	Least Concern
7	*Avicennia marina*	Mangrove	Least Concern
8	*Eucalyptus camaldulensis*[38]	Safaida	Near Threatened
9	*Prosopis cineraria*	Khejri	Not Evaluated
10	*Eichhornia crassipes*	Water Hyacinth	Invasive
12	*Cymbopogon jwarancusa*	Khavi Grass	Not Evaluated
13	*Calotropis procera*	Aak / Sodom Apple	Least Concern
14	*Polygonum glabrum*	Dense Flower Knotweed	Least Concern

a. Tamarix dioica – Lai / Tamarisk

155. *Tamarix dioica* was observed extensively along subproject drains, especially where embankments consist of sandy, semi-saline soils. This hardy shrub naturally stabilizes loose soils along drain slopes and creates microhabitats that support insect life and occasional bird perches. Its tolerance for saline and alkaline soils makes it a useful indicator of soil conditions along these drains. For subproject rehabilitation, Tamarix stands are valuable as natural erosion control.

b. Salvadora persica – Peelu / Toothbrush Tree

156. *Salvadora persica* occurs very rarely near drain embankments and slightly elevated patches that avoid long-term waterlogging. This semi-arid tree develops deep roots that help bind embankment soils, particularly along sections of Ghorabari and Pir Pathai drains. Its berries attract local birdlife, adding minor habitat value.

c. Prosopis juliflora – Mesquite (Invasive)

157. *Prosopis juliflora* is now widespread along drain edges, canal bunds and roadsides throughout the subproject area. Its drought and salinity tolerance, combined with prolific seed dispersal, allows it to form dense thickets that outcompete native vegetation. Though it can provide local fuelwood and some soil binding, its negative impacts outweigh benefits when unmanaged: it hinders drain maintenance and restricts access for cleaning and inspections. For SCRP, active management is required to clear Prosopis stands that directly encroach on drain alignments or reduce flow capacity.

d. Typha domingensis – Cattail

158. *Typha domingensis* is typical of low-lying, waterlogged spots near drain outfalls and seasonal ponds. Its dense root mats can help filter runoff and trap sediment, while also serving as nesting habitat for wetland birds. However, Typha can grow vigorously in slow-flowing channels, causing blockages. For subproject drainage efficiency, it is advisable to allow Typha in controlled buffer strips at outfall wetlands where it can assist in water quality improvement but remove it from active channels where it would impede flow.

[38] See: https://www.iucnredlist.org/search?query=Johnius&searchType=species

e. Phragmites karka – Reed Grass

159. Similar in ecological function to Typha, *Phragmites karka* thrives along standing or slow-moving sections of drains and adjacent wetlands. It is common near drain outfalls and in low depressions where seasonal standing water persists. Its extensive rhizome system binds soil and supports wetland habitat. For subproject, reed grass should be maintained in buffer zones along wetland fringes but periodically cleared inside drain channels to safeguard hydraulic capacity.

f. Avicennia marina – Grey Mangrove

160. Avicennia marina occurs in the tidal fringes downstream of Ghora Bari and along low-lying coastal edges where drainage outfalls reach brackish waters. These mangroves are critical for shoreline stabilization, sediment trapping, and coastal biodiversity, providing breeding habitats for fish and juvenile crustaceans. For subproject, protecting Avicennia stands is a priority. Drainage discharge management must ensure that salinity levels and sedimentation patterns in these mangrove belts are not adversely altered, safeguarding their vital role in coastal resilience.

g. Ipomoea carnea – Bush Morning Glory

161. *Ipomoea carnea* was noted in semi-flooded patches and drain margins where water collects in shallow pools. This shrub can tolerate seasonal inundation and quickly colonizes exposed wet ground. While it provides some stabilization and low habitat value, it can become weedy and dense, encroaching into channels.

h. Calotropis procera – Ak / Sodom Apple

162. *Calotropis procera* is a hardy shrub growing in drier, non-irrigated embankment sections and canal roadsides. It survives arid conditions and stabilizes dry, loose soils. Its ecological value is limited but its presence indicates areas of low moisture and higher salinity. For subproject, it poses no threat to drain function and may be retained in low-density stands where it does not obstruct access for maintenance vehicles.

i. Saccharum spontaneum – Kans Grass

163. *Saccharum spontaneum* grows along riparian zones and floodplain patches, particularly on older drain embankments. Its strong root system binds soil effectively and its tall stems reduce wind and water erosion. It can thrive in moist soils near channels. For subproject, Kans grass should be retained as a stabilizing species where practical, with periodic cutting near drains to maintain clear flow paths.

j. Sorghum halepense – Johnson Grass

164. Sorghum halepense was observed near low-lying drain segments and on seasonally damp lands. As a perennial grass, it spreads rapidly and provides effective ground cover that protects soil from erosion. However, it can become invasive if left unmanaged.

k. Ipomoea aquatica – Water Spinach

165. *Ipomoea aquatica* occurs in stagnant water and shallow drain pools, often where water velocity is low and sediment settles. It can assist in phytoremediation and nutrient uptake but spreads quickly and mats of Water Spinach may obstruct drains. Within subproiect, it must be periodically cleared from main channels to maintain designed flow capacity.

I. General Habitat Observations

166. The drain corridors surveyed under subproject demonstrate a mosaic of habitats — saline soils supporting halophytes like Tamarix and Salvadora, seasonally flooded edges with reed beds of Typha and Phragmites, and tidal fringe zones hosting essential mangrove ecosystems. Dry embankment stretches retain resilient xerophytes such as Prosopis and Calotropis. Together, this vegetation provides natural soil binding, moderates erosion, supports local biodiversity, and, where appropriate, contributes to water quality improvement. Mature trees, either natural or planted, are located along the existing alignments of drains and canals. The number and identification of species of mature trees at the proposed site is part of baseline data collected during screening surveys. Following are the numbers of mature trees to be removed by the subproject, and a compensatory plantation is proposed at a ratio of 1:5 (5 trees to be planted for every tree cut):

Table IV-13: Affected Mature trees along the drains

Subproject Name	Number of trees affected
Pir Pathai Outfall Drain	36
Sakro Branch	242
Ghora Bari Outfall Drain	29
Garho Outfall Drain	16
Buhara Outfall Drain	53
Total	**376**

5. Faunal Survey of Ghora Bari Catchment

167. Faunal survey was carried out by EMC ecological experts from 27 January to 07 February, 2025 & from 23-24 April, 2025, via walk-over survey making a linear transact with a width of 50 m from centerline on both sides along drainage corridors, wetlands, and outfall drains to document biodiversity, assess habitat conditions, and understand species interactions with drainage infrastructure. This below section presents the fauna identified during site visits, describes their habitat characteristics, and outlines their ecological roles within the drainage project context.



Ceryle rudis



Nest of Petrochelidon fluvicola



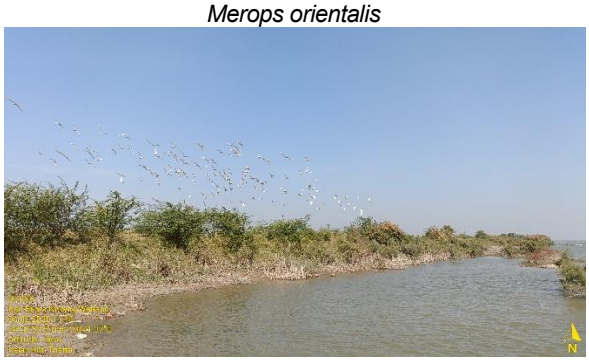
Periophthalmus spp.



Merops orientalis



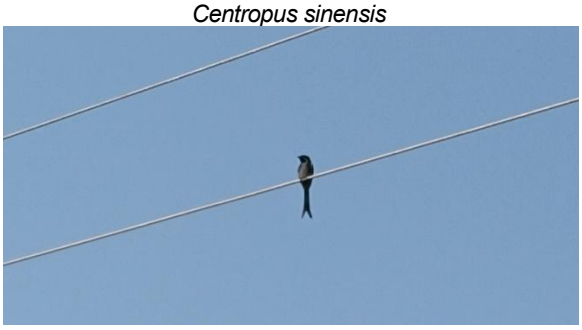
Haliaeetus leucoryphus



White herons



Centropus sinensis



Dicrurus macrocercus



Ceryle rudis



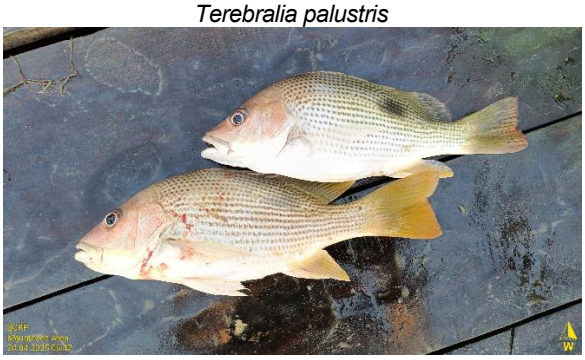
Arius sp.



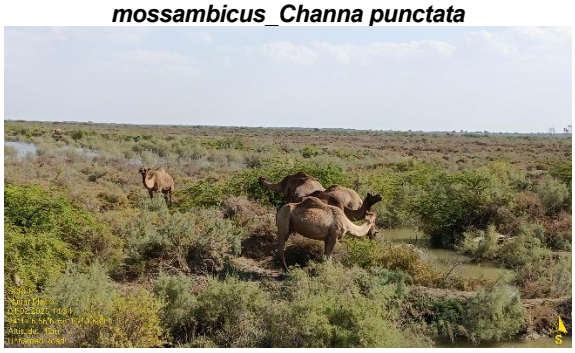
Terebralia palustris



Mugil cephalus_Oreochromis mossambicus_Channa punctata



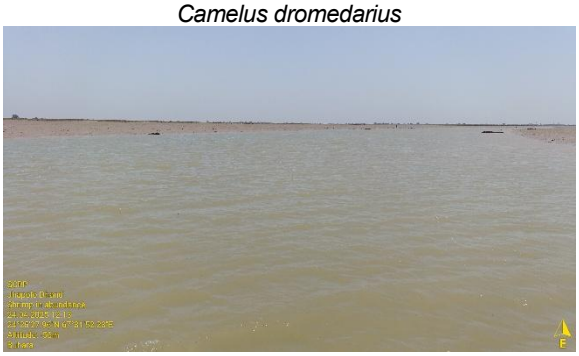
Pomadasys maculatus



Camelus dromedarius



Cerithidea cingulata



View of Jhapolo Dhand at the end of the drain



Mollusks and shrimps were observed during the survey

Figure IV-14: Pictures of Faunal Survey

Table IV-14: Observed Faunal species during survey

ref	Scientific Name	Common Name	IUCN Category
1	*Ceryle rudis*	Pied Kingfisher	Least Concern
2	*Dicrurus macrocercus*	Black Drongo	Least Concern
3	*Merops orientalis*	Green Bee-eater	Least Concern

4	*Centropus sinensis*	Greater Coucal (Crow Pheasant)	Least Concern
5	*Petrochelidon fluvicola*	Streak-throated Swallow	Least Concern
6	*Camelus dromedarius*	Dromedary Camel	Domesticated, Not Evaluated
7	*Scylla serrata*	Mangrove Crab (Mud Crab)	Data Deficient
8	*Terebralia palustris*	Mangrove Whelk	Not Evaluated
9	*Cerithidea cingulata*	Mud Creeper (Cerith Snail)	Not Evaluated
10	*Mugil cephalus*	Flathead Grey Mullet	Least Concern
11	*Oreochromis mossambicus* / *O. niloticus*	Tilapia	Vulnerable (VU)
12	*Channa punctata*	Spotted Snakehead	Least Concern
13	*Pomadasys maculatus*	Spotted Javelin (Blackspot Grunter)	Least Concern
14	*Arius* spp. (likely *A. gagora*)	Sea Catfish	Least Concern
15	*Periophthalmus* spp.	Mudskipper	Least Concern
16	*Haliaeetus leucoryphus*	Pallas's Fish Eagle	Endangered (EN)
17	*Penaeus indicus*	Jaira Shrimp	Least Concern
18	*Periophthalmus novemradiatus*	Indian Mudskipper	Data Deficient
19	*Cyprinus carpio*	Gulfam	Least Concern
20	*Cirrhinus mrigala*	Morakhi	Least Concern
21	*Labeo catla*	Theli	Least Concern
22	*Oreochromis niloticus*	Dayyo	Least Concern

a. Avifauna

168. Several bird species were recorded during monitoring, indicating healthy wetland and drain corridor environments. The Pied Kingfisher (*Ceryle rudis*) was observed perching along canal sand drains, reflecting the presence of small fish and reasonable water quality. The Black Drongo (*Dicrurus macrocercus*) and Green Bee-eater (*Merops orientalis*) were commonly sighted near drain embankments, playing a role in insect population control. The Greater Coucal (*Centropus sinensis*) was recorded in shrubby areas along drain corridors, while Streak-throated Swallows (*Petrochelidon fluvicola*) were noted nesting under bridges across drainage channels, demonstrating the coexistence of wildlife with infrastructure. The survey found a dozen nests of Streak-throated Swallows under a bridge. The survey, however, did not find any other nests or breeding sites of observed birds along the drains and canal. The survey was done in two random periods due to limitation of study period, and no seasonal variations were observed.

169. Significantly, Pallas's Fish Eagle (*Haliaeetus leucoryphus*) was recorded near wetland and drain outfall zones. This globally threatened raptor prefers large wetlands, lakes, and riverine habitats, where it preys on fish and waterbirds. Its presence indicates a healthy wetland environment with sufficient fish availability and minimal disturbance. As a Near Threatened species, it adds important conservation value to subproject's biodiversity monitoring efforts.

170. Due to the observed occurrence of Pallas's Fishing Eagle (*Haliaeetus leucoryphus*) – which is classified as Endangered (EN) on the IUCN Red List[39] in the subproject AoI, triggers the need for undertaking a Critical Habitat Assessment (CHA) according to the ADB SPS 2009 Appendix 1. Hence, a CHA will be undertaken by SID and its findings and associated mitigation measures will be integrated in the final Environmental Management Plan (EMP).

[39] Pallas's Fishing Eagle (Haliaeetus leucoryphus) is classified as Endangered (EN) on the IUCN Red List due to a global population decline caused by habitat degradation, wetland disturbance, and human encroachment, with fewer than 2,500 mature individuals remaining worldwide (https://www.iucnredlist.org/species/22695159/112303975) & (https://en.wikipedia.org/wiki/Pallas%27s_fish_eagle)

171. The avifaunal habitat was modified[40] as the observed fauna was recorded along the drains and canal AoI.

b. Mammals

172. The Dromedary Camel (Camelus dromedarius) was observed grazing on halophytic and xerophytic vegetation near the outfall channel. As an integral part of local livelihoods, their presence influences the vegetation structure and may require consideration within the drainage corridor vegetation management strategy.

c. Crustaceans and Mollusks

173. Species such as the Mangrove Crab (*Scylla serrata*), Mangrove Whelk (*Terebralia palustris*), and Mud Creeper (*Cerithidea cingulata*) were recorded in brackish water environments and mudflat areas near drainage outfalls. These species play an essential role in nutrient recycling and indicate functional estuarine and wetland systems near drainage channels.

174. The crustaceans and mollusks habitat was natural[41] as the observed fauna was recorded near the drain outfalls connected to deltaic plains.

d. Fish

175. Multiple fish species were recorded, including the Flathead Grey Mullet (*Mugil cephalus*), Tilapia (*Oreochromis mossambicus* / *O. niloticus*), Spotted Snakehead (*Channa punctata*), Spotted Javelin (*Pomadasys maculatus*), and Sea Catfish (*Arius spp.*), which were found in the drains. Their presence confirms ecological productivity and the availability of aquatic resources in the drains. These fish observed inside the drains comprising it as modified habitat.

176. Additionally, mudskippers (*Periophthalmus spp.*) were observed on drains near outfalls which shows the intrusion of seawater, indicating healthy intertidal habitats within the drainage-linked landscape. Indian Mudskipper (*Periophthalmus novemradiatus*) is abundantly present along tidal mudflats and near outfalls of the drains. The presence of Indian Mudskipper observed to be in natural habitat after the outfall regulators.

177. Shrimps were observed in Jhapolo Dhand which is a potential critical habitat[42] due to assemblages of shrimps (Penaeus indicus) and various mollusk communities that are associated with primary production. Pir Pithai drains discharges into an oval shaped natural water body referred to as Jhapolo Dhand (See **Annex III** for location). The Jhapolo Dhand exhibits rich aquatic ecology including the presence of shrimps (*Penaeus indicus*) and mollusks communities which are thriving due to confluence of seawater and freshwater discharging from the drain. Notably, the presence of shrimps (Penaeus indicus) and various mollusk communities suggests a productive estuarine environment where brackish conditions, resulting from the mixing of tidal seawater inflow and freshwater drainage from upstream agricultural areas, create an ideal habitat for these species.

[40] Modified Habitat, where the natural habitat has apparently been altered, often through the introduction of alien species of plants and animals, such as in agricultural areas (SPS 2009).

[41] Natural Habitat. Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions. (SPS 2009).

[42] A Critical habitat is a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities. Critical habitats include those areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites (ADB SPS 2009).

The freshwater contribution from the Pir Pithai Drain is particularly significant. The water typically exhibits low salinity due to drainage and moderate levels of biological oxygen demand (BOD), indicative of organic matter that is biodegradable and not heavily polluted. These characteristics support the growth of primary producers, such as phytoplankton and benthic algae, which form the base of the aquatic food web. As a result, the nutrient-rich yet not overly polluted water promotes favorable breeding and feeding conditions for shrimps and mollusks, key species in the estuarine trophic chain.

178. There is one natural water pond locally named as Jamdari Dhand which is a potential critical habitat[43] due to reported visits of migratory birds, is located along Ghora Bari drain, spread over an area of 340 acres (See **Annex III** for location). It collects mostly rainwater. There is an outlet which releases excess water fromthe pond into the drain. Half of the pond covers with Lai (*Tamarix aphylla*) and Common Reed (*Phragmites australis*) which are native grasses. The reeds provide shelter and breeding grounds for aquatic and semi-aquatic species. As per local consultations, different species of fish found in the pond namely Gulfam (*Cyprinus carpio* - LC), Morakhi (*Cirrhinus mrigala - LC*), Theli (*Labeo catla - LC*) and Dayyo (*Oreochromis niloticus - LC*). Locals also witnessed visits of migratory birds in winter.

179. The Indus Delta is a significant area for shrimp fisheries in Pakistan, with various species inhabiting its mangrove creeks and coastal waters. Specifically, the Indus River Estuary (IRE) serves as a nursery for numerous shrimp species, including commercially important ones like Penaeus, Metapenaeus, and Parapenaeopsis[44].

6. Floral Survey of Nagan Dhoro Catchment

180. Vegetation monitoring under the Sindh Coastal Resilience Project (SCRP) was carried out along the Nagan Dhoro and Geri drains and Pinnah Lake. This exercise documented the presence, condition, and ecological role of key plant species, with a focus on understanding their relationship to the drainage infrastructure and the wider resilience objectives of the project. Floral monitoring revealed a diverse assemblage of halophytic and xerophytic plant species adapted to semi-arid and saline conditions. Key vegetation included Tamarix indica, Prosopis juliflora, Salvadora oleoides, Phragmites karka, and Avicennia marina. These species were distributed across different habitat types such as embankments, wet depressions, and intertidal zones. Their ecological roles are critical — from erosion control and soil stabilization to providing habitat for avian and aquatic fauna.

181. Some of the mature trees located alongside of the existing drains are planted by Irrigation Department, in which Babbur (Acacia nilotica) and Nim (Azadirachta inidica) and Sufaida (Eucalyptus) species are dominant. The objective for the plantation of trees alongside banks of water channels is to prevent soil erosion and stability of banks. However, most of the sections of drains are covered extensively with wild and invasive shrubs. Undergrowth may include small bushes of Tamarix spp., and Prosopis juliflora and Halocnemum strobilaceum. During rehabilitation activities, in addition to shrubs and weed clearing, some of the mature trees need to be cut down. Below is the plant species observed along the drain during floral survey.

[43] Ibid.

[44] Babar, Syed & Shah, Syed & Mu, Yongtong & Pavase, Tushar & Abbas, Ghulam & Soomro, Maqsood & Kalhoro, Muhammad & Mohsin, Muhammad & Noman, Muhammad & Ali, Mumtaz & Abdul Malik, Dr. (2019). Current status of shrimp fishery in Pakistan: economic role, challenges, opportunities and strategies for aquaculture development. Indian Journal of Geo-Marine Sciences. 48. 1743-1754.



Acacia nilotica



Prosopis juliflora



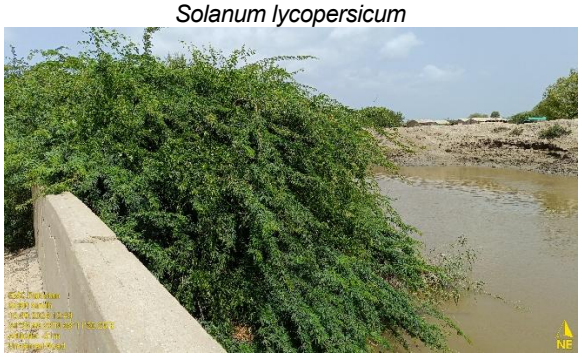
Calotropis procera



Solanum lycopersicum



Saccharum sp.



Prosopis juliflora



Moringa oleifera



Typha angustifolia & Ipomoea spp.



Ficus benghalensis



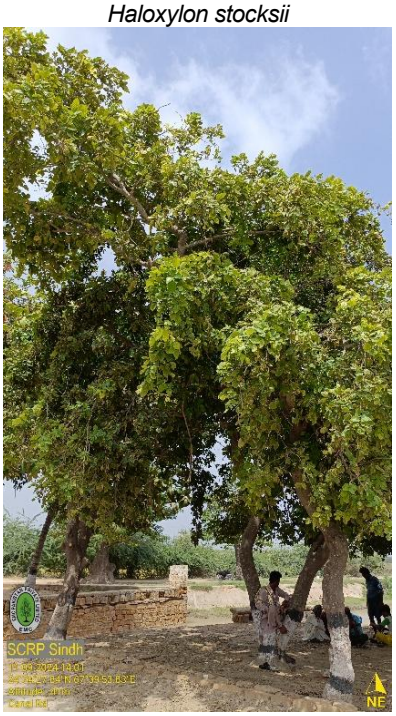
Phoenix dactylifera



Haloxylon stocksii



Avicennia marina



Ficus religiosa



Eichhornia crassipes



Polygonum glabrum



Eichhornia crassipes



Avicennia marina



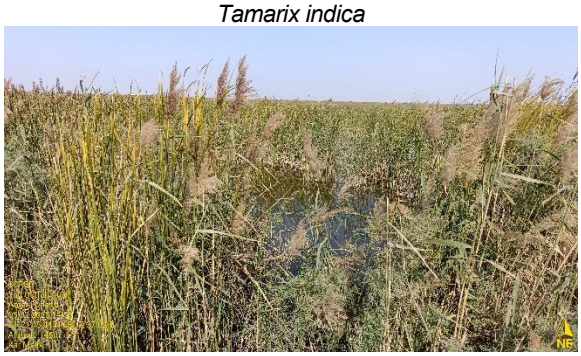
Salvadora oleoides



Tamarix indica



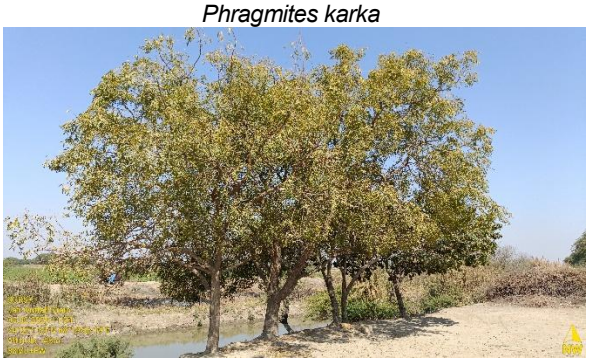
Halocnemum strobilaceum



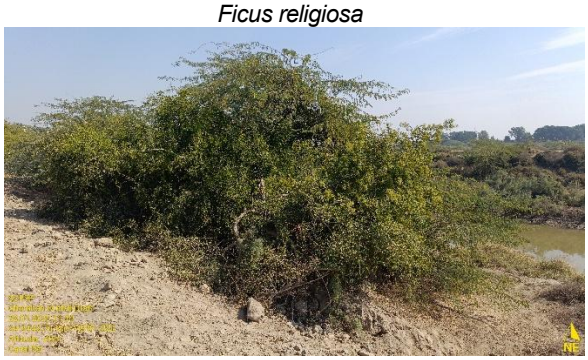
Phragmites karka



Ficus religiosa



Azadirachta indica



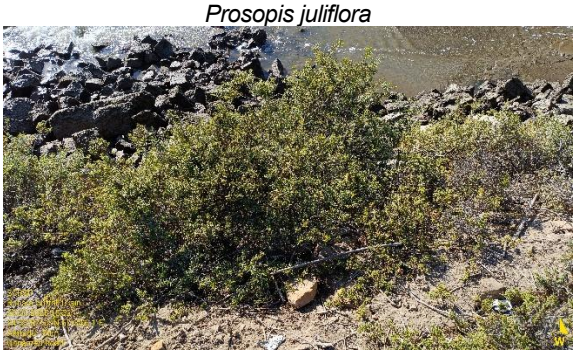
Capparis decidua



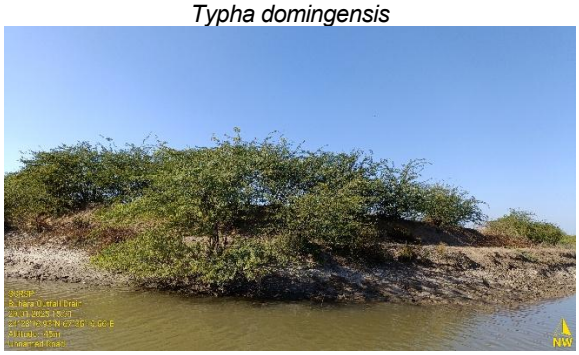
Prosopis juliflora



Typha domingensis



Atriplex crassifolia



Prosopis juliflora

Figure IV-15: Pictures of observed floral species along the subproject AoI

Table IV-15: List of Floral Species identified during survey

#	Scientific Name	Local Name	IUCN Category
1	*Tamarix dioica*	Lai	Least Concern
2	*Salvadora oleoides*	Pilu	Least Concern
3	*Phragmites karka*	Reed	Least Concern
4	*Prosopis juliflora*	Mesquite	Least Concern
5	*Azadirachta indica*	Neem	Least Concern
6	*Ficus religiosa*	Peepal	Least Concern
7	*Avicennia marina*	Mangrove	Least Concern
8	*Calotropis procera*	Aak / Sodom Apple	Least Concern

a. General Habitat Observations

182. The drain corridors surveyed under subproject demonstrate a mosaic of habitats — saline soils supporting halophytes like Tamarix and Salvadora, seasonally flooded edges with reed beds of Phragmites, and tidal fringe zones hosting essential mangrove ecosystems. Dry embankment stretches retain resilient xerophytes such as Prosopis and Calotropis. Together, this vegetation provides natural soil binding, moderates erosion, supports local biodiversity, and, where appropriate, contributes to water quality improvement.

183. Mature trees either natural or planted, are located along the existing alignments of drains. The number and identification of specie of mature trees at the proposed site is part of baseline data collected during screening surveys.

184. Following are the numbers of mature trees to be affected by the project:

Table IV-16: Affected Mature trees along the drains

Subproject Name	Number of trees affected
Nagan Dhoro Outfall Drain	29
Geri Branch Drain	77
Total	**106**

7. Faunal Survey of Nagan Dhoro Catchment

185. Faunal survey was carried out along drainage corridors, wetlands, and outfall drains to document biodiversity, assess habitat conditions, and understand species interactions with drainage infrastructure. This below section presents the fauna identified during monitoring visits, describes their habitat characteristics, and outlines their ecological roles within the drainage project context.

186. Faunal monitoring confirmed the presence of ecologically and economically significant species across the Nagan Dhoro catchment. Aquatic fauna included *Scylla serrata* (mud crab), *Oreochromis mossambicus* (Tilapia), Mugil *cephalus* (grey mullet), and *Channa punctata* (spotted snakehead), all found in brackish pools and wetland areas, particularly near mangroves and stagnant water zones. Their presence indicates functioning aquatic habitats, although their sensitivity to water quality changes necessitates protection during rehabilitation activities.

187. Avifauna and terrestrial observations included *Ceryle rudis* (Pied Kingfisher), *Merops orientalis* (Green Bee-eater), *Centropus sinensis* (Greater Coucal), *Cerithidea cingulata* (brackish water snail), and *Camelus dromedarius* (dromedary camel). These species utilize vegetated drain embankments for foraging, nesting, and grazing, underscoring the ecological importance of maintaining vegetative buffers and minimizing human disturbance.



Ceryle rudis



Scylla serrata



Periophthalmus spp.



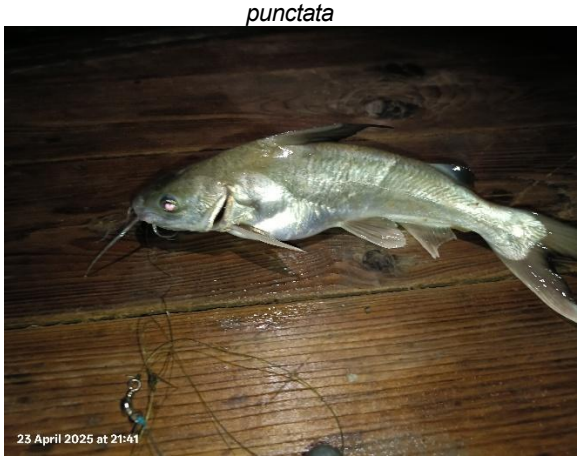
Pelecanus onocrotalus



Mugil cephalus_Oreochromis mossambicus_Channa punctata



White heron



Arius sp.



Terebralia palustris



Camelus dromedarius



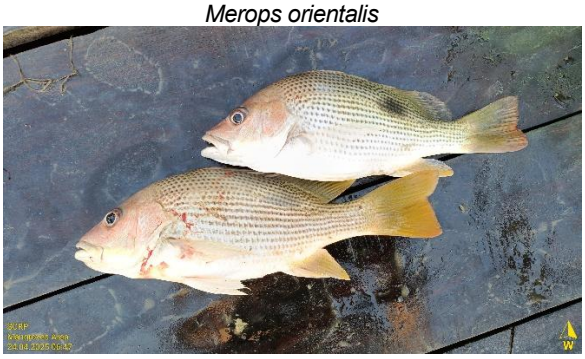
Centropus sinensis



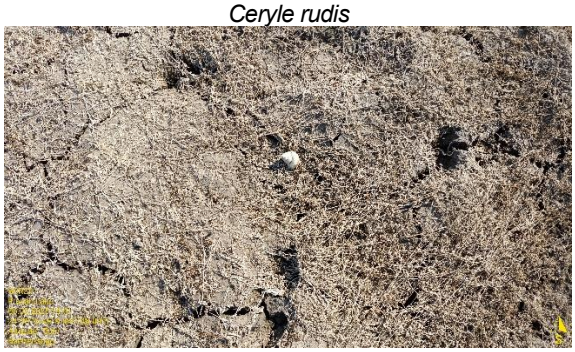
Merops orientalis



Ceryle rudis



Pomadasys maculatus



Cerithidea cingulata

Figure IV-16: Pictures of Faunal Survey

Table IV-17: Observed Faunal species during survey

#	Scientific Name	Common Name	IUCN Category
1	*Ceryle rudis*	Pied Kingfisher	Least Concern
2	*Merops orientalis*	Green Bee-eater	Least Concern
3	*Centropus sinensis*	Greater Coucal (Crow Pheasant)	Least Concern
4	*Camelus dromedarius*	Dromedary Camel	Domesticated, Not Evaluated
5	*Scylla serrata*	Mangrove Crab (Mud Crab)	Data Deficient
6	*Terebralia palustris*	Mangrove Whelk	Not Evaluated
7	*Cerithidea cingulata*	Mud Creeper (Cerith Snail)	Not Evaluated
8	*Mugil cephalus*	Flathead Grey Mullet	Least Concern
9	*Oreochromis mossambicus* / *O. niloticus*	Tilapia	Vulnerable (VU)
10	*Channa punctata*	Spotted Snakehead	Least Concern
11	*Pomadasys maculatus*	Spotted Javelin (Blackspot Grunter)	Least Concern
12	*Arius* spp. (likely *A. gagora*)	Sea Catfish	Least Concern
13	*Periophthalmus* spp.	Mudskipper	Least Concern
14	*Penaeus indicus*	Jaira Shrimp	Least Concern
15	*Periophthalmus novemradiatus*	Indian Mudskipper	Data Deficient
16	*Cyprinus carpio*	Gulfam	Least Concern

#	Scientific Name	Common Name	IUCN Category
17	*Cirrhinus mrigala*	Morakhi	Least Concern
18	*Labeo catla*	Theli	Least Concern
19	*Oreochromis niloticus*	Dayyo	Least Concern
20	*Pelecanus onocrotalus*	Great White Pelicans	Least Concern, Migratory

a. Avifauna

188. Several bird species were recorded during monitoring, indicating healthy wetland and drain corridor environments. The Pied Kingfisher (*Ceryle rudis*) was observed perching along canal and drains, reflecting the presence of small fish and reasonable water quality. The Green Bee-eater (*Merops orientalis*) was commonly sighted near drain embankments, playing a role in insect population control. The Greater Coucal (*Centropus sinensis*) was recorded in shrubby areas along drain corridors.

189. Great White Pelicans (*Pelecanus onocrotalus*) are migratory and are often seen in the Indus Delta region during the winter months. Their presence in the monitored drain segment indicates the ecological importance of the drainage water bodies as stopover and feeding habitats for large waterfowl species. Great White Pelicans are currently listed as Least Concern on the IUCN Red List but are sensitive to habitat disturbance, pollution, and drainage modifications.

b. Mammals

190. The Dromedary Camel (*Camelus dromedarius*) was observed grazing on halophytic and xerophytic vegetation near the outfall channel. As an integral part of local livelihoods, their presence influences the vegetation structure and may require consideration within the drainage corridor vegetation management strategy.

c. Crustaceans and Mollusks

191. Species such as the Mangrove Crab (*Scylla serrata*), Mangrove Whelk (*Terebralia palustris*), and Mud Creeper (*Cerithidea cingulata*) were recorded in brackish water environments and mudflat areas near drainage outfalls. These species play an essential role in nutrient recycling and indicate functional estuarine and wetland systems near drainage channels.

d. Fish

192. Multiple fish species were recorded, including the Flathead Grey Mullet (*Mugil cephalus*), Tilapia (*Oreochromis mossambicus* / *O. niloticus*), Spotted Snakehead (*Channa punctata*), Spotted Javelin (*Pomadasys maculatus*), and Sea Catfish (*Arius spp.*), which were found in the drains. Their presence confirms ecological productivity and the availability of aquatic resources in the drains. Additionally, mudskippers (*Periophthalmus spp*.) were observed on drains near outfalls which shows the intrusion of seawater, indicating healthy intertidal habitats within the drainage-linked landscape. Indian Mudskipper (Periophthalmus novemradiatus) is abundantly present along tidal mudflats and near outfalls of the drains.

193. Shrimps were observed near Nagan Dhoro outfall and in Mangrove plantation area. Notably, the presence of shrimps (*Penaeus indicus*) and various mollusk communities suggests a productive estuarine environment where brackish conditions, resulting from the mixing of tidal seawater inflow and freshwater drainage from upstream agricultural areas, create an ideal habitat for these species. The freshwater contribution from the Nagan Dhoro Drain is particularly significant. The water typically exhibits low salinity due to drainage and low to moderate levels of biochemical oxygen demand (BOD), indicative of organic matter that is biodegradable and not heavily polluted.

These characteristics support the growth of primary producers, such as phytoplankton and benthic algae, which form the base of the aquatic food web. As a result, the nutrient-rich yet not overly polluted water promotes favorable breeding and feeding conditions for shrimps and mollusks, key species in the estuarine trophic chain.

194. The Indus Delta is a significant area for shrimp fisheries in Pakistan, with various species inhabiting its mangrove creeks and coastal waters. Specifically, the Indus River Estuary (IRE) serves as a nursery for numerous shrimp species, including commercially important ones like Penaeus, Metapenaeus, and Parapenaeopsis[45].

8. Floral Survey of Jati Malkani Catchment

195. Vegetation monitoring within the Project was carried out along Jati and Malkani Drains. This exercise documented the presence, condition, and ecological role of key plant species, with a focus on understanding their relationship to the drainage infrastructure and the wider resilience objectives of the Project. Floral monitoring revealed a diverse assemblage of halophytic and xerophytic plant species adapted to semi-arid and saline conditions. Key vegetation included *Tamarix indica, Prosopis juliflora* and *Phragmites karka*. These species were distributed across different habitat types such as embankments, wet depressions, and intertidal zones. Their ecological roles are critical — from erosion control and soil stabilization to providing habitat for avian and aquatic fauna.

196. Some of the mature trees located alongside the existing drains are planted by the Irrigation Department, in which Babbur (*Acacia nilotica*) and Nim (*Azadirachta inidica*) species are dominant. The objective for the plantation of trees alongside banks of water channels is to prevent soil erosion and stability of banks. However, most of the sections of drains are covered extensively with wild and invasive shrubs. Undergrowth may include small bushes of *Tamarix spp.*, and *Prosopis juliflora* and *Halocnemum strobilaceum*. During rehabilitation activities, in addition to shrubs and weed clearing, some of the mature trees need to be cut down.

197. Below is the plant species observed along the drain during a floral survey.



Phragmites karka



Azadirachta indica

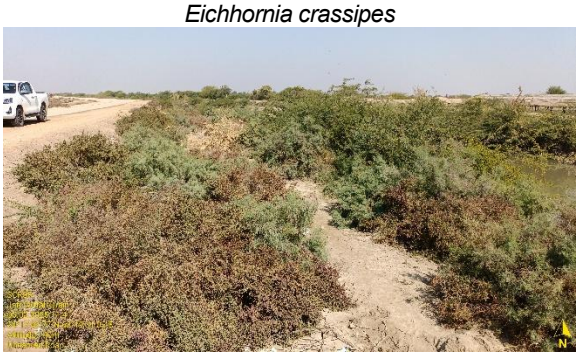
[45] Babar, Syed & Shah, Syed & Mu, Yongtong & Pavase, Tushar & Abbas, Ghulam & Soomro, Maqsood & Kalhoro, Muhammad & Mohsin, Muhammad & Noman, Muhammad & Ali, Mumtaz & Abdul Malik, Dr. (2019). Current status of shrimp fishery in Pakistan: economic role, challenges, opportunities and strategies for aquaculture development. Indian Journal of Geo-Marine Sciences. 48. 1743-1754.



Eichhornia crassipes



Ficus religiosa



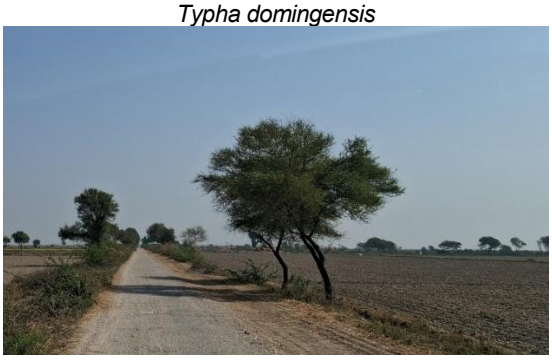
Tamarix dioica



Typha domingensis



Tamarix dioica and Phragmites karka



Acacia nilotica



Halocnemum strobilaceum



Tamarix indica

Figure IV-17: Pictures of Observed Floral Species along the Subproject AoI

Table IV-18: List of Floral Species Identified During Survey

ref	Scientific Name	Local Name	IUCN Category
1	*Tamarix dioica*	Lai	Least Concern
2	*Tamarix indica*	Lal jhao	Least Concern
3	*Phragmites karka*	Reed	Least Concern
4	*Prosopis juliflora*	Mesquite	Least Concern
5	*Azadirachta indica*	Neem	Least Concern
6	*Ficus religiosa*	Peepal	Least Concern
7	*Halocnemum strobilaceum*	Samphire	Least Concern

a. Tamarix indica

198. Tamarix *indica* was extensively observed across various habitats, particularly in Jati and Malkani locations. This species thrives in semi-saline and brackish conditions and is commonly found in wet depressions along the margins of drains. Tamarisk plays a vital ecological role in stabilizing soil structures and promoting water retention in otherwise arid landscapes. Furthermore, the dense foliage and branching pattern offer refuge and nesting opportunities for avian fauna and invertebrates. Its deep-rooted system enables it to survive in saline and waterlogged conditions, making it a dominant species in disturbed riparian and drainage-associated habitats.

b. Tamarix dioica

199. *Tamarix dioica*, commonly known as lal jhao or Indian Tamarisk, is a salt-tolerant, deciduous shrub widely distributed in arid and semi-arid regions of South Asia, particularly along riverbanks, saline flats, and degraded lands. It is characterized by its slender, wispy branches and small, scale-like leaves that help minimize water loss in harsh environments. *Tamarix dioica* plays a vital ecological role in stabilizing soils, especially in saline or waterlogged conditions, and acts as a pioneer species in reclamation of degraded coastal and inland landscapes. Its deep root system not only prevents erosion but also supports biodiversity by providing shelter for insects, birds, and small fauna.

c. Prosopis juliflora – Mesquite (Invasive)

200. *Prosopis juliflora* was found abundantly along the dry stretches of both the Jati and Malkani drains. This species typically colonizes degraded lands and saline soils, reflecting its high adaptability. While considered invasive, its presence contributes to erosion control and provides shade as well as limited fodder value. However, its aggressive growth pattern may outcompete native species if not managed carefully. In the context of the drain Project, its role in soil binding is acknowledged, but a strategic approach is necessary to contain its expansion into sensitive wetland zones.

d. Phragmites karka – Reed Grass

201. Similar in ecological function to Typha, *Phragmites karka* thrives along standing or slow-moving sections of drains and adjacent wetlands. It is common near drain outfalls and in low depressions where seasonal standing water persists. Its extensive rhizome system binds soil and supports wetland habitat. For subProject, reed grass should be maintained in buffer zones along wetland fringes but periodically cleared inside drain channels to safeguard hydraulic capacity.

e. Halocnemum strobilaceum

202. *Halocnemum strobilaceum* is a salt-tolerant, low-growing succulent shrub commonly found in highly saline and arid environments, particularly along the coastal and deltaic regions of Sindh. During the monitoring of Jati and Malkani drains, this species was observed growing in degraded saline patches and along the fringes of tidal outfall zones. Its jointed, fleshy stems and capacity to thrive in hypersaline soils make it an important pioneer species for stabilizing salt-affected lands. Ecologically, *H. strobilaceum* plays a critical role in soil conservation, erosion control, and habitat formation for small fauna, while also serving as an indicator of saline stress in the landscape. Its natural occurrence along drainage corridors suggests its potential inclusion in nature-based solutions for revegetation and saline soil rehabilitation.

f. Azadirachta indica

203. *Azadirachta indica*, locally known as Neem, is planted along village edges, roadsides, and embankments throughout the Jati–Malkani catchment, particularly in dry elevated zones adjacent to the drain alignment. This hardy, fast-growing tree is highly drought-tolerant and thrives in semi-arid climates with poor soils, making it a preferred species for roadside greening, bio-shield establishment, and community shade provisioning in southern Sindh. Its dense foliage provides critical microclimatic relief in exposed areas, while the leaves, bark, and seeds are valued for their medicinal and pesticidal properties. Neem trees along the Malkani drain embankments contribute to dust suppression, habitat provision for pollinators and birds, and stabilization of loose topsoil. Their presence reflects both ecological intent and community preference for multipurpose species in afforestation and roadside planting schemes. They should be preserved during rehabilitation works, and new Neem plantations may be encouraged in buffer zones, particularly where saline levels are moderate and groundwater access is viable.

g. Ficus religiosa

204. Ficus religiosa, commonly known as the Peepal tree, holds both ecological and cultural significance across Sindh and is found sporadically along older settlements and near the banks of freshwater sources in the Jati–Malkani region. Within the catchment, mature Peepal trees are often located near temples, community gathering points, or old roadside berms, where they are preserved for their sacred status. Ecologically, the species plays a crucial role in urban-rural biodiversity, supporting a wide variety of birds, bats, and epiphytes through its expansive canopy and year-round leaf cover. Its deep-rooted system contributes to subsurface soil stabilization, and its ability to tolerate intermittent waterlogging makes it suitable near embankments or recharge zones. In the SCRP context, the presence of Peepal trees along the drain corridors enhances the landscape structure, promotes bird movement corridors, and underscores the need to integrate culturally sensitive flora into the Project's environmental safeguards. These trees must be retained and carefully protected during all phases of civil works, with their locations geo-referenced and incorporated into plantation management and cultural heritage plans.

h. General Habitat Observations

205. The drain corridors surveyed under the subproject demonstrate a mosaic of habitats — saline soils supporting halophytes like *Tamarix spp.*, seasonally flooded edges with reed beds of Phragmites, and tidal fringe zones hosting scrubbed lands. Dry embankment stretches retain resilient xerophytes such as Prosopis. Together, this vegetation provides natural soil binding, moderates erosion, supports local biodiversity, and, where appropriate, contributes to water quality improvement.

206. Mature trees, either natural or planted, are located along the existing alignments of drains. The number and identification of species of mature trees at the proposed site is part of baseline data collected during screening surveys.

207. Following are the numbers of mature trees to be removed by the subproject and a compensatory plantation is proposed at a ratio of 1:5 (5 trees to be planted for every tree cut):

Table IV-19: Affected Mature Trees Along the Drains

Subproject Name	Number of trees affected
Jati Outfall Drain	53
Malkani Outfall Drain	44
Total	**97**

9. Faunal Survey of Jati Malkani Catchment

208. A faunal survey was carried out by EMC ecological experts from 27th January to 7th February, 2025 and from 23rd and 24th April, 2025, via walk-over survey making a linear transact with a width of 50 m from centerline on both sides along drainage corridors, wetlands, and outfall drains to document biodiversity, assess habitat conditions, and understand species interactions with drainage infrastructure. This section presents the fauna identified during monitoring visits, describes their habitat characteristics, and outlines their ecological roles within the drainage Project context.

209. Faunal monitoring confirmed the presence of ecologically and economically significant species across the Jati Malkani catchment. Aquatic fauna included *Scylla serrata* (mud crab), *Oreochromis mossambicus* (Tilapia), Mugil *cephalus* (grey mullet), and *Channa punctata* (spotted snakehead), all found in brackish pools and wetland areas, particularly near mangroves and stagnant water zones. Their presence indicates functioning aquatic habitats, although their sensitivity to water quality changes necessitates protection during rehabilitation activities.

210. Avifauna and terrestrial observations included *Ceryle rudis* (Pied Kingfisher), *Merops orientalis* (Green Bee-eater), *Centropus sinensis* (Greater Coucal), *Cerithidea cingulata* (brackish water snail). These species utilize vegetated drain embankments for foraging, nesting, and grazing, underscoring the ecological importance of maintaining vegetative buffers and minimizing human disturbance.



Ceryle rudis



Scylla serrata



Periophthalmus spp.



Pelecanus onocrotalus





Mugil cephalus_Oreochromis mossambicus_Channa punctata



White heron



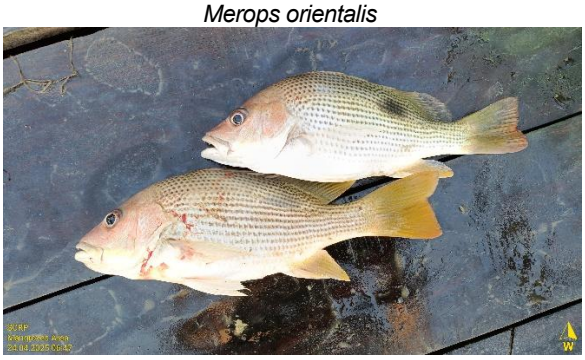
Aquila nipalensis



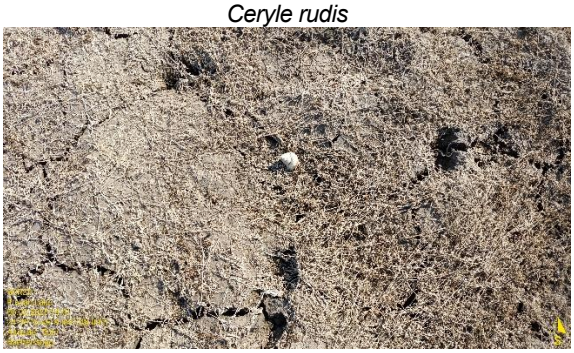
Centropus sinensis



Merops orientalis



Ceryle rudis



Pomadasys maculatus

Cerithidea cingulata

Figure IV-18 (top): Pictures of Faunal Survey

Table IV-20 (below): Observed Faunal Species During Survey

ref	Scientific Name	Common Name	IUCN Category
1	*Aquila nipalensis*	Steppe Eagle	Endangered
2	*Ceryle rudis*	Pied Kingfisher	Least Concern
3	*Merops orientalis*	Green Bee-eater	Least Concern
4	*Centropus sinensis*	Greater Coucal (Crow Pheasant)	Least Concern
5	*Scylla serrata*	Mangrove Crab (Mud Crab)	Data Deficient
6	*Terebralia palustris*	Mangrove Whelk	Not Evaluated
7	*Cerithidea cingulata*	Mud Creeper (Cerith Snail)	Not Evaluated
8	*Mugil cephalus*	Flathead Grey Mullet	Least Concern
9	*Oreochromis mossambicus* / *O. niloticus*	Tilapia	Vulnerable (VU)
10	*Channa punctata*	Spotted Snakehead	Least Concern
11	*Pomadasys maculatus*	Spotted Javelin (Blackspot Grunter)	Least Concern
12	*Arius* spp. (likely *A. gagora*)	Sea Catfish	Least Concern
13	*Periophthalmus* spp.	Mudskipper	Least Concern
14	*Penaeus indicus*	Jaira Shrimp	Least Concern

ref	Scientific Name	Common Name	IUCN Category
15	*Periophthalmus novemradiatus*	Indian Mudskipper	Data Deficient
16	*Cyprinus carpio*	Gulfam	Least Concern
17	*Cirrhinus mrigala*	Morakhi	Least Concern
18	*Labeo catla*	Theli	Least Concern
19	*Oreochromis niloticus*	Dayyo	Least Concern
20	*Pelecanus onocrotalus*	Great White Pelicans	Least Concern, Migratory

a. Avifauna

211. Several bird species were recorded during monitoring, indicating healthy wetland and drain corridor environments. The Pied Kingfisher (*Ceryle rudis*) was observed perching along drains, reflecting the presence of small fish and reasonable water quality. The Green Bee-eater (*Merops orientalis*) was commonly sighted near drain embankments, playing a role in insect population control. The Greater Coucal (*Centropus sinensis*) was recorded in shrubby areas along drain corridors.

212. Great White Pelicans (*Pelecanus onocrotalus*) are migratory and are often seen in the Indus Delta region during the winter months. Their presence in the monitored drain segment indicates the ecological importance of the drainage water bodies as stopover and feeding habitats for large waterfowl species. Great White Pelicans are currently listed as Least Concern on the IUCN Red List but are sensitive to habitat disturbance, pollution, and drainage modifications.

213. The avifaunal habitat was modified[46] as the observed fauna was recorded along the drains of the AoI.

214. The Steppe Eagle (*Aquila nipalensis*), an Endangered raptor listed on the IUCN Red List, is a significant winter migrant to the dry plains and coastal wetland fringes of Sindh, including the saline creeks and arid floodplains surrounding the Malkani Outfall Drain. These habitats, comprising open scrublands interspersed with *Tamarix spp*. and *Halocnemum spp.,* offer ideal foraging grounds for the eagle due to the availability of small mammals and carrion. Observations during field monitoring confirm its presence along the embankments and adjacent mudflats, indicating the ecological importance of these drainage corridors. To safeguard this species during drain rehabilitation works, all activities near known roosting or foraging areas should be carefully planned. Additionally, disturbance buffers of at least 50 meters should be maintained around active roosting sites, and use of heavy machinery should be minimized near sensitive zones. Awareness sessions for construction crews, coupled with environmental supervision during works, are essential to mitigate inadvertent disturbances to this globally threatened raptor.

b. Crustaceans and Mollusks

215. Species such as the Mangrove Crab (*Scylla serrata*), Mangrove Whelk (*Terebralia palustris*), and Mud Creeper (*Cerithidea cingulata*) were recorded in brackish water environments and mudflat areas near drainage outfalls. These species play an essential role in nutrient recycling and indicate functional estuarine and wetland systems near drainage channels.

[46] Modified Habitat, where the natural habitat has apparently been altered, often through the introduction of alien species of plants and animals, such as in agricultural areas (SPS 2009).

216. The crustaceans and mollusks habitat was natural[47] as the observed fauna was recorded near the drain outfalls connected to deltaic plains.

c. Fish

217. Multiple fish species were recorded, including the Flathead Grey Mullet (*Mugil cephalus*), Tilapia (*Oreochromis mossambicus* / *O. niloticus*), Spotted Snakehead (*Channa punctata*), Spotted Javelin (*Pomadasys maculatus*), and Sea Catfish (*Arius spp.*), which were found in the drains. Their presence confirms ecological productivity and the availability of aquatic resources in the drains. Additionally, mudskippers (*Periophthalmus spp*.) were observed on drains near outfalls which shows the intrusion of seawater, indicating healthy intertidal habitats within the drainage-linked landscape. Indian Mudskipper (Periophthalmus novemradiatus) is abundantly present along tidal mudflats and near outfalls of the drains. These fish were observed inside the drains comprising it as modified habitat.

218. Shrimps were reported to be caught by locals along Jati Drain and nearby creek system. Notably, the presence of shrimps (*Penaeus indicus*) and various mollusk communities suggests a productive estuarine environment where brackish conditions, resulting from the mixing of tidal seawater inflow and freshwater drainage from upstream agricultural areas, create an ideal habitat for these species. The freshwater contribution from the Jati Outfall Drain is particularly significant. The water typically exhibits low salinity due to drainage and low to moderate levels of biochemical oxygen demand (BOD), indicative of organic matter that is biodegradable and not heavily polluted. These characteristics support the growth of primary producers, such as phytoplankton and benthic algae, which form the base of the aquatic food web. As a result, the nutrient-rich yet not overly polluted water promotes favorable breeding and feeding conditions for shrimps and mollusks, key species in the estuarine trophic chain.

219. The Indus Delta is a significant area for shrimp fisheries in Pakistan, with various species inhabiting its mangrove creeks and coastal waters. Specifically, the Indus River Estuary (IRE) serves as a nursery for numerous shrimp species, including commercially important ones like *Penaeus spp., Metapenaeus spp., and Parapenaeopsis spp.*[48]

220. Critical habitat screening is essential for areas supporting species of high conservation value as well as species having aggregated abundance and ecological roles (e.g., spawning grounds, nursery habitats), especially in deltaic and estuarine ecosystems.

221.

D. Description of Social Environment

222. A district-wise social baseline is provided in the below sections[49].

[47] Natural Habitat. Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions. (SPS 2009).
[48] Babar, Syed & Shah, Syed & Mu, Yongtong & Pavase, Tushar & Abbas, Ghulam & Soomro, Maqsood & Kalhoro, Muhammad & Mohsin, Muhammad & Noman, Muhammad & Ali, Mumtaz & Abdul Malik, Dr. (2019). Current status of shrimp fishery in Pakistan: economic role, challenges, opportunities and strategies for aquaculture development. Indian Journal of Geo-Marine Sciences. 48. 1743-1754.
[49] Sindh District Profile-2021

1. District Thatta

a. Administration Background

223. District of Thatta's population is about 0.98 million which is almost 2.0% of Sindh's population of about 47.9 million. With 184,868 households, the average household size in the district of Thatta is 5.3 as per the Census of 2017 compared to average household size of 5.5 in Sindh. According to MICS 2018-19, mean household size of Thatta is 7.7 as compared to mean household size of 6.5 in Sindh. 82% of Thatta's population resides in rural areas and 18% resides in the urban areas.

224. Thatta's population comprises of 510,279 males and 469,504 females with 52% and 48% of the

225. district's population respectively. District of Thatta spans over an area of 7,705 sq. km which is 5.5% of Sindh's total area of 140,914 sq. km. The population density of the district is 127/sq. km.

226. District Thatta comprises of 4 talukas, namely: - Ghorabari, Keti Bunder, Mirpur Sakro, and Thatta. District Thatta has 4 Urban Centers, 55 Union Councils and 655 Revenue Villages.

Table IV-21: Population Distribution by gender and urban/Rural Census-2017





Population	Households
979,817	184,868
Rural	**Rural**
803,759	152,881
82.00%	83.00%
Urban	**Urban**
176,058	31,987
18.00%	17.00%

Population by Gender

	Total	Rural	Urban
Male	510,279	418,992	91,287
Female	469,504	384,754	84,750
Transgender	34	13	21

Source: PBS- Final Census Results 2017

b. Housing

227. Housing characteristics including household size, ownership status, roofing, walls and assets provide a holistic description of the overall well-being of the household. Description of household characteristics provide a snapshot for the government to improve target housing conditions as per district-wise deprivations.

228. In District Thatta, 88.4% of population owns houses while 11.7% don't own their houses (4.4% rented) compared to 77.7% of the population in Sindh province who own their houses. According to MICS 2018-19, the average number of persons per room in Thatta is 4.9 compared 4.1 persons

per room in Sindh. Similarly, the mean household size of District Thatta is 7.7 compared to mean household size of 6.5 in Sindh.

229. Only 39.8% of households in Thatta have Pacca roofing compared to 70.7% households in province that have Pacca roofing. Similarly, only 38.1% households in Thatta have Pacca walls compared to 70.7% households in the province that have Pacca walls.

Table IV-22: Ownership of Housing of district Thatta

Location	Own %	Rent %	Others/Missing %
Sindh	77.7	14.9	7.3
Thatta	88.4	4.4	7.3

Source: Sindh District Profile-2021

c. Utilities

230. Access to basic facilities like clean drinking water, toilets and sanitation services provide a holistic supply-side service provision coverage in a district.

231. In District Thatta, 82.0% of households have improved sources of drinking water compared to 96.0% households in Sindh having improved sources of drinking water. In terms of access to sanitation services, 24.4% of households in Thatta have access to improved sanitation services compared to 65.9% of households in Sindh with access to improved sanitation services. The prevalence of open defecation in Thatta is 58.4% compared to 24.0% in Sindh.

232. To ascertain whether environment-friendly practices are adopted at household level for cooking, heating and lighting, it is essential to gauge the prevalence of reliance on clean fuels. In District Thatta, only 21.6% of the households rely primarily on clean fuels for cooking compared to 50.2%of households relying on clean fuel for cooking in Sindh. Similarly, only 15.5% of households in District Thatta rely primarily on clean fuels for space heating compared to 30.2% of households in Sindh.

Table IV-23: Source of Drinking Water of district Thatta

Location	Basic Service %	Limited Service %	Unimproved %	Surface water %
Sindh	90.3	5.7	2.1	1.9
Thatta	72.8	9.1	2.4	15.8

Source: Sindh District Profile-2021

Table IV-24: Access to Sanitation district Thatta

Location	Basic Service %	Limited Service %	Unimproved %	Surface water %
Sindh	58.8	7.1	11.1	24
Thatta	20.6	3.8	17.1	58.4

Source: Sindh District Profile-2021

d. Health

233. District Thatta has a total of 8 Government, Departmental, Private and Local Bodies Hospitals with a capacity of 300 beds compared to 648 Hospitals in Sindh with a capacity of 30,126 beds. Thatta has a total of 22 Basic Health Units (BHUs) with a capacity of 44 beds compared to 800 BHUs in Sindh with a capacity of 1615 beds. Thatta has a total of 6 Rural Health Centers (RHCs) with a capacity of 80 beds compared to 133 RHCs in Sindh with a capacity of 1703 beds in Sindh.

234. Thatta has a total of 91 Dispensaries with a capacity of 10 beds compared to 2,996 Dispensaries with a capacity of 715 beds in Sindh. District Thatta has a total of 8 TB Clinics with no beds

compared to 228 TB Clinics with total capacity of 42 beds in Sindh. Thatta has 6 Mother and Child Health Centers (MCHCs) with a total of 4 beds compared to 227 MCHCs with a total of 181 beds. Similarly, Thatta has 1 Maternity Home out of 42 Maternity Homes in the province.

Table IV-25: Health care facilities in Thatta

Health facility name	Medical Centers	Beds
Basic Health Units (BHUs)	22	44
Rural Health Centres (RHCs)	6	80
Dispensaries	91	10
Government	10	0
Semi Government	3	0
Local Bodies	50	0
Private	28	10
TB Clinics	8	0
Government	8	0
Private	0	0
Mother and Child Health Centres (MCHC)	6	4
Government	0	0
Semi Government	1	4
Local Bodies	0	0
Private	5	0
Maternity Homes (Government)	1	NA

Source: Sindh District Profile-2021

235. Number of indoor patients served in District Thatta are 28,923 out of 744,618 indoor patients in the province. Similarly, number of outdoor patients served in District Thatta are 1,111,130 out of 43,718,506 outdoor patients in Sindh

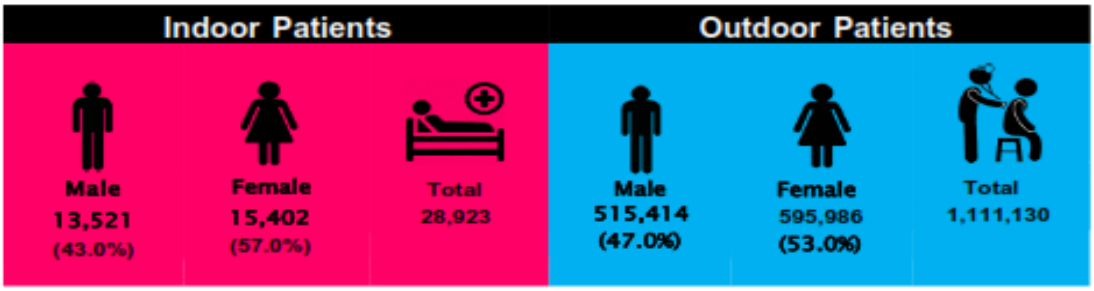


Figure IV-19: Patients Record of district Thatta (Source: Sindh District Profile-2021)

236. The patients per bed in District Thatta are 3,799 compared to 1,455 patients per bed in Sindh. The patients per doctor in Thatta are 5,859 compared to 3,159 patients per doctor in Sindh. Patients per nurse in Thatta are 52,000 compared to 12,411 patients per nurse in Sindh. Total Number of Government Medical, Nursing and Para-Medical Staff is 508 in District Thatta out of 18,429 Government Staff in Sindh. The total number of Semi-Government Medical, Nursing and Para-Medical Staff is 11 out of 2,985 Semi-Government Staff in Sindh. The total number of Local Bodies and Private Medical, Nursing and Para-Medical Staff is 158.



Figure IV-20: Population served by Doctor/Nurse of district Thatta (Source: Sindh District Profile-2021)

e. Education

237. District of Thatta has a total of 1,607 schools out of a total of 49,103 schools in the province of Sindh. Out of 1,607 schools, there are 552 schools for boys,182 schools for girls, and 873 mixed schools.

Table IV-26: Numbers of Government Schools in district Thatta

Location	Total	Boys	Girls	Mixed
Sindh	49,103	8,617	6,685	33,801
Thatta	1,607	552	182	873

Source: Sindh District Profile-2021

238. 1,607 schools in District Thatta have a total enrollment of 78,434 with 50,854 boys (64.8%) and 27,580 girls (35.2%). There are 1,727 male teachers and 663 female teachers in the schools in Thatta. Total number of rooms in 1,607 school s in Thatta amount to 3,476 out of which 2,501 are classrooms. There are 908 functional schools in Thatta while 699 schools are dysfunctional, non-functional, non-viable or closed.

Table IV-27: Enrollments of Students in district Thatta

Location	Boys	Girls
Sindh	2,812,000	1,749,140
Thatta	50,854	27,580

Source: Sindh District Profile-2021

239. Male literacy rate (15-49 years) in Thatta is 26.5% compared to 59.0% in Sindh while the female literacy rate is 14.3% compared to 40.9% in Sindh.

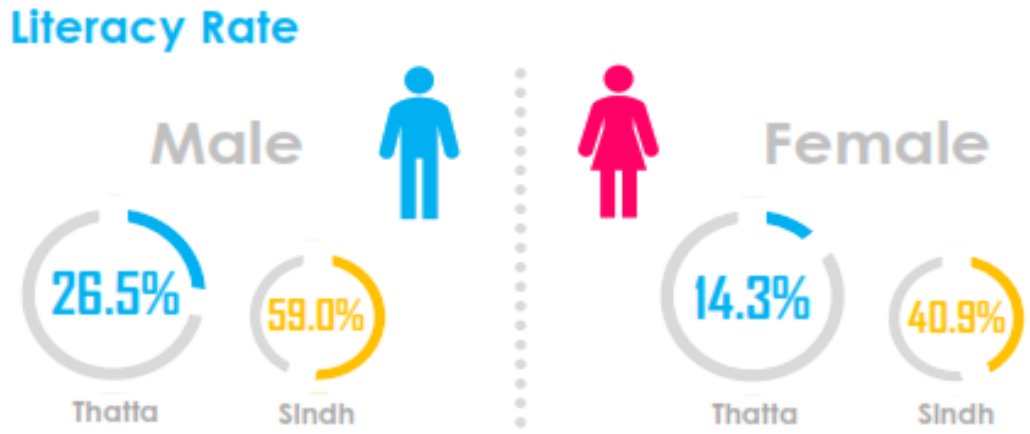


Figure IV-21: Male and Female literacy rate of district Thatta

f. MPI (Multi-Dimensional Poverty Index)

240. Multi-Dimensional Poverty Index measures the number of people/households that are 'multidimensionally' poor. Essentially, it means the number of people (or HHs) deprived in at least one third of the weighted indicators (H) along with the weighted average number of deprivations poor people experience at the same time (A). The weighted indicators are along three broad dimensions: -Education, -Health, and -Living Standards

241. In District Thatta, the MPI value is 0.60 which is higher than the average MPI Value of 0.25 in Sindh,

Table IV-28: MPI Head Count of district Thatta

Location	M-Poverty Headcount 2018 (H)	MPI 2018	% Vulnerable to Poverty	% In Severe Poverty
Sindh	0.47	0.25	12.5	28.3
Thatta	0.86	0.60	4.00	69.00

g. Economic Profile

Agriculture

242. Out of the area under cultivation for major crops, District Thatta contributes to 155,194 hectares(5.1%) out of 3,028,496 hectares in Sindh. In terms of highest proportions of area under cultivation for major crops, rice and sugarcane are at the forefront in Thatta with 88,034 hectares and 36,369 hectares under cultivation in the district. Similarly, the production of rice in Thatta is 238,946 M. Tons and production of sugarcane is 2,156,914 M. Tons. Irrigated Area in District Thatta is 146,223 hectares and Un-Irrigated area is 16,999 hectares.

Canals

243. are the mode of irrigation for 139,622 hectares in District Thatta out of 1,287,845 hectares irrigated by Canals in Sindh. Tube-wells are the mode of irrigation for 6,601 hectares in Thatta out of 361,199 hectares irrigated by Tube-wells in Sindh. Area sown in Thatta is 163,222 hectares out of 2,645,545 hectares of area sown in Sindh (both irrigated and un-irrigated).

Table IV-29: Crop Production of district Thatta

Crops	Area (Hectarage)	Share in Acreage (%)	Productions (M.Tons)	Share in Production (%)
Bajra	57	0.0	40	0.0
Barley	2,033	30.0	1,105	28.0
Cotton (in bales)	6,223	1.0	32,103	1.0
Gram	0	0.0	0	0.0
Jawar	117	1.0	99	1
Maize	1,060	29.0	1,069	29
Mustard	3,233	7.0	2,780	5
Rice	88,034	11.0	238,946	8
Sesamum	0	0.0	0	0.0
Sugarcane	36,369	11.0	2,156,914	10
Tobacco	0	0.0	0	0.0
Wheat	18,068	2.0	58,935	2

Livestock & Fisheries

244. The livestock head-count in District Thatta is 2,297,937 out of the total livestock count of 46,279,313 in Sindh (4.9%). District Thatta has 410,614 cattle, 367,117 buffaloes, 162,131 sheep, 351,366 goats, and 973,268 poultry. Fish production in Thatta is 8,670 M. Tons out of 133,150 M. Tons in Sindh (6.5%). Thatta has a total of 6,922 fishermen out of 45,013 in Sindh (15.4%). Similarly, Thatta has 1,031 boats out of 7,215 boats in Sindh.

Table IV-30: Livestock Count of Thatta

Livestock	Sindh	Thatta	Share of Thatta (%)

Cattle	6,925,022	410,614	5.9
Buffaloes	7,341,162	367,117	5.0
Sheep	3,958,508	162,131	4.0
Goats	12,572,221	351,366	2.7
Camels	278,424	10,702	3.8
Horses	44,999	3,036	6.7
Mules	19,512	566	2.9
Asses	1,004,925	19,137	1.9
Poultry	14,135,540	973,268	6.8

2. District Sujawal

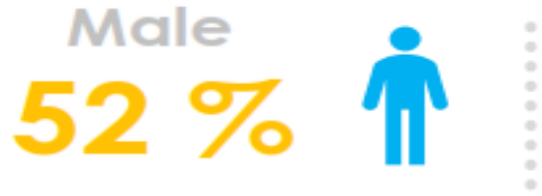
a. Administration Background

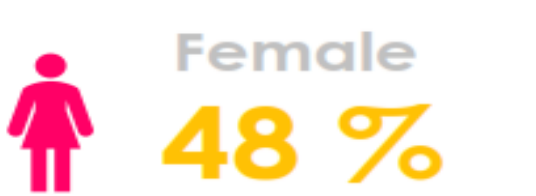
245. District of Sujawal's population is about 0.78 million which is almost 1.6% of Sindh's population of about 47.9 million. With 153,018 households, the average household size in the district of Sujawal is 5.1 as per the Census of 2017 compared to average household size of 5.58 in Sindh. According to MICS 2018-19, mean household size of Sujawal is 7.1 as compared to mean household size of 6.5 in Sindh. 89.0% of Sujawal's population resides in rural areas and 11.0% resides in the urban areas.

246. Sujawal's population comprises of 406,754 males and 375,193 females with 52% and 48% of the district's population respectively. District of Sujawal spans over an area of 7,335 sq. km which is 5.2% of Sindh's total area of 140,914 sq. km. The population density of the district is 110/sq. km. District Sujawal comprises of 5 talukas, namely: - Jati, Kharochan, Mirpur Bhatoro, Shah Bunder and Sujawal.

247. District Sujawal has 4 Urban Centers, 37 Union Councils and 388 Revenue Villages.

Table IV-31: Population Distribution by gender and urban/Rural Sujawal





Population	Households
781,967	153,018
Rural	**Rural**
696,262	136,397
89.00%	89.00%
Urban	**Urban**
85,705	16,621
11.00%	11.00%

Population by Gender

	Total	Rural	Urban
Male	406,754	362,585	44,169
Female	375,193	333,675	41,518
Transgender	20	2	18

Source: PBS- Final Census Results 2017

b. Housing

248. Housing characteristics including household size, ownership status, roofing, walls and assets provide a holistic description of the overall well-being of the household. Description of household characteristics provide a snapshot for the government to improve target housing conditions as per district-wise deprivations.

249. Housing characteristics including household size, ownership status, roofing, walls and assets provide a holistic description of the overall well-being of the household. Description of household characteristics provide a snapshot for the government to improve target housing conditions as per district-wise deprivations.

250. Only 20.6% of households in Sujawal have Pacca roofing compared to 70.7% households in province that have Pacca roofing. Similarly, only 19.2% households in Sujawal have Pacca walls compared to 70.7% households in the province that have Pacca walls.

Table IV-32: Ownership of Housing of district Sujawal

Location	Own %	Rent %	Others/Missing %
Sindh	77.7	14.9	7.3
Sujawal	92.9	2.2	14.8

Source: Sindh District Profile-2021

c. Utilities

251. Access to basic facilities like clean drinking water, toilets and sanitation services provide a holistic supply side service provision coverage in a district.

252. In District Sujawal, 82.3% of households have improved sources of drinking water compared to 96.0% households in Sindh having improved sources of drinking water. In terms of access to sanitation services,17.0% of households in Sujawal have access to improved sanitation services compared to 65.9% of households in Sindh with access to improved sanitation services. The prevalence of open defecation in Sujawal is 82.4% compared to 24.0% in Sindh.

253. To ascertain whether environment-friendly practices are adopted at household level for cooking, heating and lighting, it is essential to gauge the prevalence of reliance on clean fuels. In District Sujawal, only 9.8% of the households rely primarily on clean fuels for cooking compared to 50.2% of households relying on clean fuel for cooking in Sindh. Similarly, only 9.3% of households in District Sujawal rely primarily on clean fuels for space heating compared to 30.2% of households in Sindh.

Table IV-33: Source of Drinking Water of district Sujawal

Location	Basic Service %	Limited Service %	Unimproved %	Surface water %
Sindh	90.3	5.7	2.1	1.9
Sujawal	72.3	10.0	0.8	16.8

Source: Sindh District Profile-2021

Table IV-34: Access to Sanitation district Sujawal

Location	Basic Service %	Limited Service %	Unimproved %	Surface water %
Sindh	58.8	7.1	11.1	24
Sujawal	18.5	6.2	8.7	66.6

Source: Sindh District Profile-2021

d. Health

254. District Sujawal has a total of 7 Government, Departmental, Private and Local Bodies Hospitals with a capacity of 188 beds compared to 648 Hospitals in Sindh with a capacity of 30,126 beds. Sujawal has a total of 29 Basic Health Units (BHUs) with a capacity of 58 beds compared to 800 BHUs in Sindh with a capacity of 1615 beds. Sujawal has a total of 2 Rural Health Centers (RHCs) with a capacity of 30 beds compared to 133 RHCs in Sindh with a capacity of 1703 beds in Sindh.

255. Sujawal has a total of 76 Dispensaries with a capacity of 10 beds compared to 2996 Dispensaries with a capacity of 715 beds in Sindh. District Sujawal has a total of 6 TB Clinics with no beds compared to 228 TB Clinics with total capacity of 42 beds in Sindh. Sujawal has 2 Mother and Child Health Centers (MCHCs) with no beds compared to 227 MCHCs with a total of 181 beds.

Table IV-35: Government and Private Health Facilities in Sujawal

Health facility name	Medical Centers	Beds
Basic Health Units (BHUs)	29	58
Rural Health Centres (RHCs)	2	30
Dispensaries	76	10
Government	20	0
Semi Government	0	0
Local Bodies	35	0
Private	21	10
TB Clinics	6	0
Government	6	0
Private	0	0
Mother and Child Health Centres (MCHC)	2	0
Government	0	0
Semi Government	0	0
Local Bodies	0	0
Private	2	0
Maternity Homes (Government)	0	0

Source: Sindh District Profile-2021

256. Number of indoor patients served in District Sujawal are 31,592 out of 744,618 indoor patients in the province. Similarly, number of outdoor patients served in District Sujawal are 1,017,366 out of 43,718,506 outdoor patients in Sindh.

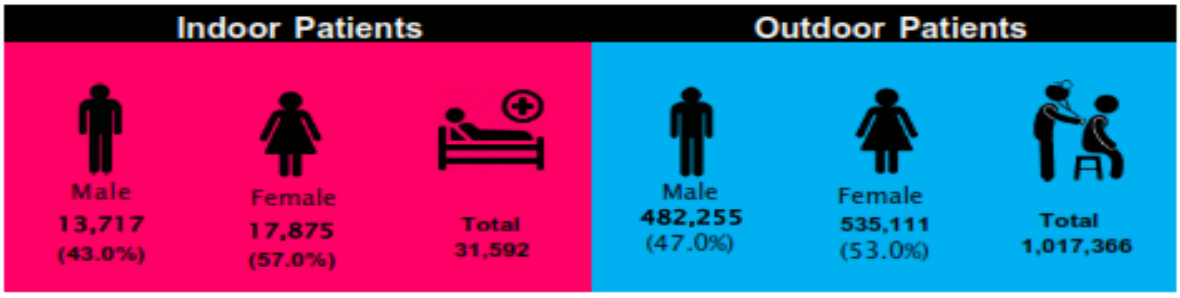


Figure IV-22: Patients Record of district Sujawal (Source: Sindh District Profile-2021)

257. The patients per bed in District Sujawal are 2,689 compared to 1,455 patients per bed in Sindh. The patients per doctor in Sujawal are 3,511 compared to 3,159 patients per doctor in Sindh. Patients per nurse in Sujawal are 40,474 compared to 12,411 patients per nurse in Sindh. Total Number of Government Medical, Nursing and Para-Medical Staff is 376 in District Sujawal out of 18,429 Government Staff in Sindh.

258. The total number of Semi-Government Medical, Nursing and Para-Medical Staff is 14 out of 2,985 Semi Government Staff in Sindh. The total number of Local Bodies Medical, Nursing and Para-Medical Staff is 49 and 61 for Private Medical Facilities.



Figure IV-23: Population served by Doctor/Nurse of district Sujawal (Source: Sindh District Profile-2021)

e. Education

259. District of Sujawal has a total of 1,829 schools out of a total of 49,103 schools in the province of Sindh. Out of 1,829 schools, there are 508 schools for boys, 195 schools for girls, and 1,126 mixed schools.

Table IV-36: Numbers of Government Schools in district Sujawal

Location	Total	Boys	Girls	Mixed
Sindh	49,103	8,617	6,685	33,801
Sujawal	1,829	508	195	1,126

Source: Sindh District Profile-2021

260. 1,829 schools in District Sujawal have a total enrollment of 68,861 with 46,726 boys (67.8%) and 22,135 girls (32.2%). There are 1,551 male teachers (85.2%) and 269 female teachers (14.8%) in the schools in Sujawal. Total number of rooms in 1,829 schools in Sujawal amount to 2,702 out of which 2,183 are classrooms. There are 964 functional schools in Sujawal while 865 schools are dysfunctional, non-functional, non-viable or closed.

Table IV-37: Enrollments of Students in District Sujawal

Location	Boys	Girls
Sindh	2,812,000	1,749,140
Sujawal	44,726	22,135

Source: Sindh District Profile-2021

261. Male literacy rate (15-49 years) in Sujawal is 28.0% compared to 59% in Sindh while the female literacy rate is 10.1% compared to 40.9% in Sindh.



Figure IV-24: Male and Female literacy rate of district Sujawal

f. MPI (Multi-Dimensional Poverty Index)

262. Multi-Dimensional Poverty Index measures the number of people/households that are 'multidimensionally' poor. Essentially, it means the number of people (or HHs) deprived in at least one third of the weighted indicators (H) along with the weighted average number of deprivations poor people experience at the same time (A). The weighted indicators are along three broad dimensions: -Education, -Health, and -Living Standards.

263. In District Sujawal, the MPI value is 0.5 which is higher than the average MPI Value of 0.25 in Sindh.

Table IV-38: MPI Head Count of district Sujawal

Location	M-Poverty Headcount 2018 (H)	MPI 2018	% Vulnerable to Poverty	% In Severe Poverty
Sindh	0.47	0.25	12.5	28.3
Sujawal	0.85	0.50	5.80	72.50

E. The Microenvironment

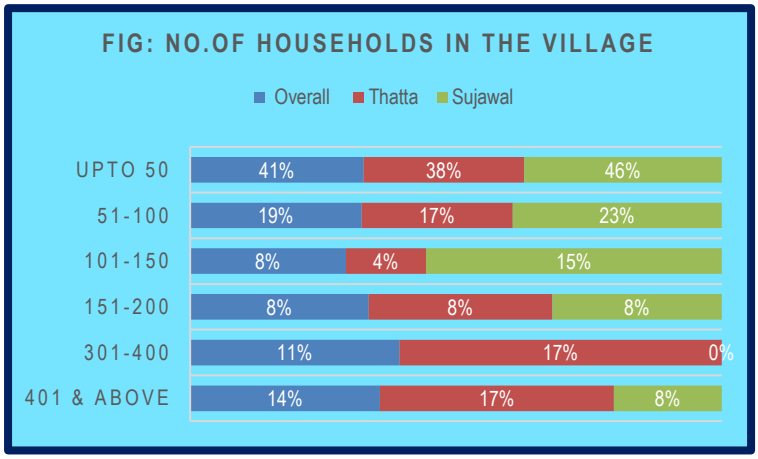
264. A socio-economic profile has been developed for the local community using focused group discussions (FGDs) questionnaire. The questionnaire is attached in **Annex IV**. Set of semi-structured questions were asked. A total of 37 Male FGDs and 30 Female FGDs were undertaken with the local community which resides along the subprojects. Three towns namely Buhara, Ver and Pir Patho as well as 35 villages located along the drains and proposed plantation sites were visited during social survey.

265. Following is the summary of socio-economic data separated for male and female FGDs.

F. Male FGD social data

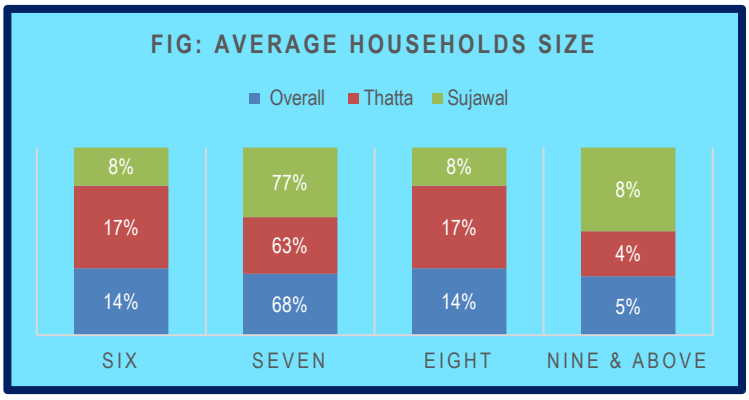
1. Number of Households in the Village

266. Smaller villages of up to 50 households, dominate in Sujawal (46%) and Thatta (38%), with 41% overall. Thatta has a slightly higher proportion of mid-sized villages (301-400 households) compared to Sujawal, where no villages fall into this category. Larger villages (401+ households) are more common in Thatta (17%) than in Sujawal (8%), indicating population concentration differences. This indicates that Sujawal has a more evenly distributed household size range, whereas Thatta has a greater proportion of villages in mid-to-large categories.



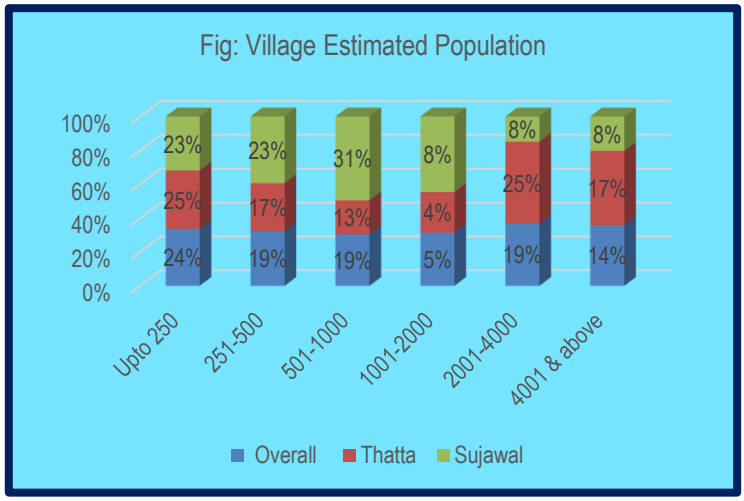
2. Average Household Size in the Area

267. Most households (68% overall) have 7 members, with Sujawal reporting a higher proportion (77%) than Thatta (63%). Larger households (9 or more members) are less common (5% overall), with Sujawal having a slightly higher percentage (8%) compared to Thatta (4%). Smaller households (6 members) are more prevalent in Thatta (17%) compared to Sujawal (8%).



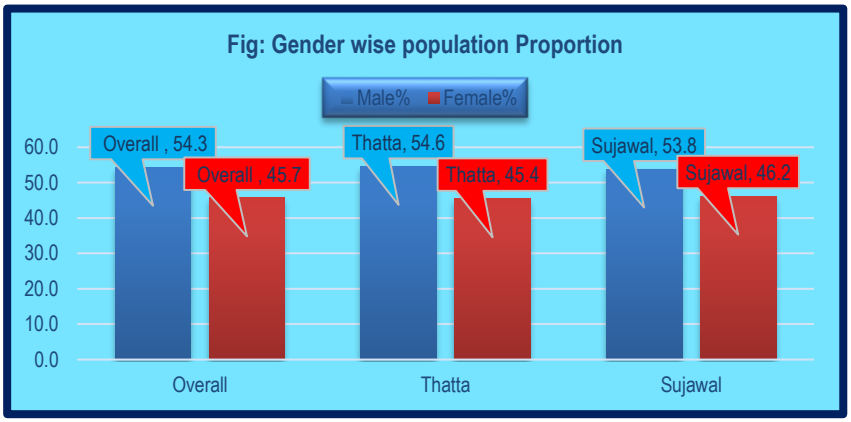
3. Village Estimated Population

268. Most villages (24%) have a small population (up to 250 people), indicating scattered rural settlements. Sujawal has a higher proportion (31%) of villages with populations between 501-1000, compared to Thatta (13%). Thatta has a greater concentration of larger villages (2001-4000 people: 25% and 4001 and above: 17%) compared to Sujawal (8% in both categories). Larger villages (1001+ people) make up a smaller proportion of the total settlements, indicating rural communities are generally low-density.



4. Gender-Wise Population Proportion

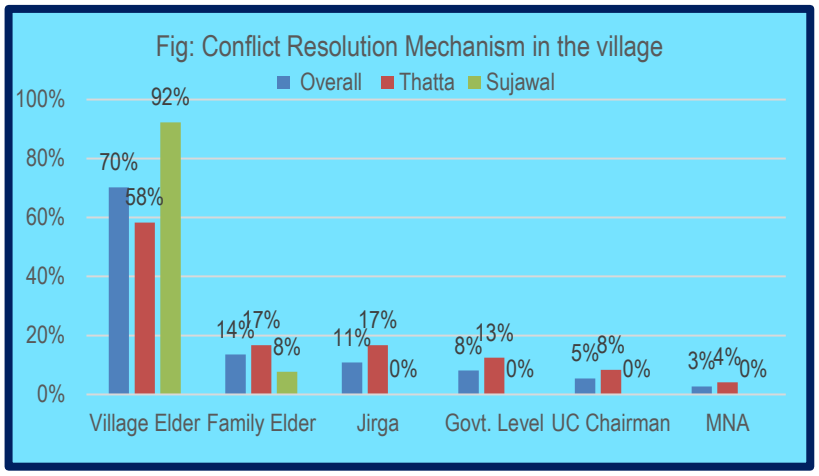
269. Males constitute a higher proportion of the population in all areas, averaging 54% across the surveyed regions. Thatta has the highest male population share (54.6%), while Sujawal has the lowest (53.8%).



270. The female population is slightly higher in Sujawal (46.2%) compared to Thatta (45.4%), but the difference remains marginal. The overall gender ratio shows a slight male dominance, which may reflect demographic trends such as male-dominated labor migration or higher male birth rates.

5. Conflict Resolution Mechanism in the Village

271. Village elders play the most significant role in conflict resolution, with 92% reliance in Sujawal and 58% in Thatta. Family elders contribute slightly in Thatta (17%) but less in Sujawal (8%).

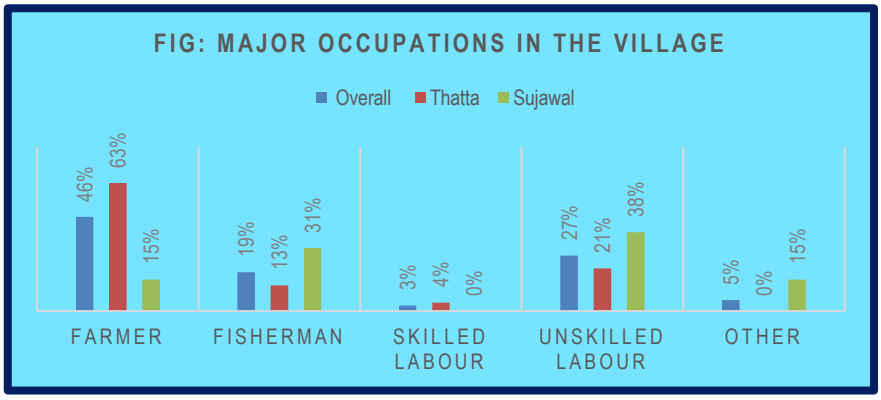


272. Jirga is only reported in Thatta (17%) and is absent in Sujawal, indicating regional differences in traditional dispute resolution. Government-level mechanisms (including UC Chairman and MNA) have minimal involvement, suggesting a reliance on local informal systems.

273. Thus, it can be inferred that Sujawal shows a strong preference for village elders (92%), while Thatta demonstrates more diversity in conflict resolution methods.

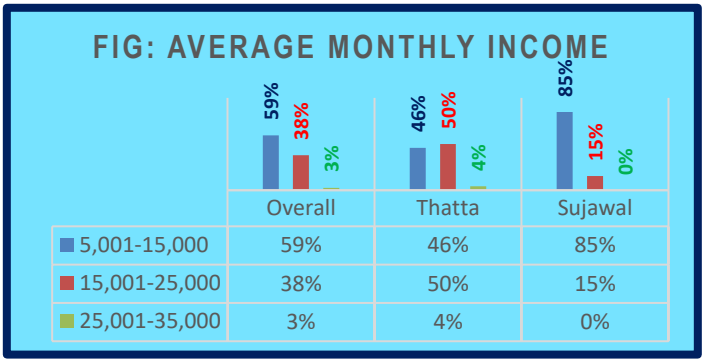
6. Major Occupations in the Village

274. Farming is the dominant occupation overall (46%) and particularly high in Thatta (63%), while in Sujawal, only 15% of respondents are engaged in farming. Fishing is more common in Sujawal (31%) compared to Thatta (13%), likely due to geographical differences. Unskilled labor is the second-largest occupation, with Sujawal having the highest percentage (38%), while skilled labor remains extremely low (3% overall), with no reported skilled workers in Sujawal. A small percentage (5%) of respondents are engaged in "Other" occupations, with a higher presence in Sujawal.



7. Average Monthly Income in the Area

275. Low-income households dominate across all regions, with 59% of respondents earning between 5,001 – 15,000 PKR. Sujawal has the highest percentage (85%) of households in the lowest income bracket, indicating significant economic vulnerability.

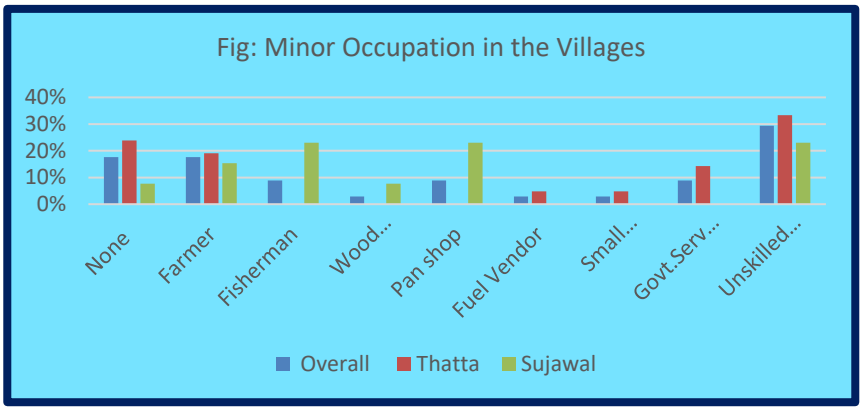


276. Thatta has a relatively better income distribution, with 50% of

respondents earning 15,001 – 25,000 PKR. Higher-income households (earning 25,001 – 35,000 PKR) are minimal, with only 3-4% of respondents in this bracket and none in Sujawal.

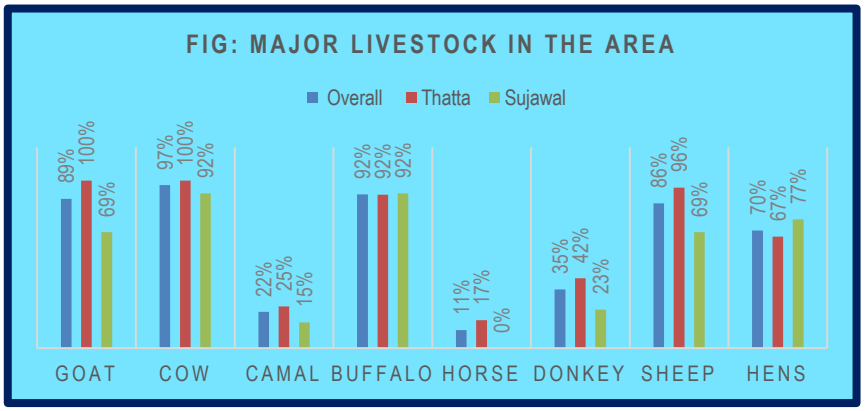
8. Minor Occupations in the Villages

277. Unskilled labor is the most common minor occupation (30% overall), with Thatta having the highest proportion (33%). A significant number of respondents (~15%) reported no minor occupation, with Thatta having the highest percentage (22%). Wood cutting is notably higher in Sujawal (8%) compared to Thatta (0%), suggesting higher dependence on natural resources. Government employment remains low (9% overall), but Thatta has slightly more representation (14%) compared to Sujawal (0%). Small business ownership is minimal across both districts, with only 3-5% engaged in entrepreneurial activities.



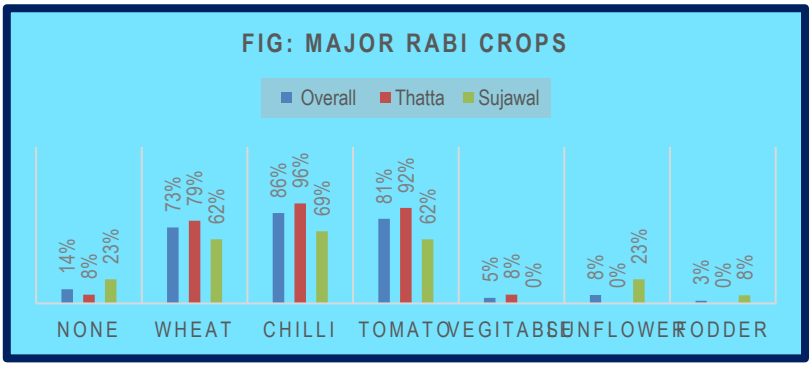
9. Major Livestock in the Area

278. Goats and cows are the most commonly owned livestock, with Thatta reporting 100% ownership in both categories. Buffaloes are widely present (92%) across all both districts, showing uniform livestock distribution. Camels and horses are less commonly owned, with Sujawal having no reported horse ownership. Ownership of donkeys is more prevalent in Thatta (42%) than Sujawal (23%), likely due to their role in transportation. Sheep ownership is significantly higher in Thatta (99%) compared to Sujawal (69%). Hen ownership is relatively high, with Thatta (87%) having the most, followed by Sujawal (77%).



10. Major Rabi Crops in the Area

279. Wheat is the dominant Rabi crop (73% overall), with higher cultivation in Thatta (79%) than Sujawal (62%). Chili is the most widely grown crop (86% overall), with Thatta (90%) having the highest cultivation. Tomato farming is more prevalent in Thatta



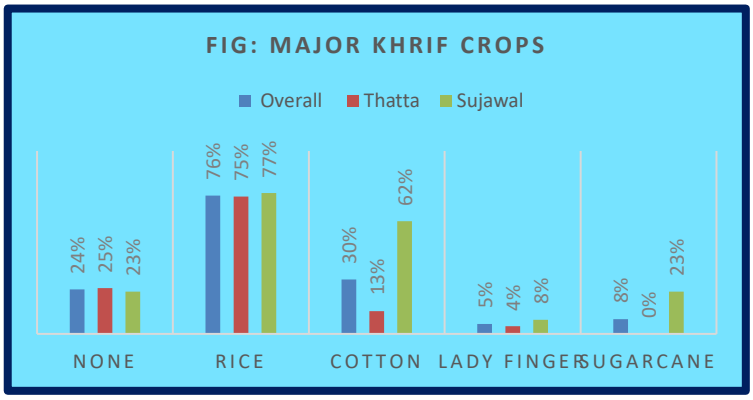
(92%) compared to Sujawal (62%).

280. Sunflower is only cultivated in Sujawal (23%) and is absent in Thatta. Vegetable and fodder cultivation are very low, with no recorded sunflower or vegetable farming in Thatta.

281. A significant proportion of farmers (14% overall) do not cultivate any Rabi crops, with the highest percentage in Sujawal (23%), indicating possible resource constraints.

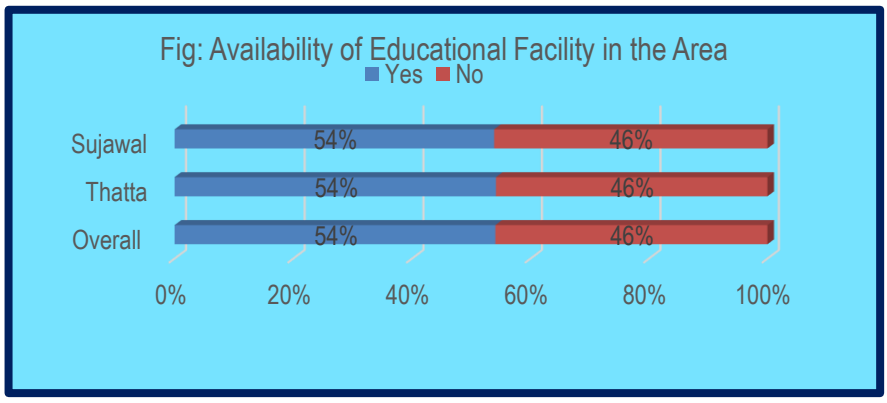
11. Major Kharif Crops in the Area

282. Rice is the dominant Kharif crop, cultivated by 76% of farmers overall, with slightly higher cultivation in Sujawal (77%) than Thatta (75%). Cotton cultivation is significantly higher in Sujawal (62%) compared to Thatta (13%), indicating a regional preference for this cash crop. A notable portion of respondents (24%) do not cultivate any Kharif crops, suggesting potential issues related to water availability, land access, or economic constraints. Sugarcane is only cultivated in Sujawal (23%), with no reported cultivation in Thatta. Lady Finger (Okra) is grown on a very small scale (5% overall), with slightly higher cultivation in Sujawal (8%).



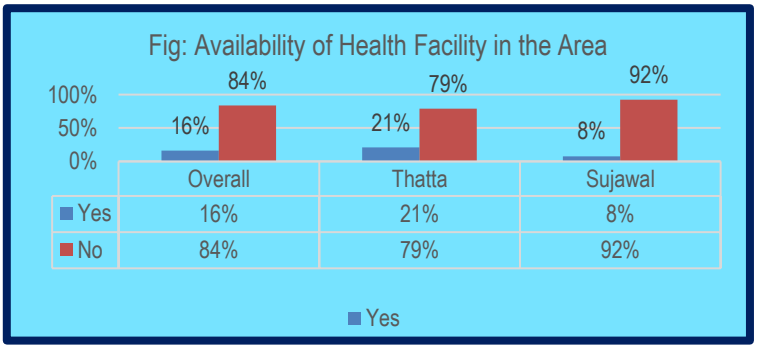
12. Educational Facility Availability

283. The results show that 54% of male respondents reported having access to educational facilities, while 46% stated that no such facilities exist in their area. This indicates that nearly half of the population lacks access to formal education, which can significantly impact literacy levels and socio-economic opportunities. The fact that both Thatta and Sujawal report the same figures suggests that educational access issues are widespread and not confined to a specific district. This highlights an urgent need for expanding educational infrastructure, particularly in underserved areas, to bridge the gap in educational access.



13. Health Facility Availability in the Area

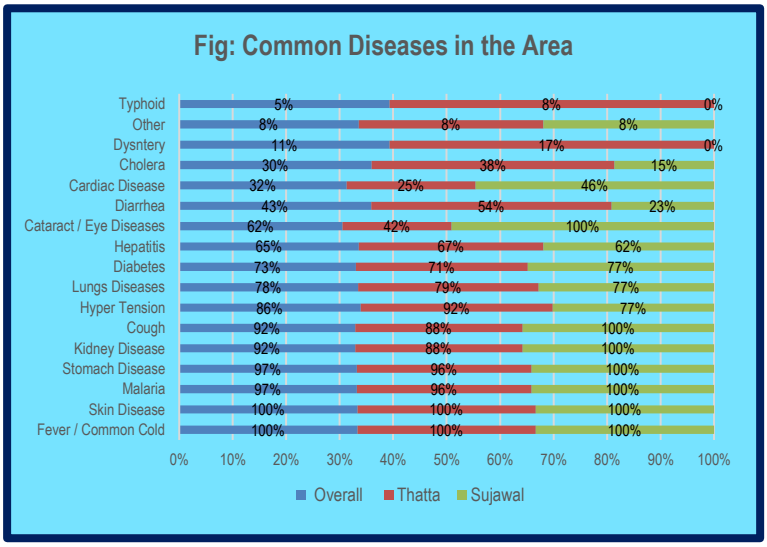
284. The results show that only 16% of respondents overall have access to healthcare facilities, while 84% report no such access. Thatta has the highest



availability (21%), while Sujawal is the most underserved (92% No access), highlighting severe gaps in healthcare infrastructure. The findings emphasize an urgent need for improving healthcare access, especially in Sujawal, where almost no respondents report availability.

14. Common Diseases in the Area

285. Fever, skin diseases, malaria, and stomach diseases are the most commonly reported illnesses, affecting 97-100% of respondents across all regions. The prevalence of Malaria (97-100%) and diarrhea (43-54%) indicate serious water sanitation challenges, thus suggesting a significant burden of infectious diseases and sanitation-related health concerns.

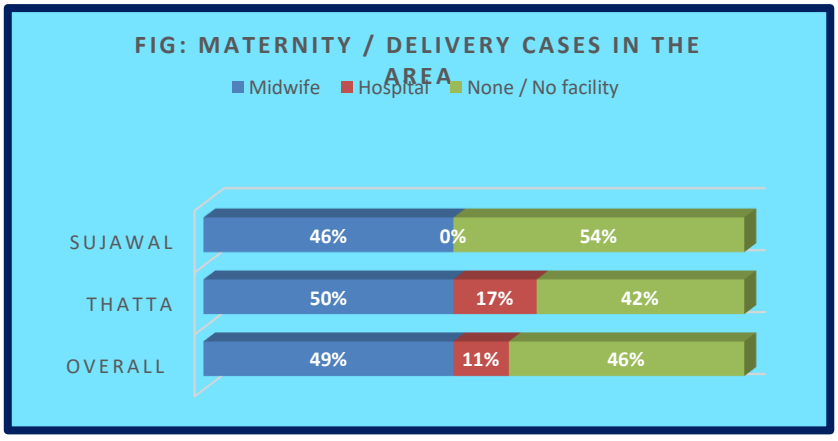


286. Chronic conditions such as lung diseases, diabetes, and hepatitis affect a significant portion (65-78%) of the population. Cataract and eye diseases are particularly severe in Sujawal (100%) compared to Thatta (42%).

287. Cholera and cardiac diseases are reported in a lower proportion, with Thatta showing slightly higher prevalence rates compared to Sujawal. Typhoid and dysentery are the least reported illnesses.

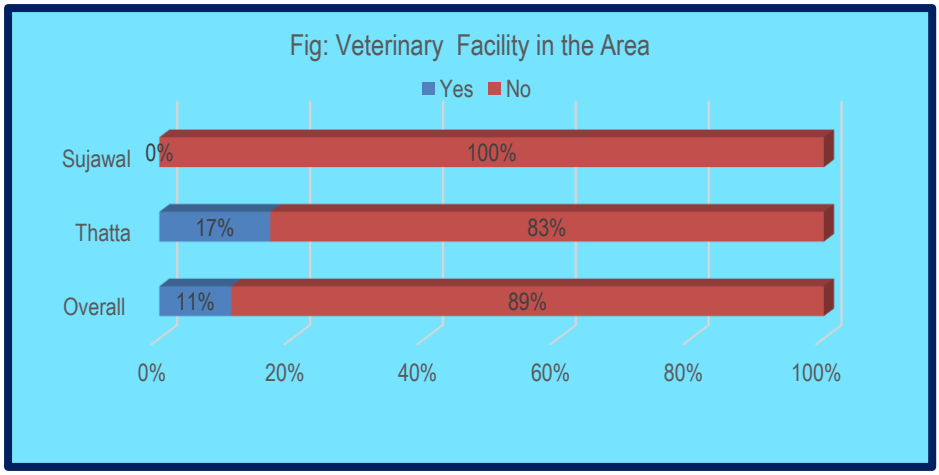
15. Maternity / Delivery Cases in the Area

288. There is a high rate of unattended births, with 54% respondents from Sujawal and 46% overall reporting lack of formal maternal healthcare access. This increases the risk of maternal and infant mortality. Only 11% of deliveries overall take place in hospitals, with Sujawal having no reported hospital deliveries. Midwives are serving as primary care providers, who assist in nearly 50% of deliveries, playing a crucial role in maternal health.



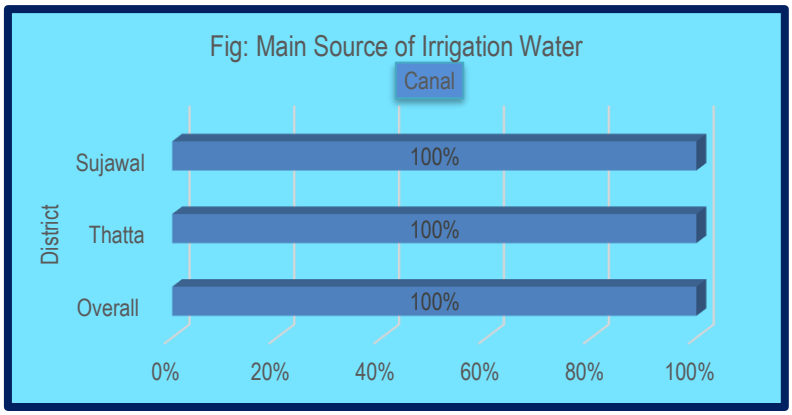
16. Veterinary Facility Availability in the Area

289. There is a severe lack of veterinary services, with a majority (89%) of respondents reporting lack of access to veterinary care, severely impacting livestock health and productivity. Critical shortage has been reported in Sujawal, with 100% of respondents reporting no facilities, livestock owners in Sujawal are particularly vulnerable. The access in Thatta though slightly better than Sujawal, still faces significant gaps, with only 17% having access to veterinary services.



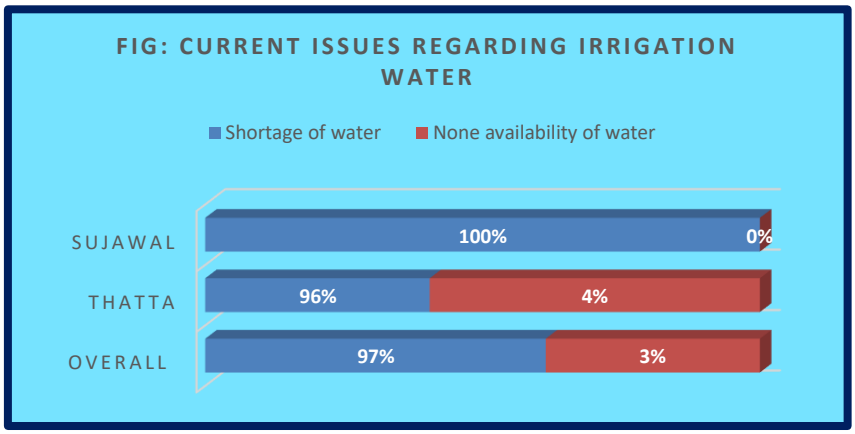
17. Main Source of Irrigation Water

290. Complete dependence on canal water means any disruption in the canal system—such as seasonal water shortages, siltation, or poor maintenance—can severely impact agriculture. Additionally, no backup irrigation sources indicate high vulnerability to climate change impacts, particularly droughts and water mismanagement, and highlights the need for sustainable water management practices.



18. Current Issues Regarding Irrigation Water

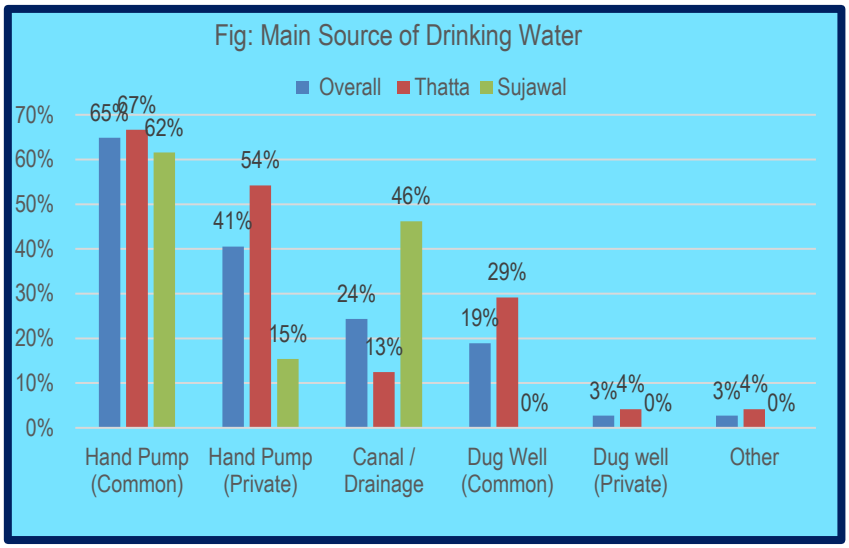
291. Water shortage is a widespread issue, affecting nearly all respondents (97% overall). Sujawal faces a universal challenge, with 100% of respondents reporting water shortages, but no cases of complete non-availability, whereas Thatta experiences a slightly more severe issue, with 4% reporting complete non-availability of water.



292. These findings highlight the dependence on unreliable irrigation systems, particularly due to canal water scarcity, as seen in the previous graph.

19. Main Sources of Drinking Water in the Area

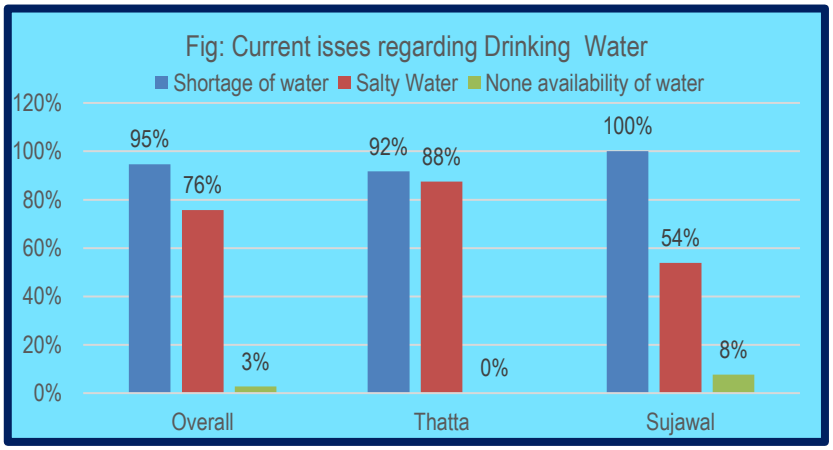
293. Hand pumps (both common and private) are the dominant drinking water sources, with Thatta showing a higher reliance on private hand pumps (54%) compared to Sujawal (15%). Dug wells are used more frequently in Thatta (29% for common wells, 4% for private wells), while Sujawal reports no use of wells.



294. A significant proportion of Sujawal's population (46%) relies on canal/drainage water, which poses serious health risks due to potential contamination. Alternative water sources are minimal, with very few respondents (3-4%) reporting reliance on other sources.

20. Current Issues Regarding Drinking Water

295. Similar to the irrigation water, shortages of drinking water also are a widespread issue across all areas, with Sujawal being the most affected (100%). Salinity is a major concern, particularly in Thatta (88%) and overall (76%), indicating deteriorating water quality.

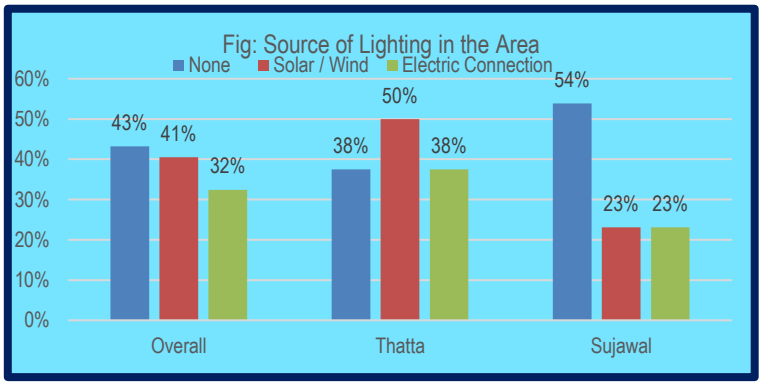


296. Non-availability of drinking water is reported in Sujawal (8%) and overall (3%), highlighting extreme cases of water deprivation. On the other hand, Thatta has a higher percentage of salty water complaints.

297. These findings reinforce the need for urgent water management and quality improvement initiatives.

21. Lighting Sources in the Area

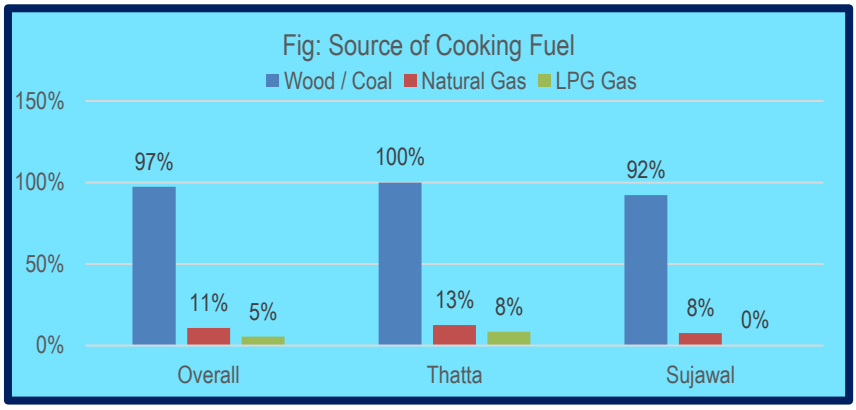
298. Overall, only 32% of households have an electric connection with the lowest access in Sujawal (23%), highlighting poor electricity access across the region, resulting in 43% of household's



overall lack lighting, with Sujawal (54%) being the most affected. Solar/wind energy usage is relatively high in Thatta (50%) but much lower in Sujawal (23%). This suggests unequal access to renewable energy solutions.

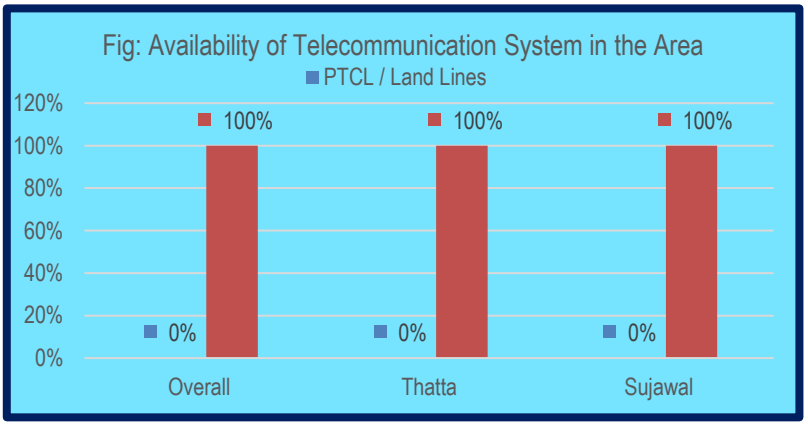
22. Cooking Fuel Sources in the Area

299. There is a heavy dependence on traditional fuels, with over 90% of respondents relying on wood/coal, indicating continued use of biomass for cooking. Respondents have also reported limited access to modern fuels, such as LPG usage is negligible (0-8%), and natural gas availability is also low (8-13%), highlighting the lack of modern cooking fuel infrastructure. Sujawal has the lowest access to alternative fuels (only 8% use natural gas, 0% use LPG), making it the most energy-deprived region.



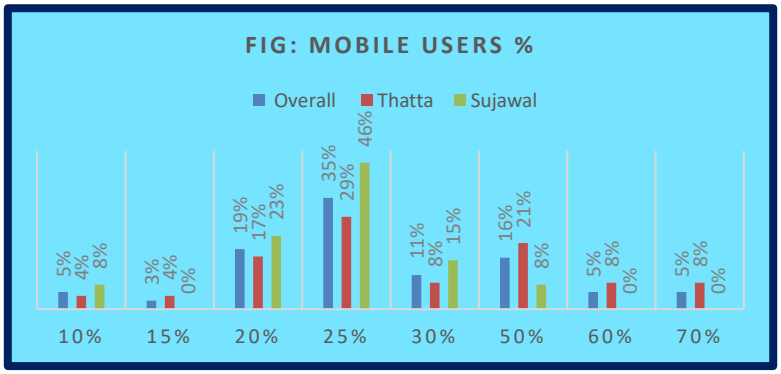
23. Telecommunication System Availability in the Area

300. Mobile services are universally available across all areas (100%), while landline/PTCL services are completely absent (0%). This highlights the shift towards mobile-based communication, with no reliance on fixed-line infrastructure. This has implications such as potential gaps in connectivity and quality, such as reliability, and internet speed in remote areas remaining uncertain.



24. Mobile Users Percentage in the Area

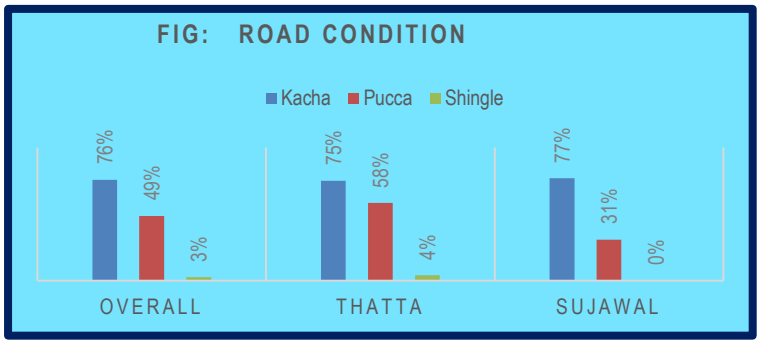
301. Mobile usage varies significantly, with the highest concentration in the 25% user category, particularly in Sujawal (46%). Sujawal has the highest percentage of mobile users in the lower categories (10-25%), indicating limited mobile penetration in higher usage brackets. Thatta has a more evenly distributed user base, with 21% reaching the 50% usage category. Few respondents (5-



8%) report having 60% or more mobile usage, suggesting mobile connectivity is still not widely adopted at high levels.

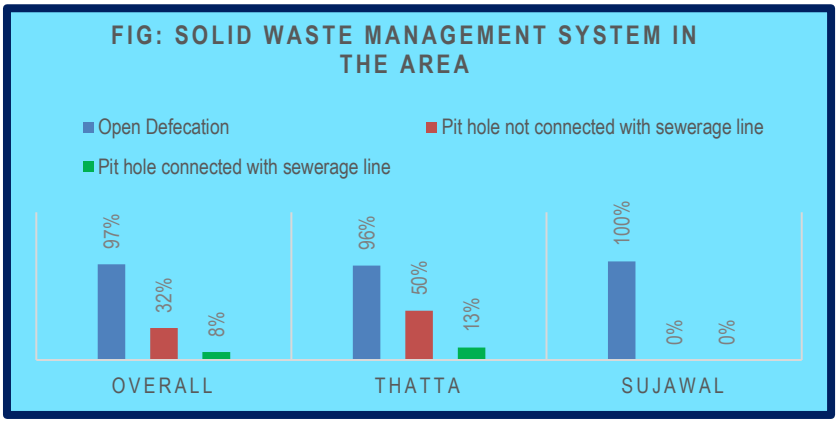
25. Road Condition

302. Kacha roads dominate across all areas (75-77%), indicating a lack of proper road infrastructure. Thatta has the highest proportion of Pucca roads (58%), while Sujawal has the lowest (31%), suggesting disparities in road development. Shingle roads are almost non-existent, with only 3-4% overall, and none reported in Sujawal.



26. Solid Waste Management System in the Area

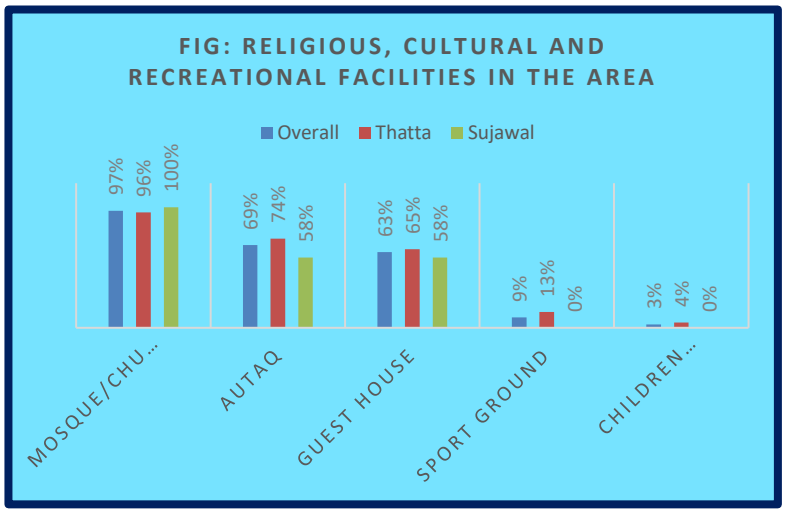
303. Open defecation is the dominant practice and is nearly universal, with 97-100% of respondents reporting its prevalence. Thatta has the highest proportion (50%) of pit latrines, but most are not connected to a sewerage system. Only 8% of respondents overall have pit latrines connected to a sewerage system, with Thatta reporting the highest (13%). Sujawal has no alternative sanitation facilities, making it the most vulnerable in terms of waste management.



27. Religious, Cultural, and Recreational Facilities in the Area

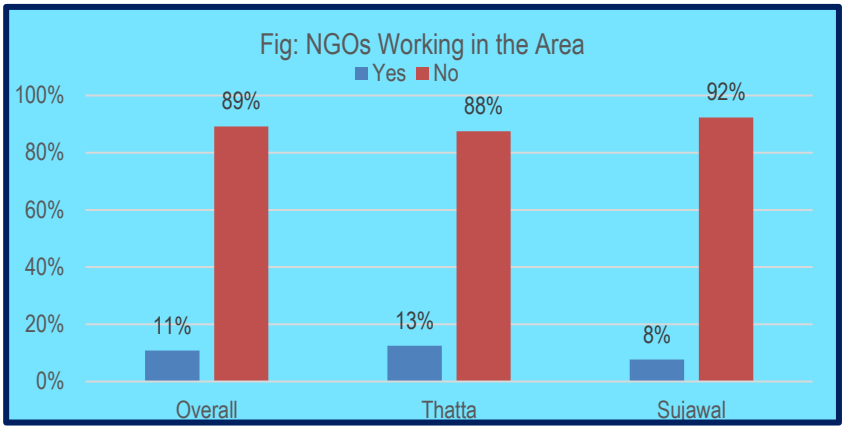
304. Religious facilities are widely available (97% overall), with Sujawal having 100% accessibility. Autaq and guest houses are present in a majority of villages but are slightly less available in Sujawal (58%) than in Thatta (74% and 65%, respectively).

305. Recreational facilities are almost non-existent, with only 9% of villages having a sports ground and 3% having a children's park. Sujawal has no reported sports grounds or children's parks, while Thatta has limited access (13% for sports grounds, 4% for parks).



28. NGOs Working in the Area

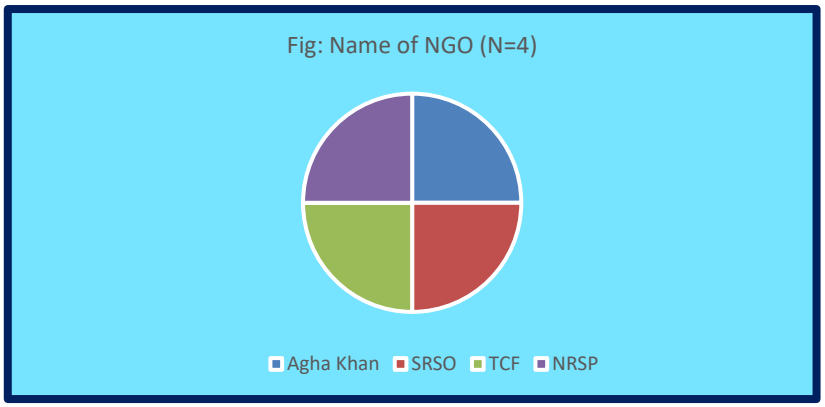
306. It can be noted that there is limited NGO presence across both districts, with only 11% overall confirming NGO activity. Thatta has a slightly higher percentage of respondents (13%) confirming NGO presence compared to Sujawal (8%), but both remain very low.



307. Sujawal is the most underserved in terms of NGO operations, with 92% of respondents reporting no engagement. The absence of NGOs suggests a lack of external development support, affecting access to social, health, and economic programs.

29. NGOs Operating in the Area

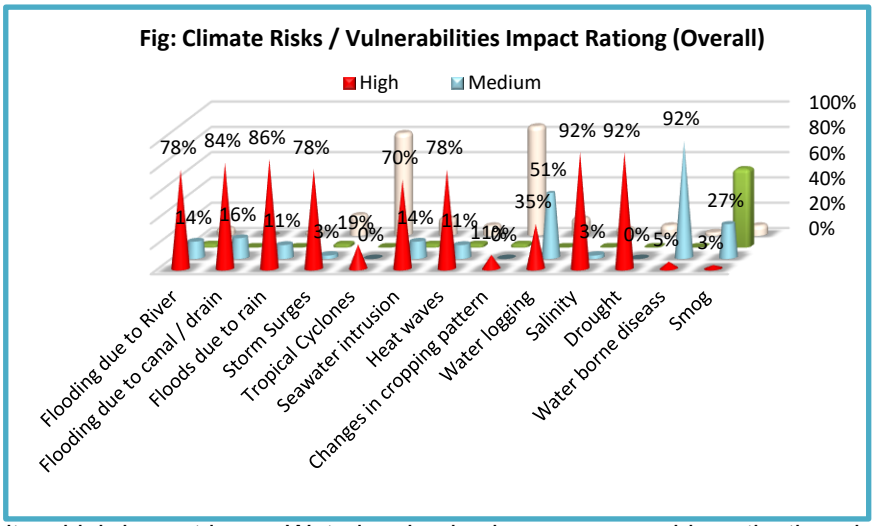
308. Four NGOs are reported to be working in the area, each contributing equally to development efforts. The presence of SRSO and NRSP suggests a focus on rural development, poverty alleviation, and community empowerment. Agha Khan Foundation and TCF indicate involvement in sectors such as health, education, and infrastructure development. Despite the presence of these NGOs, the overall NGO coverage remains low, as noted in the previous analysis



30. Climate Risks / Vulnerabilities Impact Rating (Overall)

a. Flooding and Water-Related Risks:

309. These figures suggest that flooding and storm-related hazards are the most severe climate risks, with more than 75% of respondents rating each of them as High-impact events.



b. Heat Stress:

310. Heat waves is a significant concern, with 78% of respondents perceiving it as high-impact issue. Waterlogging is also seen as problematic, though with a more balanced distribution across High and Medium ratings.

c. Soil and Water Quality Issues:

311. Both salinity and drought are ranked among the most severe threats, with 92% of respondents rating them as High-risk. This highlights the urgency of addressing soil degradation and water scarcity issues.

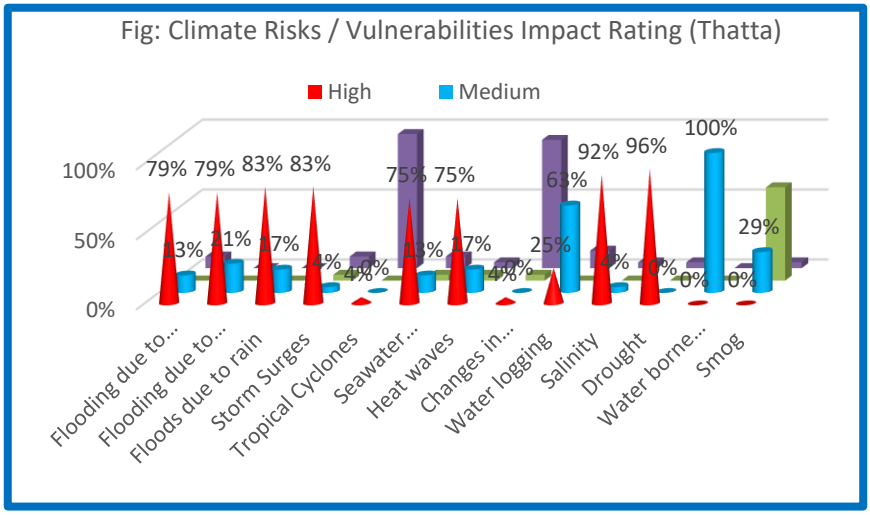
d. Health-Related Climate Risks:

312. The overwhelming 92% Medium-risk rating for waterborne diseases underscores the serious public health impact of climate-related changes. Smog, in contrast, has a lower overall impact but is still a concern for some.

31. Climate Risks / Vulnerabilities Impact Rating (Thatta)

a. Flooding and Water-Related Risks:

313. These figures indicate that flooding, storm surges, and tropical cyclones are the most severe climate risks, with over 75% of respondents rating them as High-impact events.



b. Heat Stress and Agricultural Impact:

314. Heat waves are considered a major threat (75% High), while water logging has a more balanced perception, with 62% rating it as Medium-impact.

c. Soil and Water Quality Issues:

315. Salinity and drought are among the most severe risks, with 92%-96% of respondents rating them as High-risk. These issues significantly affect agriculture and water availability.

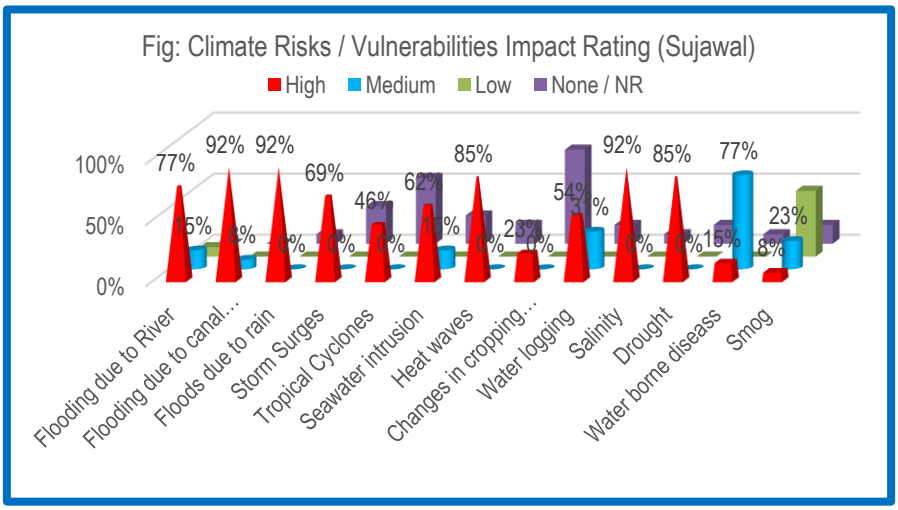
d. Health-Related Climate Risks:

316. Waterborne diseases are a critical issue, with a unanimous 100% Medium-risk rating, emphasizing urgent concerns for public health.

32. Climate Risks / Vulnerabilities Impact Rating (Sujawal)

a. Flooding and Water-Related Risks:

317. These figures indicate that flooding (both from rivers and rain) is the most severe climate risk in Sujawal, with over 90% of respondents rating it as High-impact. Storm surges and tropical cyclones are also significant concerns, though rated slightly lower.



b. Heat Stress and Agricultural Impact:

318. Heat waves are considered a major threat (85% High), and seawater intrusion (62% High) poses a significant risk to agricultural productivity. Waterlogging is split between High and Medium concerns.

c. Soil and Water Quality Issues:

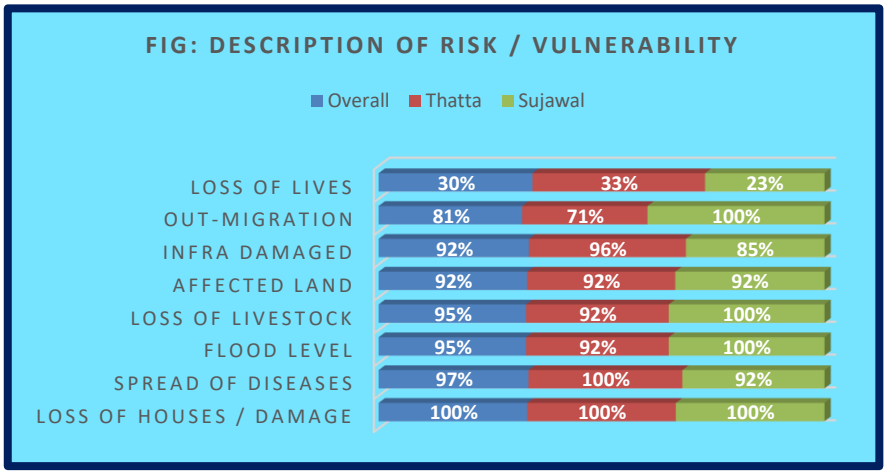
319. Salinity and drought are ranked among the most severe environmental challenges, with 85-92% of respondents rating them as High-risk. This highlights serious concerns regarding soil and water quality.

d. Health-Related Climate Risks:

320. Waterborne diseases (77% High) remain a critical issue, though slightly lower compared to Thatta. Smog is also a concern but less significant.

33. Risk / Vulnerability

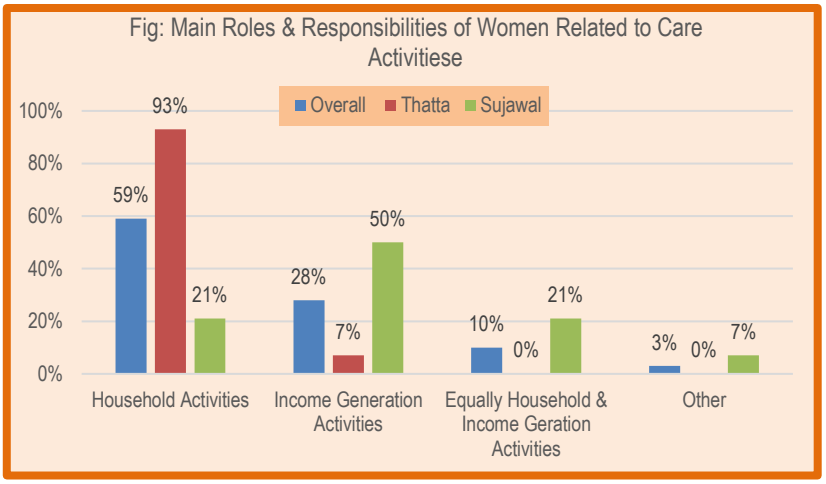
321. Sujawal faces the most severe challenges, with 100% out-migration, livestock loss, and flood impact, while respondents from Thatta report the highest risks being infrastructure damage (96%) and disease spread (100%). Housing loss/damage is a universal issue (100% across both districts), highlighting the need for resilient housing solutions. Out-migration is a critical issue in Sujawal (100%) and Thatta (71%), suggesting urgent relocation and livelihood support interventions.



G. Female FGD social data

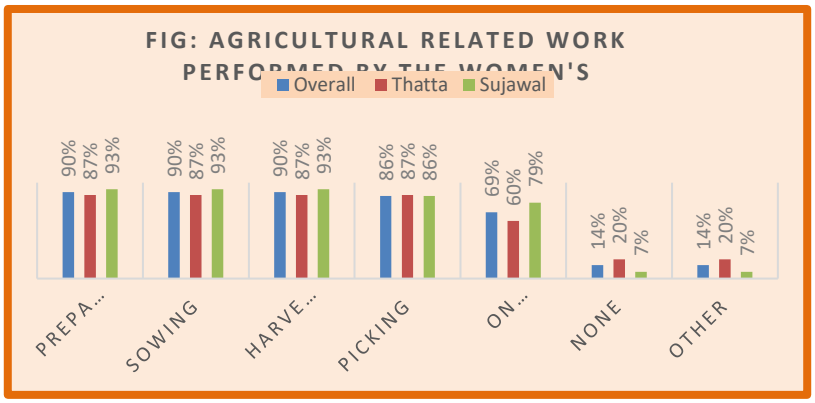
1. Roles & Responsibilities of Women Related to Care Activities

322. The majority of women in Thatta (93%) are primarily responsible for household activities, while only 21% in Sujawal report the same. On the other hand Sujawal has a higher percentage (50%) of women engaged in income generation activities compared to Thatta (7%), indicating a greater role in economic participation. A notable proportion of women in Sujawal (21%) are equally involved in both household and income-generating activities, whereas no such cases are reported in Thatta. A small percentage of women in Sujawal (7%) have responsibilities categorized as “Other,” while this category is absent in Thatta. Overall, the responses suggest that in Thatta, women’s roles are more traditional and confined to domestic responsibilities, whereas in Sujawal, women have greater economic engagement.



2. Agricultural-Related Work Performed by Women

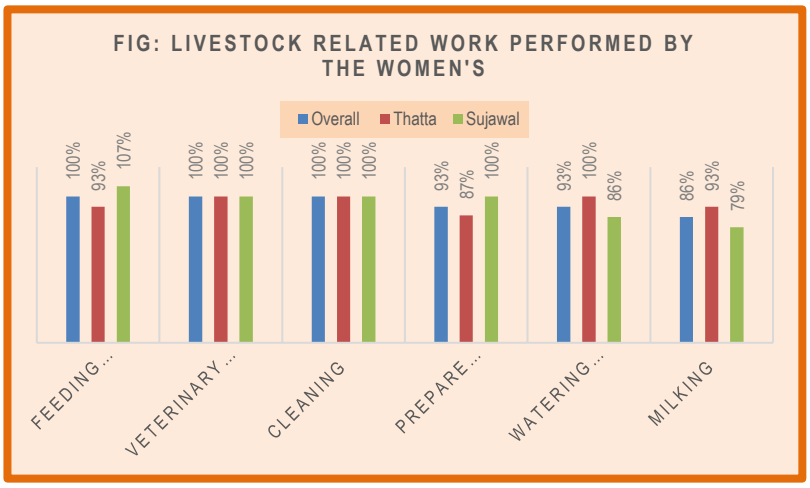
323. Similar to the trends related to livestock, women are highly engaged



in agricultural work, with 90% participation in land preparation, sowing, and harvesting. Sujawal reports slightly higher participation across most activities (93%) compared to Thatta (87%), indicating a greater dependence on women's labor in agriculture. On-farm water management sees lower participation (69% overall), with Thatta having the least involvement (60%) and Sujawal having the highest (79%). A small portion of women (14% overall) do not participate in agriculture, with Thatta having the highest non-participation rate of 20%. Thatta has a higher percentage of women engaged in "Other" agricultural tasks (20%), suggesting broader roles outside conventional farming activities. Thus women's heavy involvement in all major farming activities highlights their critical contribution to rural livelihoods.

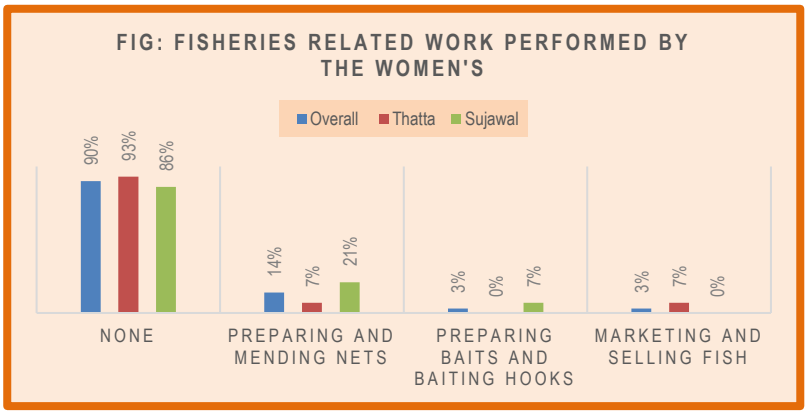
3. Livestock-Related Work Performed by Women

324. Women are universally involved in livestock activities, with 100% participation in veterinary care, cleaning, and feeding animals. Sujawal has higher or equal participation in most tasks compared to Thatta, particularly in feeding animals, preparing fodder, and watering animals. Milking is the only activity where Sujawal (79%) reports lower participation compared to Thatta (93%), indicating possible male involvement or alternative arrangements. The high level of women's involvement in livestock-related work reflects their critical role in rural economies and food security.



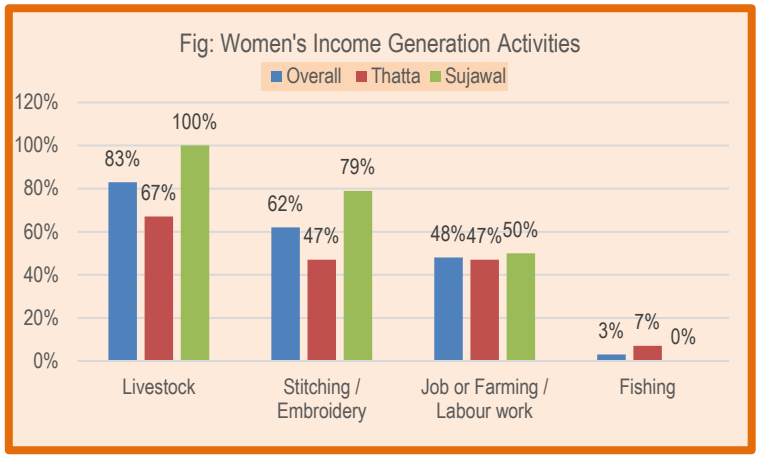
4. Fisheries-Related Work Performed by Women

325. The majority of women (90%) do not participate in fisheries-related activities, suggesting that fishing remains a male-dominated occupation. Sujawal with 88%, has a slightly lower rate of non-participation compared to 93% in Thatta , indicating a marginally higher involvement of women in fisheries in Sujawal. Net preparation and mending are the most common tasks performed by women (14% overall), with higher involvement in Sujawal (21%) than in Thatta (7%), while very few women (3%) are involved in preparing bait, with only Sujawal reporting such activity (7%). Marketing and selling fish are also limited, with Thatta reporting a small share of women's involvement (7%) while Sujawal reports no participation. These findings reflect traditional gender roles in fisheries, where women's involvement is limited mainly to secondary tasks such as net mending and bait preparation



5. Women's Income Generation Activities

326. Livestock management is the most common income-generating activity for women, with 83% participation overall. In Sujawal, all respondent women (100%) are involved in livestock, compared to 67% in Thatta. Stitching and embroidery are also major economic activities, with higher participation in Sujawal (79%) than Thatta (47%). This suggests that women in Sujawal rely more on home-based income sources.

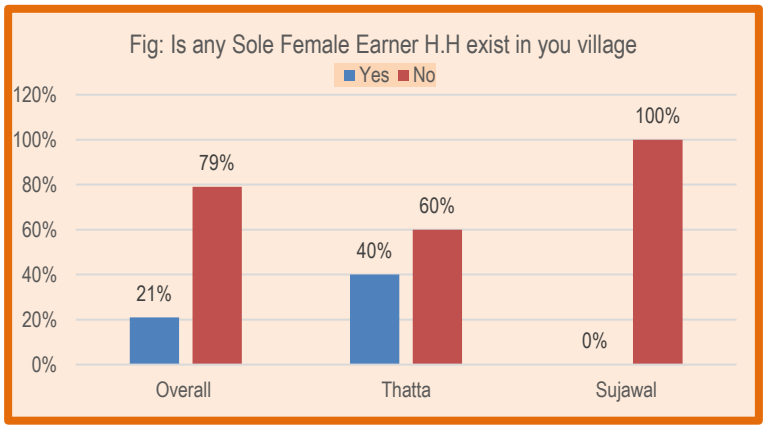


327. Job or farming/labor work shows nearly equal participation across both regions (48% overall, 47% in Thatta, 50% in Sujawal), indicating that some women are directly engaged in agricultural or daily wage labor. Fishing has the lowest participation, with only 3% of women involved overall. The activity is slightly more present in Thatta (7%) but absent in Sujawal (0%), reflecting the male-dominated nature of the fishing industry in the region.

328. The higher reliance on livestock and stitching/embroidery in Sujawal suggests fewer alternative employment opportunities compared to Thatta

6. Sole Female Earners in Households

329. Across all areas, the majority of respondents (79%) reported that sole female earner households do not exist, indicating that male members or shared earning structures predominantly support households. Thatta has the highest proportion of sole female earners (40%), suggesting a relatively higher degree of female-led household financial responsibility in that region. Sujawal has reported no sole female earners (0%), highlighting a potential reliance on male earners or extended family support.

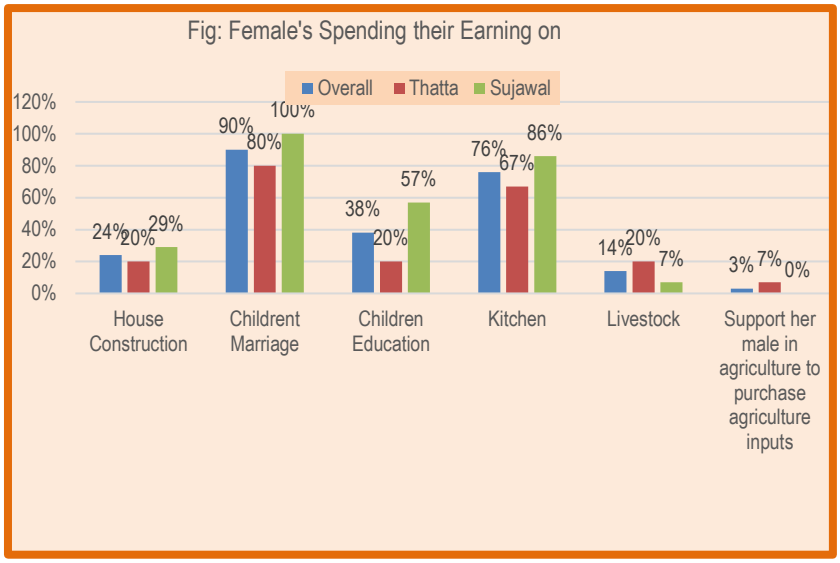


330. The overall low percentage of sole female earners (21%) may indicate limited economic opportunities for women, restricted employment options, or socio-cultural norms discouraging female financial independence.

7. Female Spending Patterns on Earnings

331. Children's marriage is the top spending priority for women, with 90% overall, and reaching 100% in Sujawal. This suggests significant social and financial emphasis on wedding expenses. Kitchen expenses are another major area, with 76% of women spending their earnings on household food

and essentials. Sujawal (86%) has the highest proportion, indicating that women in this region may bear a larger share of household financial responsibilities.

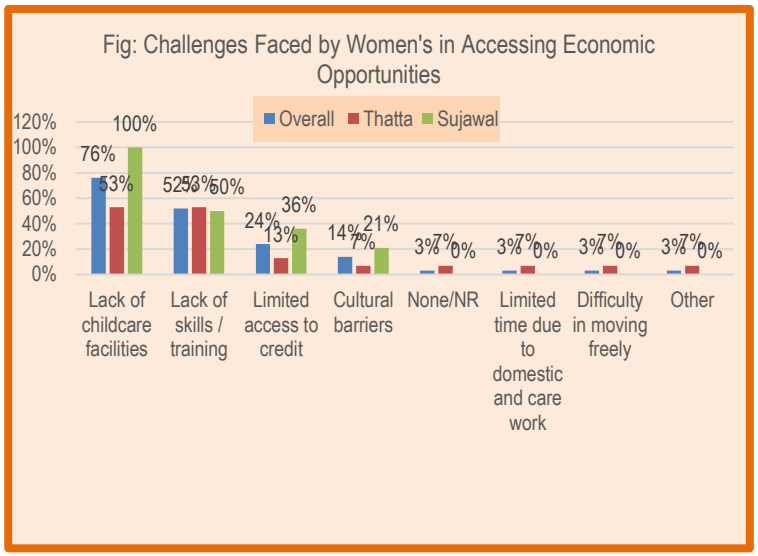


332. Spending on children's education is relatively lower overall (38%), with Thatta reporting the lowest investment (20%), whereas Sujawal shows higher commitment (57%). This may reflect financial constraints in Thatta or greater prioritization of education in Sujawal. Investment in livestock is minimal (14% overall), suggesting that women's economic contributions are not primarily directed toward asset-building activities.

333. Only 3% of women overall support male family members in agriculture, with no reported cases in Sujawal. This suggests that female earnings are largely retained for household and social obligations rather than reinvestment in family farming

8. Challenges Faced by Women in Accessing Economic Opportunities

334. The biggest barrier to women's economic participation is the lack of childcare facilities, reported by 76% overall and 100% in Sujawal. This suggests that women are unable to work due to caregiving responsibilities. Lack of skills and training is another major barrier (52% overall), with equal concerns in Thatta (5%) and Sujawal (50%). This highlights the need for vocational and educational programs.

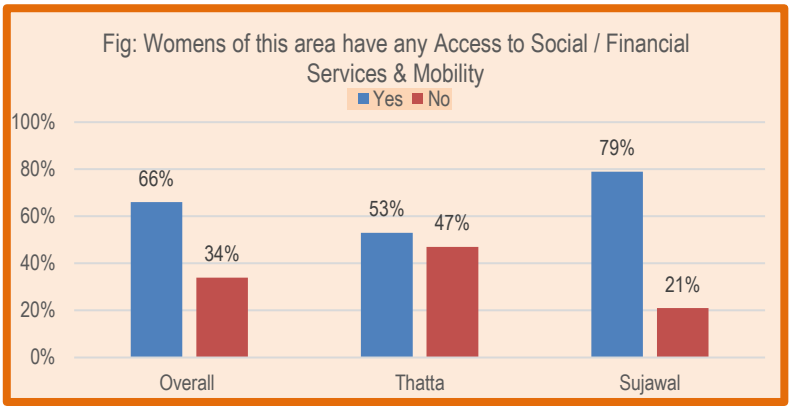


335. Access to financial credit is a notable issue, particularly in Sujawal (36%), compared to Thatta (13%). This indicates that women in Sujawal face greater difficulties in securing loans or financial resources. Cultural barriers limit women's economic participation, with Sujawal (21%) reporting more restrictions than Thatta (7%). Social norms and restrictions on mobility could be contributing factors.

336. Smaller percentages of women cite difficulty in moving freely (3%) and time constraints due to domestic work (3%) as barriers. While these are less common overall, they still impact certain women, particularly in Thatta (7% for both categories). The disparity between Thatta and Sujawal suggests that access to childcare, skills development, and credit opportunities are more restrictive in Sujawal.

9. Women's Access to Social/Financial Services & Mobility

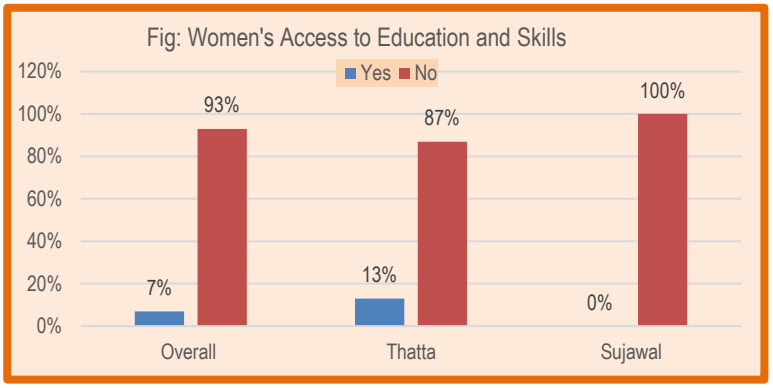
337. A significant proportion of women (66% overall) have access to social and financial services, indicating moderate integration into financial systems and mobility opportunities. Sujawal reports the highest access (79%), suggesting better financial inclusion and mobility options compared to Thatta with nearly half of the women (47%) reporting no access, highlighting mobility and financial barriers.



338. The disparity between Thatta and Sujawal highlights differences in infrastructure, cultural norms, and access to financial services that affect women's ability to engage in financial activities or move freely. Even where microfinance options are available, many women report being hesitant to take out loans due to high interest rates, with some even considering it Haram. Limited access to social and financial services can significantly hinder women's economic empowerment, decision-making abilities, and overall quality of life.

10. Women's Access to Education and Skills

339. The majority of women (93% overall) lack access to education and skills development, indicating significant educational barriers. Thatta has slightly better access (13%) compared to the overall average, but the majority (87%) still lack educational opportunities. Sujawal presents a critical challenge, with no reported access (0%) to education and skills training, reflecting extreme educational deprivation. The disparity between Thatta and Sujawal suggests that educational opportunities are unevenly distributed, with Sujawal facing the most severe limitations. This is an established fact that limited access to education and skills training restricts women's economic opportunities, decision-making power, and overall empowerment.



11. Women's Access to Pre- and Post-Natal Health Consultation Facilities

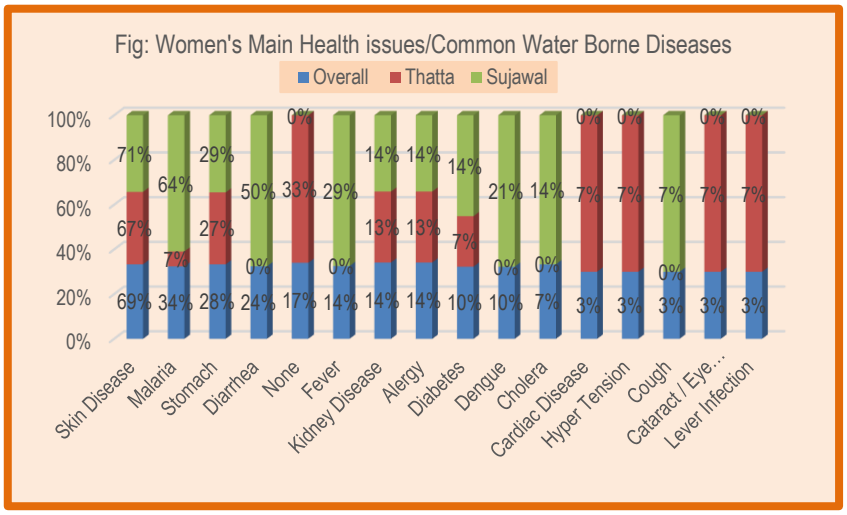
Category	Total	Thatta	Sujawal
Are any facilities for seeking Pre and Post-Natal health consultation and care available in this area?			
Yes	34%	47%	21%
No	66%	53%	79%
Main Constraints for not accessing health facilities			
No response	60%	43%	100%
Far away	40%	57%	0%

340. The data shows that access to pre and post-natal health care facilities are very limited, with overall 34% of respondents reporting availability. Thatta has better access at 47%, while Sujawal has much lower access at 21%. For those without access, distance is the primary barrier, particularly in Thatta (57%), while no distance-related issues were reported in Sujawal. Additionally, 60% of respondents did not answer, indicating a possible lack of awareness or understanding. This highlights the need for better access to and awareness of health services in these areas.

341. Limited access to pre- and post-natal care can increase maternal and infant health risks, emphasizing the need for improved service delivery.

12. Women's Main Health Issues and Common Waterborne Diseases

342. Skin diseases are the most commonly reported health issue, affecting 69% of women overall. Sujawal (71%) reports a slightly higher rate than Thatta (67%), indicating possible hygiene and sanitation challenges. Malaria is a major issue in Sujawal (64%), compared to just 7% in Thatta. This suggests differences in environmental conditions and access to preventive measures like mosquito nets.

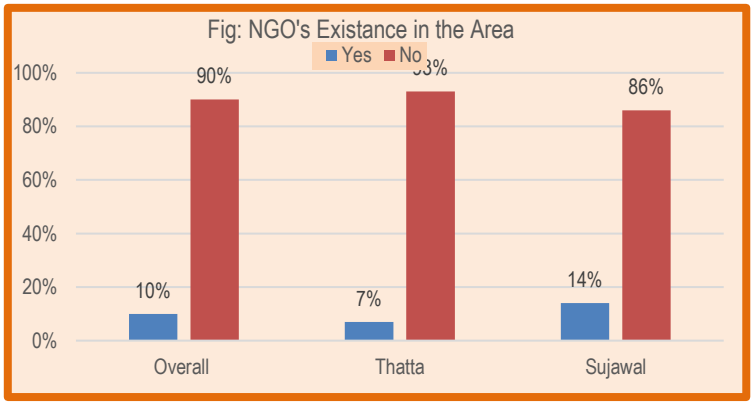


343. Waterborne diseases such as diarrhea (24% overall) and stomach issues (28% overall) are widely reported, with Sujawal showing slightly higher cases. This could indicate challenges in water quality and sanitation infrastructure.

344. Non-communicable diseases like kidney disease, fever, allergies, and diabetes are present at moderate levels (10-14%) across both regions. More severe health conditions, such as cardiac disease, hypertension, cataract/eye diseases, cough, and liver infections, are reported at much lower levels (3% overall), suggesting they are less common or underreported. The presence of diarrhea, cholera, and fever indicates a strong link between poor water quality and health issues, necessitating urgent intervention.

13. NGO Existence in the Area

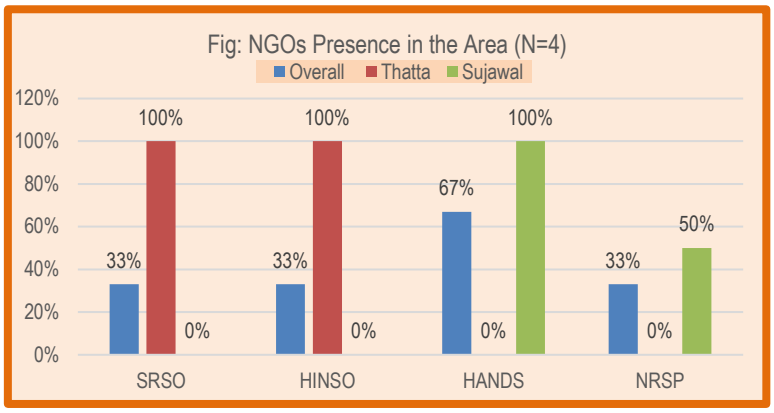
345. NGO presence is extremely low, with only 10% of respondents overall confirming their existence. Thatta has the lowest NGO presence (7%), while Sujawal has a slightly higher percentage (14%). The overwhelming majority (90%) of respondents reported no NGO activity in their areas, highlighting a severe gap in external development support.



Limited NGO involvement suggests that communities may lack access to crucial services such as education, healthcare, women's empowerment, and disaster relief.

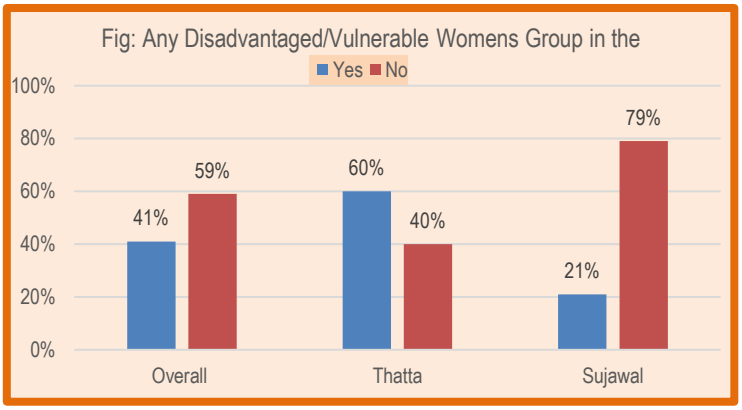
14. NGOs Presence in the Area

346. NGO presence is unevenly distributed across regions, with Thatta and Sujawal having different organizations operating. SRSO and HINSO are active exclusively in Thatta, with no presence in Sujawal. HANDS is the only NGO operating in Sujawal (100%) but has no presence in Thatta. 50% of the respondents in Sujawal identified NRSP operations, but is absent in Thatta. Overall, NGO involvement remains low, reinforcing the need for broader outreach and engagement.



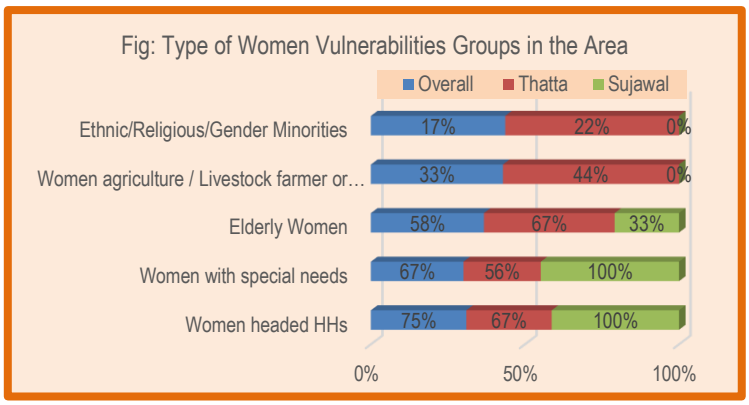
15. Disadvantaged/Vulnerable Women's Groups in the Area

347. The overall identification of vulnerable women's groups is low, with only 41% of respondents acknowledging their existence. Thatta has a higher percentage (60%) recognizing such groups, suggesting better awareness or identification mechanisms compared to Sujawal (21%). Sujawal shows a significant gap, with 79% of respondents reporting no awareness of any vulnerable women's groups, indicating a lack of recognition or support. The absence of acknowledging such groups in most areas suggests a need for better identification, awareness, and support systems for disadvantaged women.



16. Types of Women's vulnerability Groups in the Area

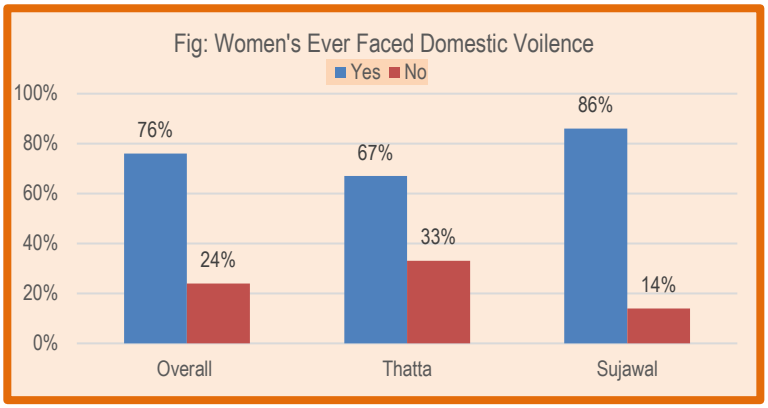
348. Women-headed households are the most commonly identified vulnerable group, with Sujawal reporting 100% and Thatta 67%. Women with special needs are also a highly recognized group, particularly in Sujawal (100%). Elderly women are also widely acknowledged as vulnerable (58% overall), with Thatta reporting the highest recognition (67%). It should be noted with particular interest that Women in agriculture/livestock farming are recognized by the respondents as vulnerable in Thatta (44%), but not in Sujawal. A similar trend can be observed in the case of



Ethnic/religious/gender minorities, which are recognized as vulnerable in Thatta (22%), but no such group is identified in Sujawal.

17. Women's Experience with Domestic Violence

349. Overall domestic violence is a widespread issue, with 76% women reported experiencing domestic violence, while only 24% reported never experiencing domestic violence. In Thatta, this situation is somewhat better where 67% reported experiencing domestic violence, while 33% reported never experiencing domestic violence. The GBV situation in Sujawal is much worse where 86% reported experiencing domestic violence and only 14% reported never experiencing domestic violence. The disparity between Thatta and Sujawal suggests that certain cultural, social, or economic factors may be contributing to higher abuse rates in Sujawal. Despite this severity, only 4% of cases were formally reported in the past year, showing a clear lack of awareness and support



350. Forced marriage is a significant issue in Thatta, with 25% reporting it. However, women participants explained that in their community, marriage decisions are made by elders, mostly men, and children's consent is not considered, as cultural norms place the responsibility on the elders.

351. Women reported that GBV is seen as normal in the area, and violence is often viewed as unimportant, with many women not taking it seriously despite frequent abuse. The main causes include men taking women's earnings, disagreements with male opinions, and not meeting expectations like providing food on time and performing other tasks. These factors contribute to a cycle of violence, reinforcing women's subordinate roles and silencing their voices.

18. Legal Support Services and Measures for GBV Survivors in the area

Category	Overall	Thatta	Sujawal
Are there any support services for GBV survivors in the village?	No	100%	100%
Category	Overall	Thatta	Sujawal
Are there any support services for GBV survivors in the village?	No	100%	100%
Category	Overall	Thatta	Sujawal
Are there any support services for GBV survivors in the village?	No	100%	100%
Category	Overall	Thatta	Sujawal
Are there any support services for GBV survivors in the village?	No	100%	100%

352. Despite the high prevalence of GBV, there are no significant community awareness programs for prevention. Only 13% of respondents mentioned such programs, with slightly more in Thatta (16%) than in Sujawal (10%). However, 18% of respondents did not answer, suggesting a lack of awareness about available initiatives. Legal support is also minimal, with only 5% mentioning it, none in Thatta, and 8% in Sujawal.

353. These findings highlight a critical gap in community awareness programmers, legal support system and prevention services for GBV survivors. There is a stronger need for accessible Institutional support systems and awareness programs to address GBV in these communities.

19. Women's role In Decision-Making in Household Matters

Household Matter	Overall	Thatta	Sujawal
Education (where to send)			
Men	97%	100%	93%
Both	3%	0%	7%
Education (whom to send)			
Men	97%	100%	93%
Both	3%	0%	7%
Health Facilities (from where to avail)			
Men	90%	87%	93%
Both	10%	13%	7%
Number of children to have			
Men	86%	80%	93%
Women	3%	7%	0%
Children's Marriages			
Men	90%	93%	86%
Both	10%	7%	14%
What Household Assets to Buy and Sell			
Men	93%	93%	93%
Both	7%	7%	7%
Women to Work Outside Home			
Men	86%	87%	86%
Both	14%	13%	14%

354. The data reveals a significant gender imbalance in household decision-making in Thatta and Sujawal, with men predominantly making decisions on education, healthcare, family planning, children's marriages, and household assets. Men are responsible for 97% of education-related decisions and 90% of healthcare decisions, with only minimal involvement from women. Similarly, men dominate decisions on the number of children to have (86%) and children's marriages (90%). Household asset purchases are fully controlled by men, and the decision for women to work outside the home also remains primarily in their hands (86%).

355. This shows a clear pattern of male dominance in decision-making across the both districts, with women having very limited input, especially in critical areas like education and family planning. It highlights the urgent need for greater gender equality in decision-making, allowing women's voices to be heard and respected equally

20. Women's Involvement in Disaster Preparedness & Response Planning

Category	Overall	Thatta	Sujawal
Base: Total	29	15	14
Have women been involved in disaster preparedness and response planning?			
Yes	7%	13%	0%
No	93%	87%	100%
Those involved in disaster preparedness	100%	100%	100%
Capacity			
Community-based disaster risk management	42%	48%	35%
Early warning systems	48%	46%	50%

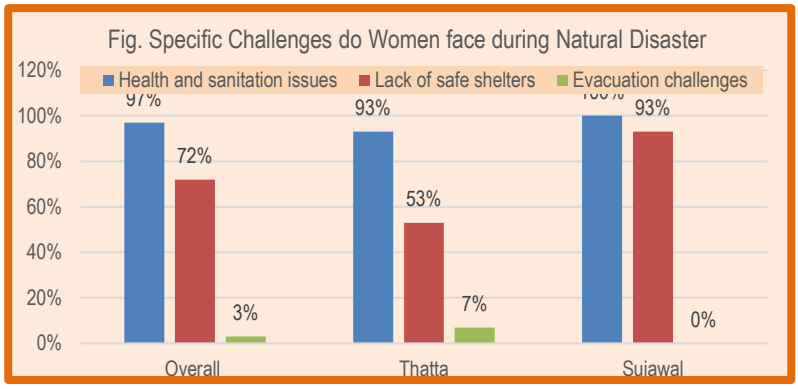
Training and capacity building	26%	15%	36%

356. Women's participation in disaster preparedness is low, with just 7% overall involvement. Sujawal leads with 13% participation, showing a well-integrated approach, while Thatta has 87% participation, leaving 13% of women not engaged, indicating a gap that needs attention. In terms of capacity building, 42% are involved in community-based disaster risk management overall, with 48% in Thatta and 35% in Sujawal. 48% overall are involved in early warning systems, with 46% in Thatta and 50% in Sujawal. However, training and capacity building sees a lower involvement at 26% overall, with 15% in Thatta and 36% in Sujawal.

357. The figures indicate a strong need for greater emphasis on increasing women's participation in disaster preparedness, particularly in areas such as training and community-based risk management.

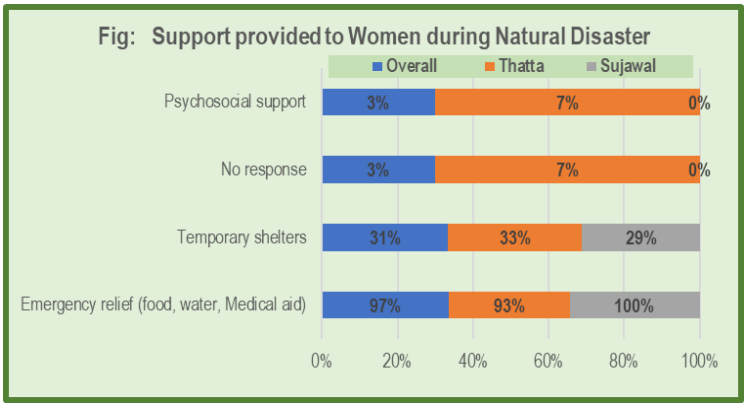
21. Challenges Women Face During Natural Disasters

358. Health and sanitation issues are the most significant challenge for women during disasters, reported by nearly all respondents (97% overall). Sujawal has the highest percentage (100%), suggesting critical concerns over hygiene, menstrual health management, and medical access. Lack of safe shelters is also a major concern, with Sujawal (93%) reporting significantly higher challenges compared to Thatta (53%). This suggests a severe gap in disaster-resilient infrastructure in Sujawal. Evacuation challenges appear to be minimal (3% overall), but Thatta reports slightly higher concerns (7%). This could indicate localized barriers to mobility or access to transportation during emergencies. The disparity in safe shelter access between Thatta and Sujawal highlights the need for targeted interventions in Sujawal.



22. Support Provided to Women During Natural Disasters

359. Emergency relief (food, water, and medical aid) is the most commonly provided support, with nearly universal coverage (97% overall). Sujawal reports full (100%) coverage, while Thatta slightly lags behind at 93%. Temporary shelter provision is moderate (31% overall), with similar levels across Thatta (33%) and Sujawal (29%), which somehow corroborates and reinforces the responses in the previous section of challenges faced by women. This suggests a need for improved access to safe shelter options. Psychosocial support is extremely low (3% overall), with Thatta (7%) reporting some assistance while Sujawal has none. This indicates a major gap in mental health and trauma support services. A small percentage of respondents in Thatta (7%) reported receiving no support at all, indicating gaps in the emergency



response system. In short, while basic relief is mostly provided, there's a clear need to pay more attention to safe shelters and mental health support for women in disaster situations.

V. CONSULTATION, INFORMATION DISCLOSURE AND GRIEVANCE REDRESS MECHANISM

360. Meaningful consultation refers to a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

A. Stakeholder Identification

361. To better understand the different stakeholder groups for the subproject, stakeholder identification exercise has been carried out whereby the different stakeholder groups and their interests in the subproject are discussed in this section:

- **Local People/Neighborhood**: All the settlements and commercial units fall inside AoI of the subproject are considered as primary stakeholders since, they could be directly affected by the anticipated impacts of the subproject. This includes APs to be identified in the RP.
- **Government Agencies & Other Service Providers**: The government agencies involved in the IEE process are mandated to have their policy and regulatory responsibilities addressed in impact analysis and mitigation consideration. These are the secondary stakeholders which includes Sindh Wildlife Department, SEPA, Sindh Fisheries Department etc.
- **NGOs**: Comments from NGOs often provide a useful policy perspective on the project's methodology and implementation mechanisms. For example, due to the vast exposure of certain NGOs like NRSP, WWF and IUCN, alternative measures for reaching the subproject goals may be advised that is more environmentally friendly and socially acceptable.

B. Stakeholder Engagement

362. Engaging a diverse range of relevant stakeholders in the SCRP project area based on their capacities, willingness, abilities, and relevance is critical. Stakeholder engagement is an ongoing process that extends beyond consultation, empowering stakeholders with an active role in shaping project-related activities. Achieving true ownership requires the participation of all relevant stakeholders in project processes according to their roles, interests, and capabilities, ensuring alignment with national climate resilience and low-carbon development goals.

363. A Stakeholder Engagement Plan (SEP) has been developed under the project that guides and directs the way people will provide inputs into the Sindh Coastal Resilience Project (SCRP, or The Project). It provides a framework and identifies mechanisms to ensure how and when people from within the Project area derive benefits from the proposed interventions. It describes the commitments and processes for the range of community, non-governmental and how they will engage with the Sundh Government, the ADB and other stakeholders during and subsequent to the implementation of the SCRP.

364. As a minimum, relevant stakeholders including affected person (APs), Vulnerable groups, neighboring communities, relevant govt. departments and NGOs shall be consulted regarding the scope of the environmental study, and will then be informed about the likely impacts of the proposed activities and proposed mitigation once the draft IEE/EIA report is under preparation.

365. There are a variety of approaches for consultation and information dissemination, including public meetings and FGDs, workshops, etc., but the most effective for community consultation is the FGDs.

C. Stakeholder Consultations during Project Preparation

366. As part of the development of the SEP, consultations will also be conducted with key stakeholders, including government departments, NGOs, community leaders, and academia. The PIU will ensure that these consultations continue throughout all phases of the project design, construction, O&M, monitoring and evaluation.

367. Consultation and engagement of communities and the households they comprise are core activities of the Project life-cycle. This is graphically depicted in Figure V-1. The main objective is to ensure that proposed Project components fully answer communities and inhabitants needs. A specific focus is given to vulnerable groups and women. In this respect consultations have been done from the first phases of Project preparation. Figure V-1 shows how the local stakeholders and populations are and will continue to be involved over the Project.

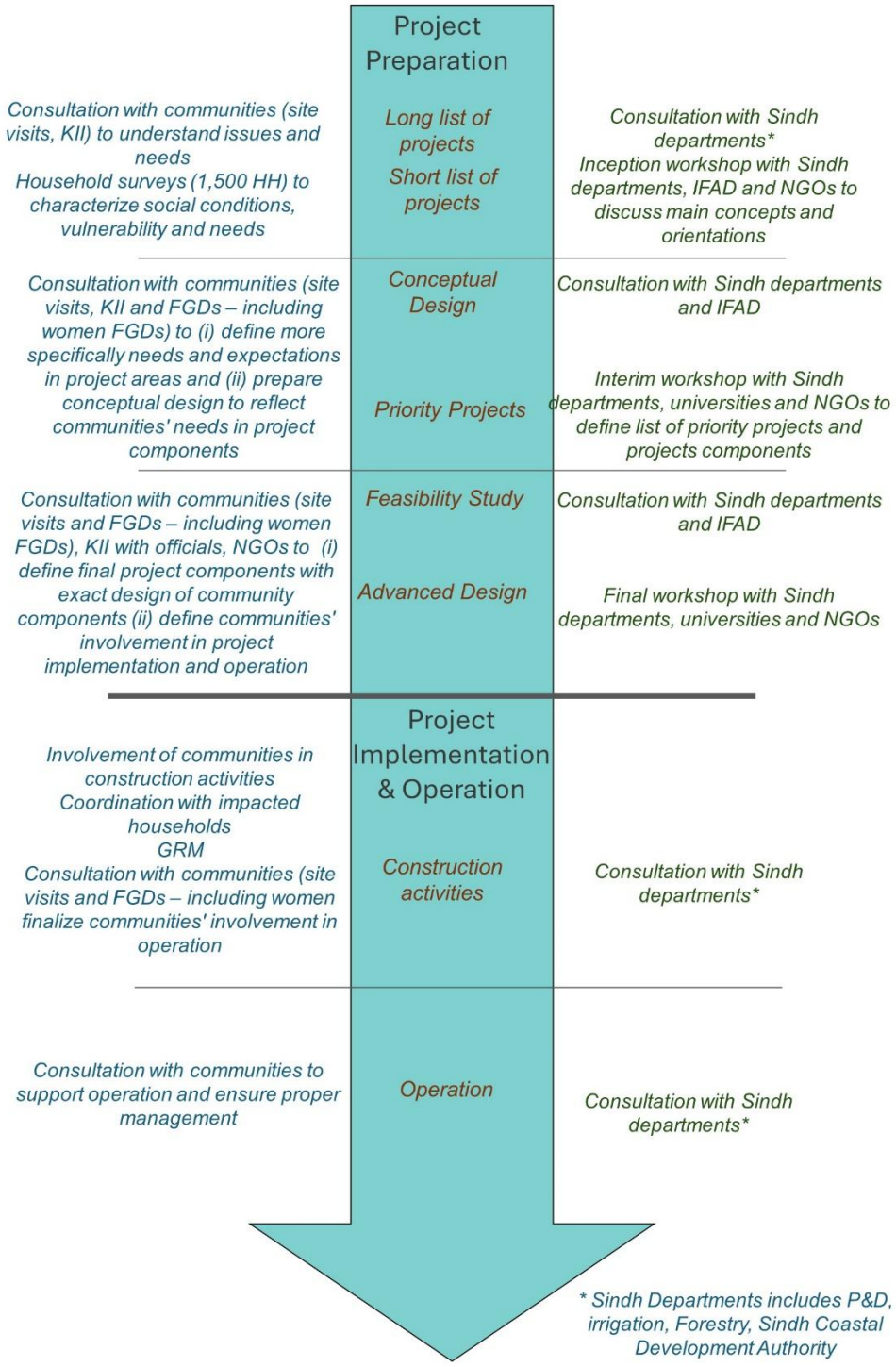


Figure V-1: Engagement of Stakeholders Over the Life of the Project[50]

368. The local people shall be informed about the project's salient features in the early stage of planning. They shall be informed about the redressal of drainage and flooding issues and safeguard towards climate impacts in addition to generation employment opportunities for local communities. Affordability is taken into account as the drainage rehabilitation works will reduce climate induced impacts indirect cost and increase agriculture productivity. On the other hand, they shall also be informed about the temporary impacts during construction phase. For social risks and

[50] Source: Project SEP Document

vulnerabilities such as HIV/AIDs, project shall develop mechanisms to address the social issues identified during the Poverty, Social and Gender Analysis (PSGA).

D. Consultation with Communities

369. A total of 37 Male FGDs and 30 Female FGDs were undertaken with the local community which resides along the subprojects. Three towns namely Buhara, Ver and Pir Patho as well as 35 villages located along the drains and proposed plantation sites were visited during social survey and FGD consultations. The details of FGDs undertaken are provided below:

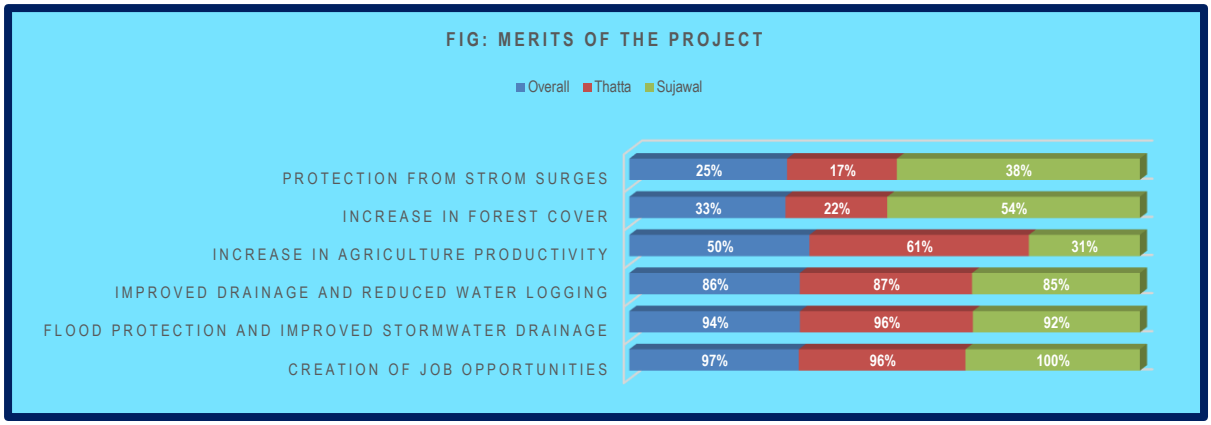
Table V-1: Details of FGDs undertaken with the Local Community

Date	Scheme	Progress	
27/01/2025	Ghora Bari Outfall Drain	Villages visited	a) Soomra Manjero b) Ubayo Jutt c) Ver City d) Pir Patho
		No. of Male FGDs	04
		No. of Female FGDs	02
28/01/2025		Villages visited	a) Ghulam Muhammad Malah b) Babur Tandio c) Allah Dino Manchero d) Arab Doki
		No. of Male FGDs	04
		No. of Female FGDs	02
29/01/2025	Pir Pithai Outfall Drain	Villages visited	a) Gul Mohammad Dal b) Wadero Dalel Jhokio c) Wadero Musa Tandio
		No. of Male FGDs	03
		No. of Female FGDs	02
	Buhara Outfall Drain	Villages visited	a) Haji Mohammad Qasim Jat b) Buhara City
		No. of Male FGDs	01
		No. of Female FGDs	01
30/01/2025	Sakro Branch Canal	Villages visited	a) Soomar Hotel/ Stop b) Haji Abdul Qadir Lashari/ Gharo Waah c) Natho Khan Samejo d) Mohammad Essa Malah e) Usman Malah f) Ibrahim Memon
		No. of Male FGDs	04
		No. of Female FGDs	03
31/01/2025	Sakro Branch Canal	Villages visited	a) Buhara City KII b) Stop 133 c) Essa Khan d) Peer Mohammad Adhya Baloch
		No. of Male FGDs	04
		No. of Female FGDs	03
01/02/2025	Garho Outfall Drain	Villages visited	a) Mohammad Aneen Jut
		No. of Male FGDs	01
		No. of Female FGDs	01
	Mui Dhand	Villages visited	a) Gul Mohammad Shoro
		No. of Male FGDs	01
		No. of Female FGDs	01
02/02/2025	Geri Branch	Villages visited	a) Arab Rind

Date	Scheme	Progress	
			b) Bachu Malah (1) c) Bachu Malah (2)
		No. of Male FGDs	03
		No. of Female FGDs	03
03/02/2025	Malkani Outfall Drain	Villages visited	a) Arib Sameja
		No. of Male FGDs	01
		No. of Female FGDs	01
04/02/2025	Nagin Dhoro	Villages visited	a) Ghulam Shah Sim b) Muhammad Dars c) Haji Umer Kathiyar d) Muhammad Bux Sial e) Arbab Pandhi
		No. of Male FGDs	05
		No. of Female FGDs	05
05/02/2025	Jati Outfall Drain	Villages visited	a) Haji Laron Thaheem b) Ghulam Hussain Mallah c) Haji Qasim Buhrio
		No. of Male FGDs	03
		No. of Female FGDs	03
06/02/2025	Bao Bijora Norang Wetland	Villages visited	a) Allu Jakhro
		No. of Male FGDs	01
		No. of Female FGDs	01
	Pinnah Lake	Villages visited	a) Safar Shedi
		No. of Male FGDs	01
		No. of Female FGDs	01
07/02/2025	Begna Mori Regulator	Villages visited	a) Begna Stop
		No. of Male FGDs	01
		No. of Female FGDs	01

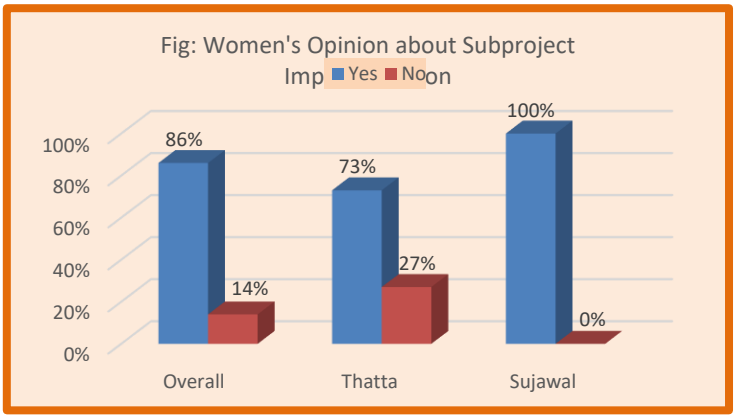
1. Project Merits

370. This project merit is widely recognized across all districts (85-87%), indicating successful drainage and water management improvements. Flood protection is rated highly across all regions (92-96%), reflecting effective infrastructure interventions. The project has also significantly contributed to job creation, with Sujawal (100%), Thatta (96%), and overall respondents (97%) recognizing employment opportunities generated by the project. Unlike flood protection, respondents from Sujawal perceive the highest benefit (38%) from storm protection, while Thatta (17%) reports a lower impact. The overall perception remains low (25%). The most significant increase in forest cover is also reported in Sujawal (54%), while Thatta (22%) shows a lower impact. The overall perception is moderate (33%), indicating varying degrees of reforestation success. Thatta (61%) reports the highest improvement in agriculture, while Sujawal (31%) reports the lowest. This suggests that agricultural interventions have been more effective in Thatta.



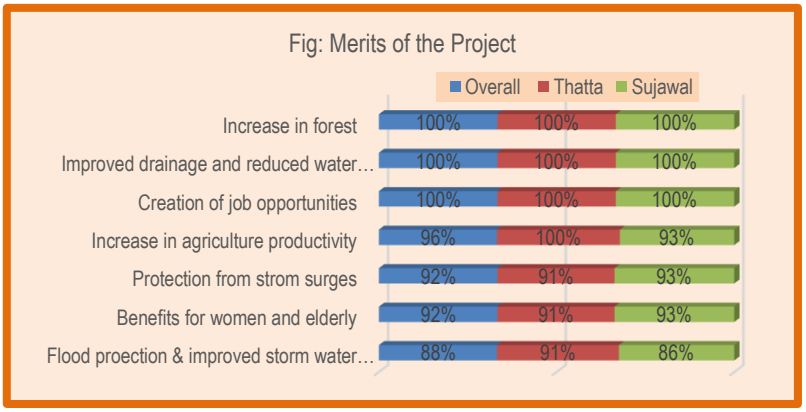
2. Women's Opinion about Subproject Implementation

371. The majority of women (86% overall) are in favor of the subproject implementation, reflecting broad support across the districts. Sujawal has a unanimous approval (100%), indicating full agreement among respondents in that area, however Thatta shows slightly lower approval (73%) and a higher percentage of dissent (27%), suggesting some concerns or reservations about the subproject in that district. The opposition in Thatta may be linked to issues such as lack of awareness, unmet expectations, or concerns about the project's impact.



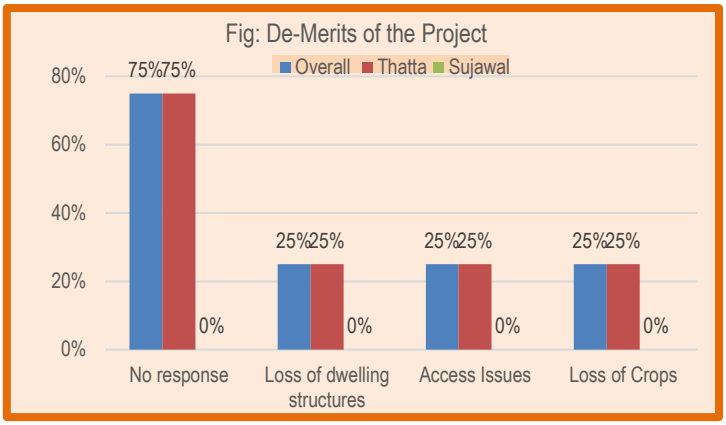
3. Merits of the Project

372. The project is overwhelmingly seen as beneficial, with multiple aspects receiving 100% agreement across both districts. Forest cover increase, drainage improvements, and job creation are universally acknowledged as project benefits (100% approval). Agricultural productivity improvement is slightly lower in Sujawal (93%) compared to Thatta (100%), suggesting possible variation in project impact. Flood protection and stormwater management received slightly lower agreement (88% overall, with 86% in Sujawal), which may indicate that some areas are still experiencing flood-related issues. Protection from storm surges and benefits for women and the elderly are highly acknowledged across all regions, though marginally lower in Thatta.



4. De-Merits of the Project

373. A majority of respondents (75%) did not identify any de-merits of the project, indicating that most people did not perceive significant negative impacts or were unaware of them. Concerns about loss of dwelling structures, access issues, and crop loss were only reported in Thatta (25% each), while no respondents from Sujawal reported these concerns.



374. This suggests that the project had minor localized negative impacts in Thatta, possibly due to infrastructure modifications, land use changes, or temporary disruptions. The absence of reported issues in Sujawal may indicate better planning, less disruption, or lower awareness of potential de-merits.






SCRSP
Shorabari Outfall Drain
Lhayo Jatt Village
27.01.2025 14:48
24°32'4.29"N 67°49'48.69"E
Altitude: 45m
GRMJ+R47, Canal Rd
EMC Pakistan
Sindh Coastal Resilience Project
Meeting with UC Chairman Ver City
31.01.2025 10:46
24.5508, 67.84594
HR2W+76R, Vur
EMC Pakistan
Sindh Coastal Resilience Project
Village Gaber Channo FGD
26.01.2025 14:04
24.3808, 67.6732
Canal Rd
SCRSP
Sakro Branch Canal
30.01.2025 12:36
24°34'2.102"N 67°47'19.69"E
Altitude: 41m
HJ2W+2R, Mirpur Sakro
SCRSP
Sakro Branch Canal
30.01.2025 13:23
24°34'2.102"N 67°47'19.69"E
Altitude: 43m
Mirpur Sakro Ghulamullah Rd
SCRSP
Sakro Branch Outfall
Natho Khan Samejo
30.01.2025 10:11
24°35'2.120"N 67°38'45.95"E
Altitude: 41m
HJ2W+2R, Mirpur Sakro
SCRSP
Sakro Branch Canal
Ghulam Ghulamullah FGD
30.01.2025 12:50
24°35'0.8"N 67°48'49.92"E
Altitude: 43m
Canal Rd
EMC Pakistan
Sindh Coastal Resilience Project
Haji Abdul Qadir Lashari Village FGD
30.01.2025 14:59
24.56742, 67.68904
Mirpur Sakro Ghulamullah Rd
SCRSP
Pir Pathai Drain
29.01.2025 12:58
24°25'55.38"N 67°39'48.37"E
Altitude: 40m
Unnamed Road
EMC Pakistan
Sindh Coastal Resilience Project
RD 163 Tail Regulator Essa Khan Village FGD
31.01.2025 13:17
24.47384, 67.57121
Unnamed Road



Figure V-2: Photodocumentary of Male FGDs




Coastal Resilience
SCRP
FGD 14
01.02.2025 13:57
24.33093, 67.58782



Figure V-3: Photodocumentary of Female FGDs

E. Consultation with Secondary Stakeholders

1. Consultation with Wildlife Department, Government of Sindh

375. The consultation was carried out on 14 May, 2025 with Wildlife Department, Government of Sindh, who has a mandate to implement The Sindh Wildlife Protection, Preservation, Conservation and Management Act, 2020. The wildlife department also designates, protects and manages protected areas in Sindh.



376. As part of the IEE process for the subproject, a consultation session was held with Mr. Wajid Ali Shaikh, Deputy Wildlife Conservator. Project details were shared, and Mr. Shaikh confirmed that no protected wildlife areas are located near the subproject components (drains, wetlands, and mangrove plantations). He noted that the project will benefit local communities and contribute to flood mitigation. Additionally, he highlighted the positive impact on coastal biodiversity through improved freshwater supply to saline ecosystems.

2. Consultation with Sindh Environmental Protection Agency (SEPA)

377. The consultation was carried out with Sindh Environmental Protection Agency (SEPA) on 15th July, 2025, who has a mandate to implement Sindh Environmental Protection Act 2014 and rules and regulations 2021 thereunder. SEPA will also provide the approval of EIA to be submitted under the project. The consultation session was carried out as part of the IEE process for the subproject. Consultation was undertaken with Ms. Farzana Naseem, Assistant Director, SEPA. Ms. Naseem emphasized that the primary role of SEPA is to implement the SEPA Act of 2014 and promote environmental conservation across Sindh. Elaborating on this, SEPA grants project approvals for a maximum of three years. If a project remains incomplete within this timeframe, the approval becomes void, requiring the project team to reapply.



378. Stakeholders emphasized the need to assess ecological species potentially impacted by the subproject and recommended engaging all primary stakeholders to ensure transparency and collaboration. In particular, Ms. Naseem stressed the importance of conducting detailed consultations with local communities to understand potential impacts of project interventions. Additionally, she raised concerns regarding the efficiency of existing wetlands, noting that rehabilitation efforts would only be viable if the wetlands function at the expected ecological performance levels. One of her major concerns was on the maintenance of new mangroves plantations, with Ms. Naseem urging to conduct trainings of locals within the locality and educate the necessary civil society groups to facilitate in ensuring the proper maintenance of all the structural and non-structural upgrades in the long run.

3. Consultation with Sindh Fisheries Department (Marine)





379. Consultation was undertaken with Ms. Kashifa Zohra, Deputy Director, Sindh Fisheries Department (Marine) on 15th July, 2025. Ms. Zohra emphasized the department's role in monitoring and conserving marine life within the project area. She noted that, whilst her department is not directly affiliated in that particular region, the plantation of mangroves should also be followed up with regular upkeep to ensure that they are not prematurely cut down. Furthermore, Ms. Zohra stressed the need to protect existing habitats of the animals present in the vicinity, with subsequent development activities requiring a thorough feasibility assessment by the department in charge to ensure proper management and mitigation measures are in place.

380. Regarding the project itself, Ms. Zohra remained optimistic regarding the outputs that such development would entail in the area. An increase in the plantation of mangroves directly benefits local communities through a flood mitigation perspective but also helps reduce fish mortality throughout the area. The possibility of repeated floods as a result of climate change makes her feel that mangroves will serve as a barrier to limit damages to the communities within the subproject district.

4. Consultation with IUCN (International Union for the Conservation of Nature)



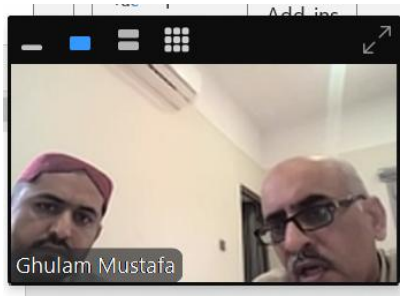
381. Consultation was undertaken with Dr. Babar Hussain, Natural Resource Management Coordinator of IUCN Pakistan on 18 July, 2025. Dr. Babar shared that the organization has implemented several mangrove restoration projects across coastal Sindh, including in Keti Bunder, Sandspit, and Hawksbay. These initiatives have involved strong community engagement efforts focused on the conservation of mangroves, coastal bird species, and marine turtles. Similar activities have also been carried out in the Manora and Salehabad areas.

382. Dr. Babar also referenced IUCN's leadership of the Sea Intrusion Project, which ran from 2014 to 2022, addressing the growing threat of saltwater intrusion in vulnerable coastal areas. As part of their interventions in Keti Bunder, IUCN installed water pumps and constructed artificial freshwater ponds to improve access to clean water for local communities. These facilities were fully funded and implemented by IUCN.

383. Regarding the Project, Dr. Babar emphasized the importance of ensuring that all relevant stakeholders are involved in the project planning and implementation process. This coordination, he noted, is essential to prevent overlap between government departments and avoid duplicating efforts already underway. Dr. Babar pointed out that most of the local population in the project area is involved in fishing, crab and jellyfish breeding, and to a lesser extent, agriculture. He recommended the construction of additional artificial ponds to support communities with freshwater

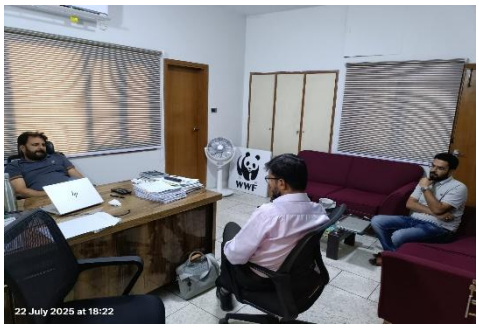
access during times of scarcity. He also recommended engaging closely with local feudal lords, who remain important and influential stakeholders in the region. He strongly recommended conducting a Community Needs Assessment at the individual village level, as each village has its own unique challenges. This approach, he explained, not only helps in identifying specific priorities but also builds trust with the local population. Finally, he proposed that local teams be formed from within each village and trained to manage and maintain the resources and facilities introduced through the project. This, he emphasized, would ensure the sustainability and long-term success of SCRP interventions.

5. Consultation with NRSP (National Rural Support Program)



384. Consultation was undertaken with Mr. Ghulam Mustafa, Regional General Manager and Mr. Ghazal, Community Development Specialist, NRSP via online platform on 17 July, 2025. The participants of the meeting strongly recommended community involvement at all stages of the project, noting that each village faces unique socio-environmental challenges and requires tailored interventions. NRSP emphasized the need for locally relevant training and workshops tied specifically to the proposed developments in each area. They advised that implementing agencies should coordinate with existing organizations and NGOs already working in these areas, as they understand local community dynamics, psychology, and trust structures. It was noted that residents in these regions have lived there for generations, and adapting to new infrastructure or development projects can be difficult. Therefore, all interventions should be community-specific, culturally sensitive, and gradually introduced.

6. Consultation with WWF



385. Consultations were held with Mr. Altaf Sheikh, Manager Conservation, WWF Sindh, and Mr. Shoaib, Coordinator Marine and Oceanography, WWF Sindh on 22 July, 2025. During the meeting, the participants emphasized that the Indus Delta harbors a unique ecology and biodiversity, including mangrove ecosystems and coastal mudflats that serve as critical hatcheries for shrimps, small fish, and crabs, and are frequented by large epipelagic species. They acknowledged the substantial benefits of the project, particularly in terms of flood mitigation and the reduction of seawater intrusion. However, concerns were raised regarding the potential impacts of increased agricultural runoff and the introduction of untreated sewage into the drainage system. It was noted that if the volume of drainage water increases due to rehabilitation and remodeling works, it could negatively affect the ecological balance of the Indus Delta. At the same time, the participants recognized that improved drainage efficiency could enhance the supply of low-salinity freshwater—essential for sustaining mangroves, shrimp populations, and mollusk communities. To ensure ecological protection, WWF recommended conducting a baseline study to document the status of aquatic fauna—especially shrimps, crabs, and mollusks—in the deltaic creeks receiving discharge from outfall drains. This baseline would serve as a reference point for assessing ecological changes during the post-construction and operational phases. Additionally, it was recommended that heavy metals, which pose a significant threat to aquatic ecosystems, be regularly monitored during the operation phase. The recommendations provided by WWF were duly noted for incorporation into the project's environmental management framework.

VI. ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS

A. Introduction

386. The proposed subprojects were assessed for anticipated environmental impacts during design and construction phase. In operation phase, the drains and canal will function as its design state. No deterioration of environment or any adverse impacts are anticipated during operation of drains. Anticipated adverse impacts are listed in Table II-1.

1. Impact Assessment Methodology

387. This ESIA study has analyzed and assessed the anticipated impacts that are likely to arise due to the identified aspects in siting/design, construction and operation phases of subprojects. Each of the potential impacts identified during the screening surveys and consultation sessions was evaluated using the environmental, socioeconomic, and project information collected. In general, the impact assessment discussion covers the following aspects:

- Present baseline conditions
- Potential changes in environmental parameters due to project (checklist method)
- Prediction of potential impacts
- Evaluation of the potential impacts
- Defining of mitigation measures to reduce impacts to as low as practicable
- Monitoring of residual impacts.

a. Impact Prediction

388. Prediction of impact from different activities during all phases of project has been made to ascertain that the spatial extent, impact duration and significance along with its rating.

389. Assessment of potential environmental impacts involved combined use of checklist and matrix method along with professional judgment to effectively evaluate the potential impacts during different stages of project activities. The formula for determining the likelihood, severity and significance of impact is shown below:

Impact Significance / Rating

Overall Impact Rating	Impact Significance
> 16	Extreme
11 ~ 16	High
7 ~ 10	Moderate
4 ~ 6	Minor
≤ 3	Insignificant

	Likelihood/Frequency				
	Almost Certain (5)	Likely (4)	Possible (3)	Unlikely (2)	Rare (1)

Consequence / Severity						
	Very High (5)	Extreme (25)	Extreme (20)	High (15)	Moderate (10)	Minor (5)
	High (4)	Extreme (20)	High (16)	High (12)	Moderate (8)	Minor (4)
	Medium (3)	High (15)	High (12)	Moderate (9)	Minor (6)	Insignificant (3)
	Low (2)	Moderate (10)	Moderate (8)	Minor (6)	Minor (4)	Insignificant (2)
	Very Low (1)	Minor (5)	Minor (4)	Insignificant (3)	Insignificant (2)	Insignificant (1)

390. Below tables are used to ascertain the probability and severity of individual impact.

	Almost Certain	Likely	Possible	Unlikely	Rare
Likelihood / Probability	Could be incurred several times in a year	Could be incurred once in a year timeframe	Could be incurred over 1-2 year timeframe	Could be incurred within 5 year timeframe	Could be incurred in a 5-20 year timeframe

Severity	Very High	High	Medium	Low	Very Low
Environment / Social	Extensive and long-term impacts causing irreversible damage to all components of environment including land, water, air, ecology and social settings as a result of pollutants releases. Examples include: Emissions of air pollutant responsible for regional impacts (e.g., CFC, GHG, Particulate matter) in large quantities, long-term impacts to water bodies from wastewater discharges, huge quantity of Solid waste generation causing impact on the services of the region including hazardous waste, extensive areas of ground damage, or large spills affecting waterway ecosystem, long term affects / diseases on social settings such as large city or a town. The concentrations of released pollutants discussed above will be significantly higher than the international as well as local environmental quality standards (WHO/IFC/SEQS).	Severe impacts causing damage to some of the components of environment like land, water, air, ecology and social settings as a result of pollutants releases but the damage will be reversible and the environmental components will be rehabilitated or readapt the original state after an extended period of time. Example include: Emissions of air pollutant responsible for regional impacts (e.g. GHG, Particulate matter) in significant quantities, or impacts to water bodies from wastewater discharges for an extended period, or extensive areas of soil contamination and large quantity of Solid waste generation causing impact on the services of the region including hazardous waste or large spills affecting waterway ecosystem, or significant impact on social settings including small town / cluster of villages or significant impact on sensitive area with significant impact for an extended period of time. The concentrations of released pollutants discussed above will be significantly higher than the international as well as local environmental quality standards (WHO/IFC/SEQS).	Local environmental impacts with degradation of sensitive habitat or potential impact to wildlife or fisheries or agricultural lands or social settings. Examples include: Emission of air pollutants in moderate quantity altering air quality in the immediate surroundings, discharges of concentrated contaminants to water, moderate quantity of Solid waste generation causing impact on the services of the area, localized areas of ground damage, significant impact on social settings including small area in a city or a village, or medium size spills of hazardous chemicals /hydrocarbons (>=0.2 m^3 and <20 m^3) in less sensitive areas. The concentrations of released pollutants discussed above will exceed the international as well as local environmental quality standards (WHO/IFC/SEQS).	Local environmental impacts with degradation of habitat or low impact to wildlife or fisheries or agricultural lands. Examples include: Emission of air pollutants in low quantity which may affect air quality in the immediate surroundings, discharges of concentrated contaminants to water, localized areas of ground damage, small quantity of Solid waste generation causing impact on the services of the area, or medium size spills of hydrocarbon (<0.2 m^3) in less sensitive areas, or physical impacts to ground directly adjacent to a site or low consumption of natural resources. The concentrations of some of the parameters of released pollutants in the environment will exceed slightly the international as well as local environmental quality standards (WHO/IFC/SEQS).	Environmental impacts are not existent, are transitory, or are limited to a relatively small area where there is no impact on flora or fauna or social settings for very small duration. Examples include: well-dispersed atmospheric emissions, dilute aqueous discharges to water, spills of hydrocarbon (negligible amount), small quality of solid waste generation that can be manageable by the project. The concentrations of released contaminants will be complying the international as well as local environmental quality standards (WHO/IFC/SEQS).

	Large uncontrolled release of hazardous material / effluent e.g., >100,000 m^3, 10,000 m^3 in sensitive area.	Uncontrolled release of reportable quantity. e.g., >1000 m^3.	Uncontained release of minimum reportable quantity.	Contained releases of hazardous material. Release contained to site.	Contained releases of non-hazardous material. No off site impacts.
	Impact far beyond the Project boundary.	Impact on immediate neighborhood beyond Project boundary.	No long-term impact beyond project boundary.	No prolonged damage.	Minor damage/ quick clean-up.
	Resettlement of population of >1,000 people and landlessness.	Resettlement of population of >200 people and landlessness.	Only economic displacement and livelihood loss for <200 people.	Nuisance to public, but no permanent loss and damage.	Negligible impact on locals.
Occupational Health	Multiple deaths or multiple persons on-site with onset of severe or life-threatening health effects alleged to be due to exposure arising from project activities.	Death or onset of severe or life-threatening health effect to single person on-site alleged to be due to exposure arising from project activities.	Single person on-site with onset of irreversible health effect alleged to be due to exposure arising from project activities.	Single person on-site, with moderate short term reversible health effect resulting in DAFWC and alleged to be due to project activities.	Minor injuries or over-exposure to single person on site, but no reported ill-health effect e.g., monitoring result shows occupational exposure limit has been exceeded like dust and noise, or one-off event such as failure of local controls or PPE
	Death or onset of severe or life-threatening health effects to single person off-site (not involved in the project activities e.g., community member, student, visitor) alleged to be due to exposure arising from project activities.	Multiple persons on-site with onset of irreversible health effects alleged to be due to exposure arising from project activities.	Multiple persons on-site with mild to moderate short term reversible health effects resulting in DAFWC and alleged to be due to project activities.	Over exposure to multiple persons on-site but no reported health effects.	
	Multiple persons off-site with onset of irreversible health effects alleged to be due to exposure arising from project activities.	Single person off-site with onset of irreversible health effect alleged to be due to exposure arising from project activities.	Single person off-site, with mild to moderate reversible short term health effects alleged to be due to project activities.	Off-site exposure likely, but no effects identified.	
		Multiple persons off-site with mild to moderate reversible short term health effects alleged to be due to exposure arising from Project's activities.			
Safety	Multiple fatalities amongst persons on-site.	Fatality to single person on-site.	Permanent injury to single person on site.	Single or Multiple minor (recordable) injuries amongst persons on site.	First Aid or Less.
	Fatality to single person off-site.	Multiple permanent injuries amongst persons on site.	Single or Multiple non-permanent injuries (DAFWC) amongst persons on site.	Recordable injury to single person off site.	No impact to persons off site

	Multiple permanent injuries to persons off-site	Permanent injury to single person off site.	Non-permanent injury to single person off site.		
		Multiple non-permanent injuries to persons off site			
DAFWC–- Days Away From **Work Cases** On-site persons – involved in project activities e.g., construction labor Off-site persons–- not involved in the project activities directly e.g., commuters, community members, residents, shop owners, school children					

2. Significance of each Impact

391. To summarize each impact prediction based on the use of above table, following matrix is used.

Impact Description	**[Increased sedimentation in streams]**		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Very Low (1)	*Likely (4)*	*Minor (14)*

B. Environmental Screening

392. All ADB loans and investments are subject to classification for the purposes of determining environmental assessment requirements. Environment categories are determined using Rapid Environmental Assessment (hereinafter referred to as "REA"). REA uses sector-specific checklists developed based on the ADB's past knowledge and experience. These checklists consist of a set of questions relating to:

- the sensitivity and vulnerability of environmental resources in project area, and
- the potential for the project to cause significant adverse environmental impacts.

C. Impacts Assessment during Siting and Design

1. Positive Impacts

393. Poor drainage facilities and overirrigation practices in the SCRP target districts has caused excessive waterlogging and salinization, resulting in extreme cases in severe deterioration of existing agricultural lands and making them unfit for agricultural production. The proposed improvement of existing drainage system and irrigation system will provide environmental benefits through the conservation and improvement of the quality of soil resources and increase in crop production. Thus, land drainage can also have a favorable environmental impact as well-designed and implemented drainage systems can control soil salinization. At the same time, soil degradation and land desertification are avoided. The project consequently will improve the living condition of communities by reducing risks associated with salinization and flood such as loss of lives, corps, loss of properties, and health risks during floods. During construction the project will contribute to the employment to the local communities.

2. Encroachment on Historical/Cultural/Archaeological Sites

394. There are no gazetted archaeological, cultural and historical sites located within the close vicinity of proposed subproject areas.

395. The possible discovery of heritage resources particularly archeological resources or random findings during the execution of rehabilitation works, will require measures to manage chance finds. This ESIA includes “Chance Find" procedures for protection of any tangible cultural heritage (archeological) discovery during construction / rehabilitation phase. The Chance Find procedure is provided in **Annex III**. The Chance Find procedure will also be included in CC bidding documents.

Impact Description	Possible discovery of heritage resources		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	High (4)	*Rare (1)*	*Minor (4)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Rare (1)*	*Insignificant (2)*

3. Biodiversity and Ecological Resources

a. Description

396. Bijora Bao Norang Wetland, which is one of the wetland subprojects is located close to a wildlife sanctuary namely **Bijoro Chach**. The wildlife sanctuary is known for important breeding area for Water Fowl. However, development of wetland and improved water retention and periphery tree cover will enhance the ecological character of the wetland.

397. Under output 2, one of the subprojects namely Mangroves Plantation (Ghorabari) will be undertaken in Indus Delta which is a Ramsar Site as well as it is 02 km away from Marho Kotri Wildlife Wildlife Sanctuary, but the purpose is to plant mangrove and improves ecological characteristics and forest cover.

398. Mangroves Plantation (Nagan Dhoro) will be undertaken in Indus Delta which is a Ramsar Site as well as a close to Keti Bundar wildlife sanctuary, but the purpose is to plant mangrove and improves ecological characteristics and forest cover. Inland Plantation (Jati) will be undertaken in Indus Delta which is a Ramsar Site as well as a close to Keti Bundar wildlife sanctuary, but the purpose is to plant trees and improves ecological characteristics and forest cover.

399. Most of the subproject’s alignments do not intrude or affect any reserved / protected forest designated under Sindh Forest Act 1927. However, the Bijora Bao Norang Wetland is located inside the reserved forest Called Bijora Forest designated by forest department. The land use around the wetland is encroached upon with cultivation by locals and no forest land use was observed. Also, the Pinnah Lake is located inside the reserved forest called Pinnah Forest designated by forest department. However, development of wetland and improves water retention and periphery tree cover will enhance the ecological character of the wetland.

400. Indiscriminate cutting of trees and not undertaking proper replantation could lead to degradation of the environment (or CoI). There are a total of 579 mature trees to be cut down during rehabilitation works along drains and a canal. Plenty of trees in Output 2 of the project i.e., in NbS have been planted by Sindh Forest Department. Nevertheless, following measures to be taken.

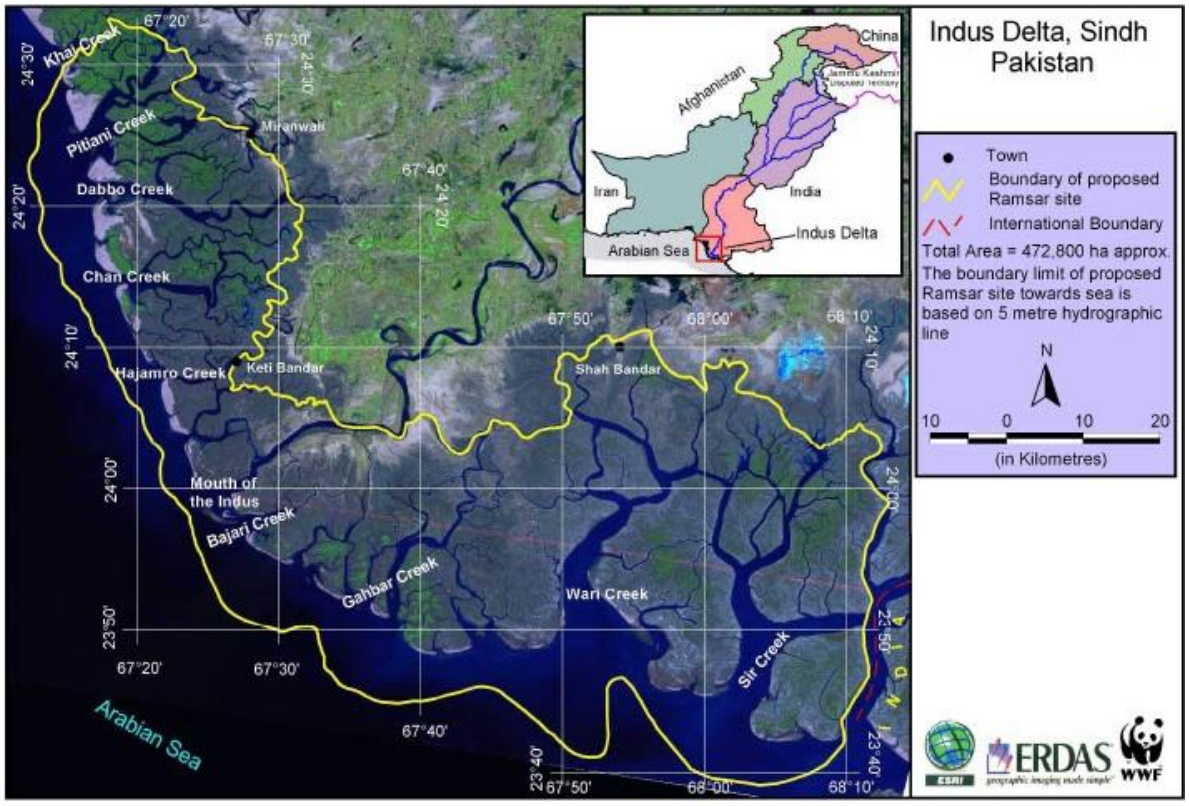


Figure VI-1: Boundaries of Indus Delta (Source: https://rsis.ramsar.org/ris/1284)

b. Mitigation Measures

401. Mitigation measures proposed are at the design stage of the subprojects:

- The vegetation cover loss shall be minimized and tree cutting will be avoided as much as possible.
- Compensatory plantation of trees which need to be cut down, shall be provided.
- The compensatory plantation of trees will be done along the existing ROW at the edge of the embankments of subprojects after rehabilitation.
- In addition, the contractor will establish his campsite on waste /barren land rather than green or agriculturally productive land, in order to minimize the clearing of vegetation.
- Contractor will be responsible for the monitoring and protection of tree cover.

Mitigation measures proposed for Intrusion in Protected Areas / IBAs are:

- An overseeing committee comprising Sindh Forest Department (SFD) and Sindh Wildlife Department (SWD) as main stakeholder with Deputy Commissioners (DCs) of that area and proponent who will look after the subproject during construction.
- Construction work shall be initiated with the consent of SFD and SWD in all ecologically sensitive areas. SFD and SWD nominated officials shall be part of the monitoring team.
- Wildlife critical areas / core areas should be avoided including feeding grounds, watering holes, ravines etc.
- Vehicle speeds will be regulated and monitored to avoid excessive dust emissions.
- Periodic counseling will be provided to drivers on mitigation measures related to off-road travel and speeds limits.
- Off-road travel should be avoided in sensitive areas as much as possible and observance of this should be monitored during construction.

- During construction movement of construction equipment will be restricted to work areas only to avoid unnecessary disturbance to soils in the project area.
- Botanists trained in the identification of plant species will accompany the construction crews whilst they operate in critical habitats.
- The monitoring team will have wildlife expert familiar with the behavior of endangered species in order to observe the effects of construction of drainage on wildlife.
- A 'no-hunting, no-trapping, no-harassment' policy will be strictly enforced at the construction sites;
- Strict administrative measures will be taken against any illegal animal hunting and poaching in such areas for anyone associated with the construction activities;
- Night work during construction in ecologically sensitive areas will be prohibited, night traveling will not be allowed unless absolutely necessary.
- All mitigations related to minimizing noise will be adhered to.
- Lights used at the construction sites and campsites will be kept to the minimum required.
- Firewood, woody plants and shrubs will not be used as fuel during construction.
- Promote the sustainable use of natural resources for the local communities living in and around the protected areas.
- Reducing campsite effluents entering into the protected areas without treatment.

Impact Description	Biodiversity and Ecological Resources		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Medium (3)	*Possible (3)*	*Moderate (9)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Possible (3)*	*Minor (6)*

4. Poverty

402. Poverty is increasing with passage of time in Sindh rural areas. In case of urban areas, poverty is more evident in slums and encroachments. The main causes of poverty are traditional agricultural practices, fragmented landholdings, non-availability of safe drinking water and sanitation facilities, low literacy rate, inadequate institutional arrangements for addressing social sector problems, and lack of access to social justice system. There are serious poverty issues relating to the fact that the poor often use land without legal title.

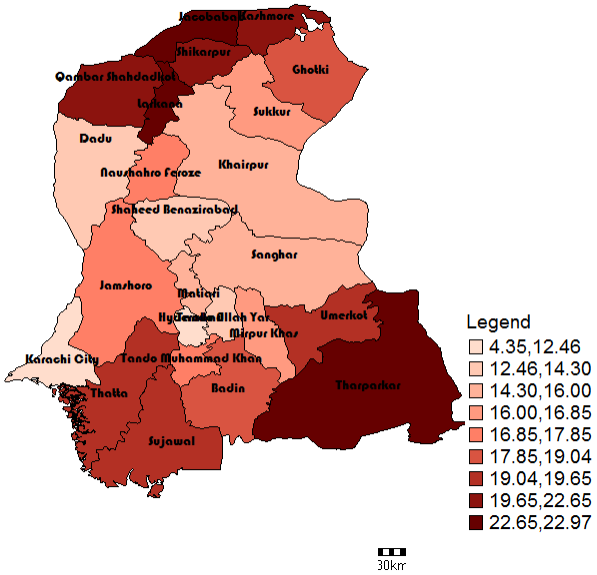


Figure VI-2: Spatial Poverty Incidence - Sindh Unidimensional Poverty[51]

403. It has been confirmed to date that no land acquisition will be required for the project development works. The components under Output 1 will be implemented strictly within the Right-of-Way (RoW) of SID and SFD. However, there is a possibility that the RoW may be encroached upon by squatter settlements, unauthorized structures, and cultivation on the land belonging to IAs.

404. The Output 2 components, which consist of nature-based solutions (NbS) undertaken by SFD, are proposed along coastal areas and may include private lands, settlements, and revenue lands. The proposed lands and creek systems in these coastal areas are highly vulnerable to climate hazards. The NbS initiatives primarily involve creating buffer plantations of mangroves and inland trees to protect the coastal regions and irrigation networks from natural calamities and climate-related impacts. These initiatives will be implemented through active community participation, including women's involvement.

405. The plantation strips proposed under Output 2 will also require the development of water conveyance systems as part of the project components. To facilitate the NbS interventions, agreements with farmers and local landowners will be undertaken by EA/IAs through mechanisms such as Voluntary Land Donation (VLD), tenancy agreements, and revenue-sharing agreements. The specific nature and type of agreements will be determined based on consultations with landowners. However, Output 2 components will avoid settlements, built infrastructure, and other existing structures, where tree plantation is not feasible.

Impact Description	Agreements with farmers and local landowners		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term

[51] Source: Calculation Using PSLM, 2010-11 - The Livelihood and Poverty Mapping Analysis at Regional Level in Pakistan, Development Economics Group, August, 2015

Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Unlikely (2)*	*Minor (4)*

5. Resettlement

a. Description

406. If involuntary resettlement is unavoidable, it will have a negative impact on the poor and marginalized population and vulnerable people. Resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits.

b. Mitigation Measures

407. Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them. Valuation and compensation of affected assets of community should be in line with LARF/Sub-project The project will be prepared subproject specific land acquisition and resettlement plan (LARP) consistent to ADB SPS, 2009 SR2 and LLA Act, 1894. The subproject specific LAPR will be implemented before commencement of physical works.



Figure VI-3: Katcha houses located along berms of Sakro Branch Canal



Figure VI-4: Some of the drains are traversing along densely populated towns

Impact Description	Resettlement Impact		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	High (4)	*Unlikely (2)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Unlikely (2)*	*Minor (4)*

6. Agriculture Activities

a. Description

408. Agriculture is the predominant economic activity of most of the rural population of Sindh. The principal sources of irrigation are the surface channels supplemented by tube-wells. Rainfall accounts only for a small proportion of the irrigation sources. Horticulture and aviculture are gaining popularity. Investments in sheep-, goat-, fish-, poultry-, and dairy-farming also exist.

409. The drainage channels are traversing along agriculture areas. Some of the agriculture farms have direct inlet into the main drains while other use subdrains. Impacts on the agriculture areas and standing crops are envisaged due to rehabilitation works in case of agriculture farms are encroaching upon the RoW or the proposed footprints of drains.



Figure VI-5: Agriculture areas along the drains

410. Contamination of agriculture land due to fuel / lubricating oil spillage is envisaged also during rehabilitation works.

411. If unavoidable, the loss of standing crops shall be compensated as per subproject specific LARP.

Impact Description	Impact on agriculture crops		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Unlikely (2)*	*Minor (4)*

7. Gender Issues

a. Description

412. There is high evidence of gender disparity across the province of Sindh. The problem is more acute in rural areas, which needs to be addressed. GPIs for rural areas are likely to be much lower than those recorded for urban areas[52]. Gender disparity in education is a considerable and complex challenge for the Government of Sindh. The problem persists across all education indicators (literacy, net primary enrolment, and particularly primary school completion).

b. Mitigation Measures

413. Subproject environmental assessment documents and LARP (if applicable) will include measures ensuring that the socio-economic needs and priorities of women are identified, addressed and mitigated. The gender provisions will be incorporated to safeguard the specific needs and problems of women displaced persons during subproject implementation. The socio-economic data gathered will be gender-disaggregated. Female staff will be hired to collect data and assist women in resettlement activities. Female household heads will be registered as the recipients of

[52] Report On the Status of Millennium Development Goals Sindh – October 2012 UNDP

compensation and rehabilitation measures due to their households. Women will be included in the consultation process through meetings held with women and will be encouraged to participate in the LARP planning and implementation process.

414. Intensive sensitization and awareness campaigns focused on women of all ages should be part of mitigation plans.

Impact Description	Gender Issues		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Possible (3)*	*Minor (6)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Very Low (1)	*Unlikely (2)*	*Insignificant (2)*

D. Impacts Assessment during Construction Phase

1. Increased Erosion and Sedimentation in Water Channels

a. Description

415. As illustrated in table III-1, there are number of outfall drains and one branch canal that need to be rehabilitated under the project. Excavation to be carried out within these perennial and non-perennial water channels for raising and strengthening of embankments, desilting and weed clearance, rehabilitation of allied structures etc. will be the greatest source of sediments, as these will be easily mobilized. Given that these channels are unlined, they are highly susceptible to erosion, particularly during the high-flow monsoon season. Conversely, erosion levels decrease during the low-flow winter season when drainage activity is minimal due to the limited availability of irrigation water. Undertaking project activities including excavation and related earthworks during peak flow periods is likely to further increase turbidity levels, potentially impacting the ecology of the receiving waters of Indus Delta.



Figure VI-6: Already eroded banks and embankments of existing drains containing drainage water

b. Mitigation Measures

416. To mitigate the potential environmental impacts of excavation and rehabilitation activities on outfall drains and branch canals, the following measures should be implemented:

- To minimize erosion and sediment transport, excavation and earthworks should be scheduled during the low-flow winter season, avoiding peak monsoon periods. Implementing the project in a phased manner by working on small sections at a time instead of large-scale, simultaneous interventions will help reduce the volume of mobilized sediments.
- Silt barriers and sediment traps should be installed to capture suspended sediments before they enter receiving waters. The use of fast-growing native vegetation along embankments will stabilize soil and reduce erosion. Riprap and geotextiles should be applied along embankments and vulnerable sections to prevent erosion, while turf reinforcement mats can provide temporary stabilization until vegetation is established.
- Regular turbidity and suspended sediment level monitoring should be conducted in affected water bodies. Temporary sedimentation basins can be constructed to allow suspended particles to settle before water re-enters the channels. Before entering sediment discharge in Indus Delta, silt curtains or cofferdams should be used to contain sedimentation, while low-impact excavation techniques will help minimize direct disturbances to water bodies.
- Proper disposal of dredged material should be ensured by transporting sediments to designated areas away from water bodies to prevent re-mobilization. Controlled dewatering methods, such as filtration systems or sediment bags, should be employed before discharging dewatered materials back into the watercourse.
- To reduce sediment loss, critical sections should be partially lined or protected with erosion-resistant materials. High-risk erosion zones should be stabilized using gabions or retaining walls, and controlled water flow should be maintained during excavation to minimize excessive scouring.
- Environmental training should be provided to construction workers on erosion control practices and sediment management. Local communities and stakeholders should be informed about project activities to minimize disruptions and ensure transparency.

Impact Description	Increased Erosion and Sedimentation in Water Channels		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Unlikely (2)*	*Minor (4)*

2. Alteration of Surface Water Hydrology and Drainage

a. Description

417. Alternation of surface hydrology is not anticipated as the project components selected to be implemented are rehabilitation works and implemented along existing water channels and allied structures. Construction and rehabilitation of water channels might require closure for extended periods if traditional construction approaches such as coffer dams are to be constructed to create a dry work area. If canals are closed, it will severely affect the irrigation needs of the command area. If drains are closed, it will affect the drainage ability of farmlands subject to temporary flooding.

b. Mitigation Measures

418. Mitigation measures proposed are:

- It is proposed that the water courses shall be diverted within the existing ROW to ensure a dry bed under the existing section or allied structure and to avoid the closure of water channels. However, if diversion is not possible, an approach using bulkhead gates are recommended to avoid the need for construction of cofferdams and thereby need for closure of the canals.
- To minimize disruption to irrigation and drainage, rehabilitation works should be executed in a phased manner, ensuring that only small sections of water channels are closed at a time. Staggered construction across different sections of the command area will prevent large-scale water flow disruptions and allow continuous water supply to farmlands.
- Temporary bypass channels or pipe culverts can be installed to maintain water flow while work is being carried out in sections. Partial closures should be prioritized over full canal shutdowns to balance rehabilitation needs with agricultural water requirements.
- Construction activities that require temporary closures should be scheduled during periods of low irrigation demand, such as the post-harvest season or the winter months when water requirements are minimal. Coordination with local agricultural stakeholders will help identify the most suitable timing for construction to minimize disruptions.
- For irrigation canal, temporary water diversion structures such as flexible pipes or lined ditches should be installed to provide an alternate water supply route to affected farmlands. For drainage channels, temporary pumping systems should be used to prevent waterlogging and ensure uninterrupted drainage of excess water from agricultural fields.
- Regular communication with farmers and local communities should be maintained to ensure that stakeholders are aware of the construction schedule and potential impacts.
- Advance notifications should be provided to allow farmers to plan their irrigation schedules accordingly. CC must maintain coordination with Irrigation department to ensure that mitigation measures are effectively implemented.

Impact Description	Closure of water channels for extended periods		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Possible (3)*	*Minor (6)*

3. Water Logging

a. Description

419. Compared to the situation in the Upper Indus, groundwater use in the Lower Indus is very modest; yet waterlogging (groundwater within 1.5 meter of the soil surface) is common and has been assessed to prevail over 1.5 to 3.5 Mha[53].

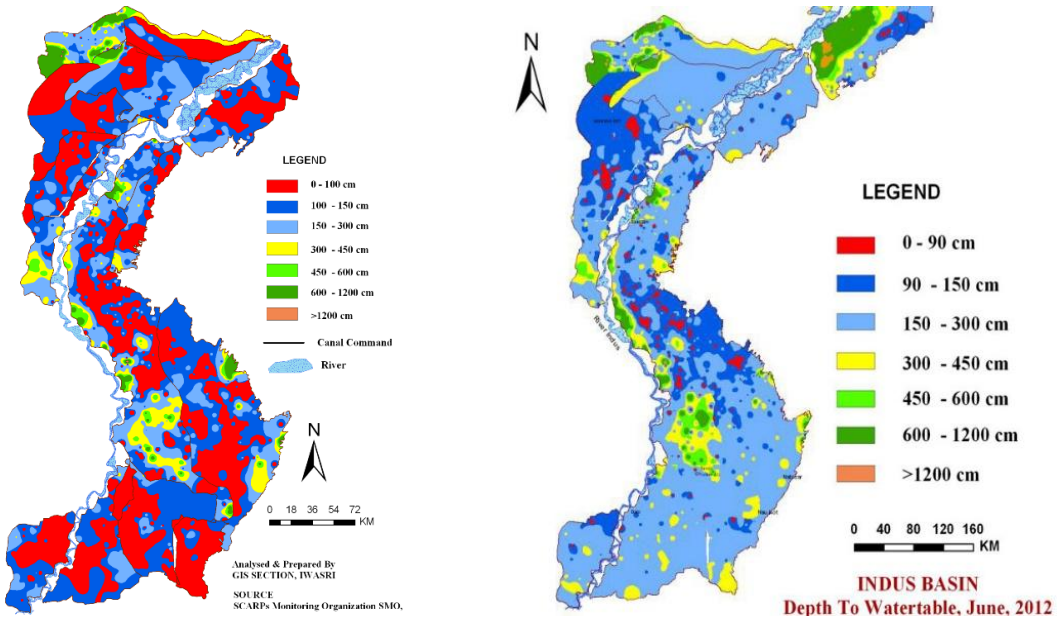
420. Excessive irrigation in areas with poor drainage causes waterlogging and salinization of the soil. When water does not penetrate deeply, it raises the water table. Air spaces in the soil are filled with water, and plant roots suffocate. Consequently, waterlogged conditions adversely affect crop yields and infrastructures. The cultivation of field and crops like red rice and commercial fish farming has declined drastically. Potable water has become scarce in the area.

b. Climate Change Induced Water Logging

421. High temperatures, especially in the pre-monsoon period, are likely to increase the intensity of rains in Sindh. These affect the intensity, frequency, and impact of the five categories[54] of floods the Sindh province is likely to be affected by.

422. The old and deteriorated drainage system in lower Sindh results in water logging and salinity which is enhanced by changing climate. The inability of the drainage infrastructures to channel the supplement irrigation water and stormwater into the sea from coastal districts i.e., Thatta, Sujawal and Badin Districts (Project Districts) causes losses and damages to agriculture lands as well as degradation to the community infrastructure. The ability of drainage has become more affected due to climate impacts like heavy monsoon rains, floods and seawater intrusion in the coastal region.

423. Historically, the districts most commonly affected, in terms of damages to human, wildlife, and rural/urban infrastructure, during 2010 and 2013 floods are Hyderabad, S. Benazirabad, Sukkur, and Thatha (PCO, IMAP, NASA 2012) (World Health Organization 2013).



[53] Resources 2015, 4(4), 831-856 (http://www.mdpi.com/2079-9276/4/4/831/htm)
[54] Monsoon Floods, Flash Floods, Floods due to Breaches, Urban Flood and Coastal Flood – Source - https://www.ndma.gov.pk/storage/plans/July2024/wfXLVc2K9Cp1MjFHq6YE.pdf

Figure VI-7: Depth to water table map of Lower Indus, post monsoon 2011[55]

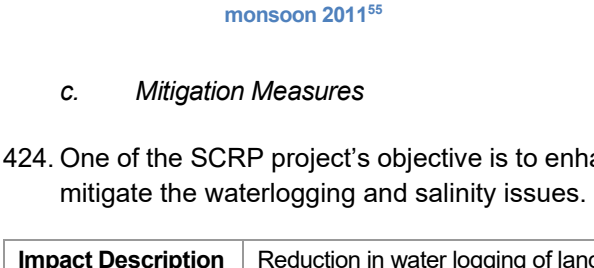
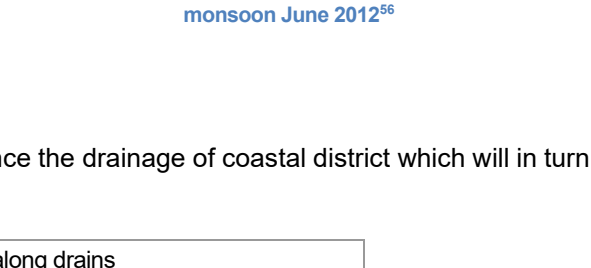


Figure VI-8: Depth to water table map of Lower Indus, pre-monsoon June 2012[56]



c. Mitigation Measures

424. One of the SCRP project's objective is to enhance the drainage of coastal district which will in turn mitigate the waterlogging and salinity issues.

Impact Description	Reduction in water logging of land along drains		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Medium (3)	*Likely (4)*	*High (12)*

4. Water Quality - (surface and ground) contamination

a. Description

425. Lubricants that enter the ground environment will render the area unusable and may pollute groundwater. Agriculture fields, outfall drains, community owned stream channels and canals can be polluted by fuel and lubricants entering these systems. The source of fuel and lubricants can be from the heavy machinery and project vehicles used during construction and rehabilitation stage.

b. Mitigation Measures

426. Mitigation measures proposed are:

- Construction Contractor (CC) of subprojects shall be responsible to take suitable preventive measures while using construction material that may result in contamination of ground and water resources like lubricants, solid waste, fuel.
- Construction camps will be proposed at least 100m away from water channels.
- Fuel and oil storage areas shall be proposed at least 100m away from water channels and be provided with a concrete platform and be bounded so that any fuel leakage is stored on site.
- These storage areas should be equipped with spill containment measures such as drip trays, absorbent pads, and containment barriers.
- Handling of lubricants and fuel should be done using appropriate pumps and leak-proof containers to minimize the risk of accidental spills.
- Care will need to be taken in handling the materials so that wastage does not enter the watercourses.
- Refueling should wherever possible be carried out at the fuel storage area and not be permitted adjacent to water channels.
- Regular maintenance and inspections should be conducted for all heavy machinery and project vehicles to ensure there are no leaks. Any equipment found with leaks should be immediately

[55] (Source: Van Steenbergen, F., Basharat, M., & Lashari, B. K. (2015). Key challenges and opportunities for conjunctive management of surface and groundwater in mega-irrigation systems: Lower Indus, Pakistan. Resources, 4(4), 831-856)
[56] (Reference: Basharat M., Hassan D. and Bajkani AA and Sultan S.J. 2014. Surface water and groundwater nexus: groundwater management options for Indus Basin Irrigation System. IWASRI Publication No. 299, WAPDA)

repaired before being used on-site. Oil pans or spill trays should be placed under parked or idle machinery to capture any drips or leaks.

- On inspection paths, asphalt should not be applied during rain so as to avoid it being washed into watercourses.
- A spill response plan should be developed and implemented, with emergency spill kits readily available at all work sites. These kits should include absorbent materials such as sand, sawdust, or commercial absorbents, along with containment booms for water bodies. Workers should be trained on spill response procedures, including immediate containment, cleanup, and proper disposal of contaminated materials.
- Used oil, lubricants, and oily waste should be handled and disposed by SEPA approved contractor. Disposal in open fields, canals, or drains must be strictly prohibited.

Impact Description	Water Quality - (surface and ground) contamination		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Very Low (1)	*Unlikely (2)*	*Insignificant (2)*

5. Waste Management

a. Description

427. Typical solid waste generated during rehabilitation works include unsuitable material potentially contains weeds, unsuitable excavated soil, uprooted shrubs, wood remains, debris from dismantled structure etc. and construction waste including containers such as bitumen drums, wrapping materials and plastic materials, waste concrete, steel scrap, wooden scaffolding, empty cement bags in small quantity etc. Solid waste generated during weed clearance and grubbing and Earth-fill material will be in large quantities.

428. This waste has the potential to cause negative impact on the surroundings if not properly managed and disposed of. It is likely to block nearby irrigation channels and may affect productivity of nearby agriculture fields. Irregular storage of this waste is hazardous to the workers at the site as well. Windblown debris is a nuisance to the nearby dwelling units. Poor waste management practices would result in short term, and long-term negative impact on the aesthetics of the surrounding.

b. Mitigation Measures

429. Mitigation measures proposed are:

- A Comprehensive Waste Management Plan for Construction phase will be developed by Construction Contractor (CC).
- A dedicated waste contractor will be hired by the Construction Contractor (CC) who will collect and dispose the waste in environment friendly manner.
- CC will develop the site-specific waste management plan.

- Debris and excavated soil generated will be reused in raising embankments subject to the suitability of the material and the approval of PMC-ES, or otherwise safely disposed of in barren land approved by ES.
- When a campsite developed for construction works is no longer required, Construction Contractor will need to remove the structures and also excavate and remove any contaminated soil.
- Proper solid waste areas of adequate capacity will be designated at campsite site to cater to daily waste generation.
- Care must be taken to prevent wastes giving rise to secondary environmental problems, such as odors or soil and groundwater contamination through rainwater leaching.
- All workers handling wastes shall use proper personal protective equipment (PPE)
- All wastes generated at facilities shall be categorized in two major categories (i.e., Hazardous wastes and Nonhazardous wastes). During construction phase, suitable areas with following color coding shall be kept to collect and segregate common wastes at all construction sites:

Waste Class	Waste material	Color code
Compostable	Food waste	Green
Inert	Dismantled pavement	Black
Recyclable	Metal / steel bars	Orange
	Glass	Blue
	Plastic	White
	Paper / Cardboards	Yellow
Hazardous	Used Oil / Oily Rags	Red
	Bitumen Containers	

- Recyclable waste will be sent to waste recycling contractor
- Compostable and inert waste will be disposed of in nearby empty land designated for landfilling by local municipal authority.
- Hazardous waste will be disposed of or incinerated by SEPA designated incinerator hired by Construction Contractor.

Table VI-1: Summary of Waste Management Options

S#	Waste Type	Category	Disposal Options
1.	Excavation debris	Non-hazardous	Reuse / dispose in low-lying areas
2.	Dismantled pavement	Non-hazardous	Recycle, reuse or sell to third party contractor.
3.	Plastic and vinyl	Non-hazardous	Recycle, reuse or sell to third party contractor.
4.	Wood	Non-hazardous	Reused as feedstock for wood composite products and roof felt, pulp, processed and raw fuels, animal bedding, mulch, soil amendments and landfill cover.
5.	Empty Drums and Containers	Non-hazardous	Disposed them off through recycler.
6.	Oil Contaminated Soil	Hazardous	SEPA certified waste contractor
7.	Oily Rags (Used)	Hazardous	SEPA certified waste contractor
8.	Bitumen Waste (Waste Paint, Drums and Rollers/ Brushes)	Hazardous	SEPA certified waste contractor
9.	Sanitary Wastewater	Non- hazardous	Treat wastewater in septic tanks and soak pits.
10.	Sludge	Hazardous	SEPA certified waste contractor

Impact Description	Construction waste management

Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Almost Certain (5)*	*Moderate (10)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Very Low (1)	*Possible (3)*	*Insignificant (3)*

6. Climate & Air Quality

a. Description

430. Lower Sindh has a damper and humid maritime climate affected by the southwestern winds in summer and northeastern winds in winter. The wind speed of this south-wester part of Sindh is categorized as marginal to good which leads to the good dispersion of air pollutants emitting from any project activities especially dust. On the other hand, this wind may carry excessive dust and pollutants to nearby community.

431. Dust from haulage vehicles as they bring borrow materials to site will be a problem for communities that live alongside the drains during the dry season. Stored borrow material can generate dust if not watered properly.

432. Combustion exhaust from vehicles and construction equipment can affect the ambient air quality of the site surroundings. The impact would be potentially significant when the ambient air quality deteriorates due to emissions from construction equipment and machinery or the construction generators etc. beyond the guidelines especially at the environmental receptors in the neighborhood. The exhaust emissions will include particulate matter (PM), hydrocarbons, Oxides of Nitrogen, Sulphur, and Carbon (NOx, SO_2, CO).

433. The small amount of exhaust emissions from the operation of generators and equipment are expected to have dispersed with the prevailing wind and may not have had any significant impact on the local air quality. Adoption of following mitigation measures will result in further reduction / prevention of these emissions.

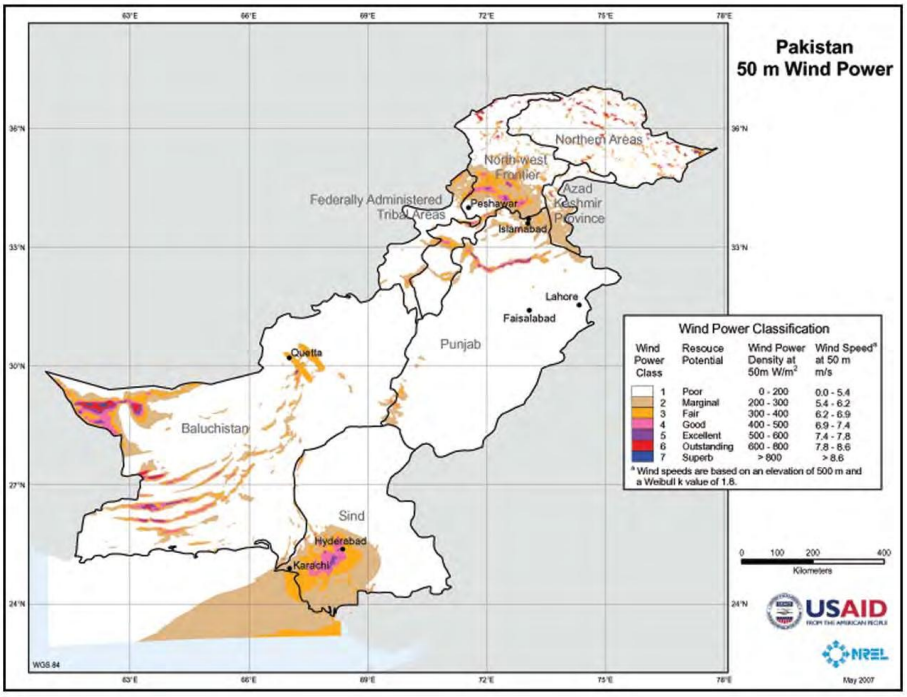


Figure VI-9: Wind Map of Pakistan showing Sindh Windy Areas

b. Mitigation Measures

434. Mitigation measures proposed are:

- In consultation with PMC, the Contractor(s) will be required to have a dust abatement program that includes spraying water on the construction sections near villages and towns.
- Periodic monitoring of dust will be required by the Construction Contractor and SEQS / IFC guidelines for ambient air quality will be complied.
- Labor will be provided with dust masks.
- Bulk cement delivery rather than bags should be used wherever possible so as to reduce dust emissions and eventual problems with disposing of the large number of bags.
- Materials will need to be stored close to the construction sections.
- The Contractor will be required to maintain dust abatement procedures for the following: (i) where construction sections and access areas pass through villages and (ii) at sections where workers are employed.
- Visual daily monitoring of dust emissions will be required by the Contractor(s).
- All vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition in order to minimize emission of pollutants.
- The stack height of the generators will be vented through vertical stacks to minimize exposure at ground level.
- It should be ensured that exhausts from these equipment and vehicles comply with relevant SEQS/IFC/WHO guidelines.
- Excessive engine idling should be discouraged and machinery causing excessive pollution (i.e., visible clouds of smoke) should be banned from sites.

Impact Description	Increased local air pollution		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation

Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Possible (3)*	*Minor (6)*

7. Noise Impacts

a. Description

435. In general, human sound perception is such that a change in sound level of 3 dB is clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of sound level. Sources of noise include bridge pile driving, improper silencing of vehicles and equipment used on the construction sections. These will impact will be most pronounced close to villages and urban areas.

436. Following table shows the noise levels of different construction equipment that can be used during drainage rehabilitation.

Table VI-2: Typical noise levels of construction equipment (noise level in dB (A) at 15 m)

Clearing		**Structure Construction**	
Front end loader	72-84	Concrete mixer	74-88
Jack hammer	81-98	Concrete pump	81-84
Excavation and Earth Moving		Concrete mixer	Concrete vibrator
Bulldozer	80	Air compressor	74-87
Backhoe	72-93	Pneumatic tools	81-98
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Scraper	80-93	Dump truck	83-94
Grading and Compaction		**Landscaping and clean-up**	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
Paving		Truck	83-94
Paver	86-88	Front end loader	72-84
Truck	83-94	Dump truck	83-94
Tamper	74-77	Paver	86-88
		Dump truck	83-94
Source: U.S. Environmental Protection Agency, Noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. December 31, 1971			

b. Mitigation Measures

- It shall be ensured that; (i) machinery is adequately silenced and (ii) machinery and pile driving operations close to villages and urban areas should be restricted to daylight hours a schedule agreed to between the contractor and the local communities.
- Mufflers or silencers should be mandatory to be equipped by all project-related vehicles.
- Additionally, employment of manual labor will reduce the need for many of the machinery operations.

- Periodic monitoring of noise will be required by the CC and SEQS / IFC guidelines for noise levels will be complied.

Impact Description	Noise emissions		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Unlikely (2)*	*Minor (4)*

8. Construction interference with Pre-existing Roads

a. Description

437. Construction work will require traffic to be diverted from intersecting roads, or wait while work is being done. Most of the pre-existing roads that link with the subproject drains are narrow and small and contain minimal traffic volume. The impact on the driving conditions existing on these pre-existing roads is minimal. Nevertheless, following mitigation measures will be adopted:

b. Mitigation Measures

- Rehabilitation works along drains will be undertaken in sections and the period of rehabilitation is considerably short.
- A traffic diversion plan will be introduced by Construction Contractor to manage smooth flow of vehicular traffic and to avoid nuisance to commuters.
- Sign postings, warning signs, diversion signs and barriers will be installed to alert public of all potential hazards including limited access to construction sites.
- Construction of segment intersecting existing roads should be carefully planned and scheduled and when the traffic movement is minimal e.g., early morning.

Impact Description	Construction interference with Pre-existing Roads		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Medium (3)	*Possible (3)*	*Moderate (9)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Unlikely (2)*	*Minor (4)*

9. Occupational & Community Health and Safety Risks

a. Description

438. There are potential occupational and community health and safety risks during construction stage of the subprojects. The site-specific health and safety risks assessment will be carried out during preparation of the site-specific EIA or IEEs and EMPs. However; the generic impacts associated with the proposed rehabilitation works are as follows;

- Worker camps can be unhygienic and affect worker health from poor sanitation and lack of potable water. Temporary breeding habitats for mosquito vectors and rodents can be created in areas of stagnant water that may remain in borrow pits and in discarded solid waste such as plastics, old tires and metal containers that may be allowed to accumulate around worker camps.

- The possibility for the transmission of communicable diseases (such as STI's and HIV/AIDS) to the local community is envisaged if labor force procured from outside local community and carry the disease.

- Accidents inevitably happen and when they do the Contractor will need to have an effective Worker Health and Safety Plan that is supported by trained first aid personnel and emergency response facilities.

b. Mitigation Measures

- Campsites shall be located at least 100m away from water courses and 300 m away from settlement.
- Campsites and construction areas will need to be provided with septic sanitation facilities and potable water.
- No untreated human waste should be allowed to enter water channels where it can affect downstream water quality and human health.
- Offset double pit toilets with pour flush are recommended over a high platform. In this type, toilet is connected with leaching pits (stone lined) which act as a partial trickling filter and hence the water that escapes is bacteriologically less/not harmful. Once a pit is filled, the second one comes in use and the first is emptied over time.
- Sludge after emptying the tanks/pits should be landfilled at proper location, covered with soil and left for degradation.
- Employment of local labor will reduce the hazards of exacerbating malaria and dengue fever. Also, local labor can reduce this concern as these people will return to their villages at night and act in accordance with accepted community norms.
- The project site will be fenced and trespassing will not be permitted.
- The contractor will ensure good liaison with local communities and will facilitate their mobility.
- Display the project activities clearly for the adjacent communities.
- Use safety signage and written instructions for workers and communities to ensure their safety.
- Labor Health and Safety Plan will be prepared by the Contractor.

439. The Contractor(s) of a subproject will be required to adopt good engineering practices to minimize safety and health hazards among its workers as well as the local population. Mitigation measures will include the following:

- Complying with safety precautions for construction workers as per the International Labor Organization (ILO) Convention rectified by Government of Pakistan are as follows;
  - Forced Labor Convention, 1930 (Convention No. 29)
  - Freedom of Association and Protection of the Right to Organize Convention, 1948 (Convention No. 87)
  - Right to Organize and Collective Bargaining Convention, 1949 (Convention No. 98) • Equal Remuneration Convention, 1951 (Convention No. 100)
  - Abolition of Forced Labor Convention, 1957 (Convention No. 105)
  - Discrimination (Employment and Occupation) Convention, 1958 (Convention No. 111)
  - Minimum Age Convention, 1973 (Convention No. 138) Minimum age specified: 14 years • Worst Forms of Child Labor Convention, 1999 (Convention No. 182)
- While preparing subprojects' IEEs or EIA, the World Bank Group General Environment, Health and Safety Guidelines[57] will be followed for appropriate occupational and community health and safety risks assessment and mitigation.
- In addition, compliance to Sindh Occupational Safety and Health Rules, 2019, the health and safety risks will be given due priority in the subproject IEE or EIA[58].
- Training workers, in construction safety procedures, equipping all construction workers with required PPE (hard boots, helmets, gloves, and protective masks etc.), and monitoring their proper and sustained usage.

Impact Description	Health and Safety Concerns		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Likely (4)*	*Moderate (8)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Very Low (1)	*Possible (3)*	*Insignificant (3)*

10. Climate Change Impacts and Challenges

a. Description

440. In Sindh, districts along the river Indus are highly vulnerable to floods (National Disaster Management Authority 2011). Flooding occurs due to glacial melt in upper catchment area, which is likely to accelerate owing to impacts of climate change. In the lower catchment area, consisting of Punjab and Sindh, flooding occurs as a result of water release from the upper catchment area and precipitation in the lower catchment area (Afzal et al. 2012). High temperatures, especially in the pre-monsoon period, are likely to increase the intensity of rains in Sindh. These affect the intensity, frequency, and impact of the five categories of floods the province is likely to be affected by. Historically, the districts most commonly affected, in terms of damages to human, wildlife, and

https://documents1.worldbank.org/curated/zh/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf
[58] https://www.pec.org.pk/wp-content/uploads/2021/05/Sindh-Occupational-Safety-and-Health-Act-2017.pdf

rural/urban infrastructure, during 2010 and 2013 floods are Hyderabad, S. Benazirabad, Sukkur, and Thatta (PCO, IMAP, NASA 2012) (World Health Organization 2013).

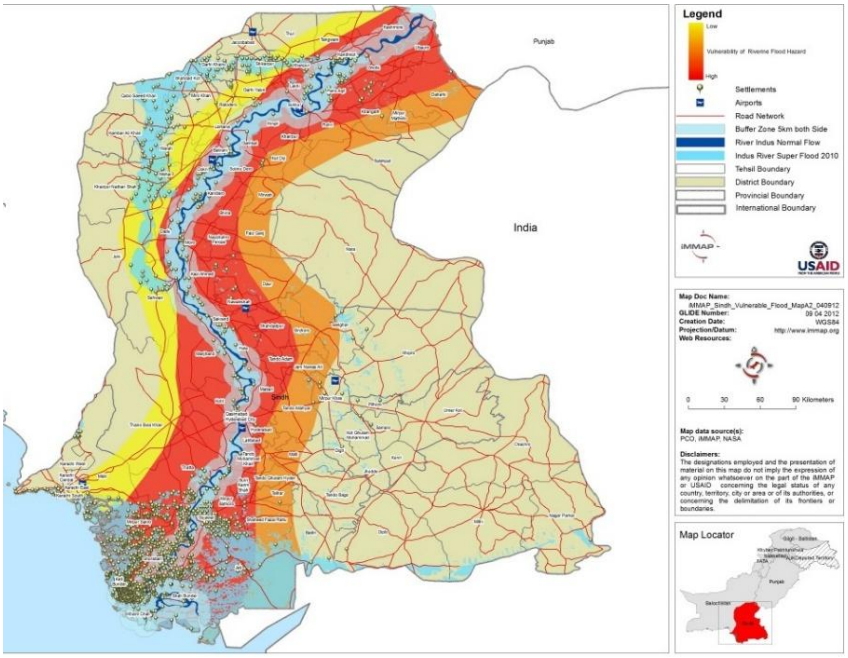


Figure VI-10: Flood Hazard Map Sindh (PCO, IMAP, NASA 2012)

441. The Indus River Basin is the most vulnerable region of flood hazard in Pakistan (Ahmed, 1956). The mountainous region of north and west are often affected by flash floods while the broad flood plains of Indus plains and low-lying deltaic region are affected by river flood. River floods in the summer season are common phenomena in the Indus River Basin.

442. There are two hydro-climatic factors which cause occurrences of floods in the Indus River Basin. The first factor is the melting of snow which accumulates in the mountainous north of Pakistan during winter. This snow cover starts melting in March-April, and reaches its maximum in July.

443. Water table in lower Sindh including deltaic region is quite high water contained is saline. Heavy soils have poor percolation and porosity to support natural drainage and reclamation. Therefore, salinity and water logging dominate already in various zones not letting the farmers to harvest their potential yields. Due to increased frequency of storm surges combined with the sea level rise, the sea water intrusion has become an emerging challenge which would claim more land area with the passage of time. The saline and sodaic contents of soil would rise to such a critical level which would ultimately deteriorate the yielding potential of fertile deltaic soils (Bot et al., 2000). There is clear evidence of elimination of natural habitat along the shoreline and northward shift of biodiversity due to over-riding push of seawater.

b. Mitigation Measures

- Environmental assessments of such subprojects which are located close to Indus River and have potential to get flooded during floods, shall be accompanied with a flood contingency plan.
- All subprojects financed through ADB, shall require a CVRA (climate change vulnerability assessment).

11. Loss of Agricultural Land for Borrow Pits

a. Description

444. Extensive borrow material will be required for earth works proposed for subproject rehabilitation / development. Borrow pits will need to be located near the sub-project channels and wetlands as a source of earth for earth fill material and approved quarry sites / borrow sites will be The details of borrow pits location and environmental as well as social feasibility will be covered in the subproject IEE or EIA.

b. Mitigation Measures

- The Contractor will ensure that borrow material /earth-fill will be obtained within RoW or approved borrow sites.
- Natural areas with high elevation can be utilized for source of borrow material /earth-fill but not those areas which are existing agriculture areas.

Impact Description	Loss of Agricultural Land for Borrow Pits		
Nature	Negative	Positive	Neutral
Phase	Siting / Design	Construction	Operation
Significance of impact w/o mitigation			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Low (2)	*Possible (3)*	*Minor (6)*
Significance of impact with mitigation measures			
Spatial extent	Localized	Regional	National
Duration	Short-term	Medium-term	Long-term
Significant	**Severity**	**Probability**	**Impact Significance**
	Very Low (1)	*Unlikely (2)*	*Insignificant (2)*

12. Labor and Employment

445. The labor force is divided in rural and urban areas. Migration of people from rural to urban areas for employment opportunities and better socioeconomic conditions is an unending phenomenon in Sindh. Growth of urban centers and establishment of some industrial estates / enterprises have all contributed towards increased urban employment opportunities in the province. The number of unemployed people has recorded unprecedented increase over the years, mainly because of high population growth rate. Investments in social sectors such as education, health, housing, water and sanitation, agriculture, transport, infrastructure, and communications, etc. have not kept pace with rapidly growing population.

446. It is proposed for any construction project, local labor within the nearest community shall be preferred for employment and jobs.

447. In Sindh due to poor socio-economic conditions, children below the age of 14 are mainly forced to work in various sectors including factories, industries, field or other hazardous zones to support their family. The Government of Sindh has passed “Sindh Prohibition of Employment of Children Bill, 2017” to discourage this practice and exploitation of children. Provision of the Act shall be followed.

13. Burden on natural resources, social infrastructure and services due to workers

448. A labor force that is not properly supplied with adequate rations or fuel will suddenly exacerbate demands on local supplies of fuelwood and wildlife. This labor force can put burden on community water supply and sanitation systems.

449. Local labor within the nearby community shall be preferred for the project to eliminate the impact on natural and social resources and services.

a. Mitigation Measures

450. Compliance to Sindh Prohibition of Employment of Children Bill, 2017, the children below the age of 14 will strictly prohibited as force labor and avoidance measures will be devised in the subprojects' EMPs.

451. Complying with safety precautions for construction workers as per the International Labor Organization (ILO) Convention rectified by Government of Pakistan are as follows;

- Forced Labor Convention, 1930 (Convention No. 29)
- Freedom of Association and Protection of the Right to Organize Convention, 1948 (Convention No. 87)
- Right to Organize and Collective Bargaining Convention, 1949 (Convention No. 98) • Equal Remuneration Convention, 1951 (Convention No. 100)
- Abolition of Forced Labor Convention, 1957 (Convention No. 105)
- Discrimination (Employment and Occupation) Convention, 1958 (Convention No. 111)
- Minimum Age Convention, 1973 (Convention No. 138) Minimum age specified: 14 years • Worst Forms of Child Labor Convention, 1999 (Convention No. 182)

452. While preparing subprojects' IEEs or EIA, the World Bank Group General Environment, Health and Safety Guidelines[59] will be followed for appropriate occupational and community health and safety risks assessment and mitigation.

453. In addition, compliance to Sindh Occupational Safety and Health Rules, 2019, the health and safety risks will be given due priority in the subprojects' IEE or EIA[60].

E. Impacts Assessment during Operation Phase

1. Community Safety Risks due to both Accidental and Natural causes

454. Structural elements or components of the sub-project will be accessible to members of the community and their failure could result in injury to the community throughout sub-project operation. Also increase in accidents related to drowning of people and livestock are expected to increase after the development / improvement of the subproject. Accidents will also be expected to increase in towns where there is a potentially dangerous mix of slow and fast traffic using the inspection path of drains.

https://documents1.worldbank.org/curated/zh/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf
[60] https://www.pec.org.pk/wp-content/uploads/2021/05/Sindh-Occupational-Safety-and-Health-Act-2017.pdf

a. Mitigation Measures

455. Emergency and safety plan will be developed by contractor/PIU for inspection paths and road bridges.

456. Properly designed speed humps, speed signs and, possibly traffic signals will be installed near settlements.

2. Soil Erosion

457. After development and rehabilitation works, the drains and canals if not lined are subject to erosion. To mitigate these effects, sustainable soil stabilization techniques such as vegetation cover and silt fences should be employed. Replanting beneficial vegetation post-clearance can aid in ecological restoration.

3. Construction of New Inlets

458. While new inlets improve water flow and distribution, they may also increase water demand, heighten resource competition, and introduce contaminants. To mitigate these risks, water quality monitoring should be enforced, inlet designs should incorporate filtration mechanisms, and hydrological modeling should be utilized to predict and manage potential adverse effects.

4. Armoring of Banks to Counter Erosion Effects

459. Bank armoring prevents soil degradation and structural damage but may alter hydrodynamics and disturb natural habitats. The use of eco-friendly materials like geotextiles and bioengineered structures can help maintain ecological integrity. Hydrological studies should guide erosion control measures, while habitat restoration programs can support displaced species and enhance biodiversity.

F. Social Impacts during Project Operation

1. Positive Socio-economic and Environmental Impacts of Drainage Improvement Works

460. Drainage improvement works play a vital role in shaping sustainable and resilient communities. They contribute significantly to economic growth, public health, and environmental protection. By ensuring proper water management, these systems mitigate the risks associated with flooding, soil erosion, and water contamination. The benefits of well-planned drainage infrastructure extend across various aspects of society, from enhancing economic stability to preserving natural ecosystems.

2. Reduced Flooding and Property Damage

461. One of the most immediate benefits of improved drainage systems is the reduction in flooding. When water is efficiently directed away from residential and commercial areas, the risk of property damage decreases significantly. Floods often result in costly repairs, displacement, and loss of valuable assets, but with effective drainage infrastructure, communities can avoid this financial burden.

3. Enhanced Public Health and Sanitation

462. Proper drainage plays a crucial role in promoting public health. Stagnant water caused by inadequate drainage creates a breeding ground for disease-carrying mosquitoes and bacteria, leading to outbreaks of malaria, dengue fever, and cholera. By efficiently channeling wastewater and stormwater, drainage systems prevent the accumulation of contaminated water, thereby

reducing the spread of waterborne diseases. Additionally, better drainage prevents sewage overflows, further improving sanitation and hygiene conditions in urban and rural areas.

4. Boosts Agricultural Productivity

463. Agriculture relies heavily on well-managed water systems. Poor drainage can lead to waterlogged fields, which severely affect crop yields and soil health. With improved drainage infrastructure, excess water is efficiently removed, ensuring optimal growing conditions for crops. Farmers benefit from higher productivity, reduced losses due to flooding, and an overall increase in income. Moreover, better water management supports food security by ensuring consistent agricultural output.

5. Increased Economic Opportunities

464. Drainage improvement, stimulates job creation. From the construction phase to maintenance and management, these projects provide employment opportunities for skilled and unskilled workers alike. Furthermore, businesses benefit from a well-maintained drainage system, as it reduces disruptions caused by water accumulation and damage to commercial areas. A well-functioning drainage system enhances overall economic activity by ensuring smooth business operations and encouraging investment in flood-free zones.

6. Improved Transportation and Infrastructure

465. Flooded roads, damaged bridges, and disrupted transport networks are common consequences of poor drainage. Improved drainage systems ensure that rainwater and runoff do not accumulate on roads, reducing the chances of erosion and infrastructure damage. This contributes to safer and more reliable transportation, allowing people to commute without delays and ensuring uninterrupted access to markets, schools, hospitals, and workplaces.

7. Protection of Natural Habitats

466. Natural ecosystems, including wetlands, forests, and marine habitats, are often affected either by excessive water accumulation and uncontrolled runoff or limited flows due to inadequate drainage. Improved drainage will ensure that these ecosystems are not overwhelmed, preserving biodiversity and sustaining wildlife. Soil erosion, another significant environmental challenge, is also minimized, as well-designed drainage systems prevent the washing away of fertile topsoil, which is essential for plant growth and agricultural productivity.

8. Climate Change Resilience

467. Project components help local population adapt to these changes by preventing waterlogging and flooding during extreme weather events.

VII. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

A. General

468. This section will provide the necessary guidance to four (04) implementing agencies, i.e., Sindh Irrigation Department (SID), Sindh Forest Department (SFD), National Institute of Oceanography (NIO) and Sindh Coastal Development Authority (SCDA), Project Implementation Unit (PIU), Environmental Specialist (ES), Social Development Specialist (Social Safeguards Expert), Project Management and Supervision Consultant (PMC), Independent Monitoring Agency (IMA) and Construction Contractor (CC) to implement good environmental and social practices to reduce environmental and social impacts while rehabilitating / reconstructing the subprojects. This section will further provide an overall approach for managing and monitoring environmental-issues and describes the institutional framework to implement the environmental and social management plan (ESMP) for this ESIA.

B. Objectives of Environmental and Social Management Plan

469. This ESMP will help IAs and PIU to address the potential negative environmental and social impacts of the project, enhance project benefits, and introduce standards of good environmental practice. The primary objectives of the ESMP are to:

- Define the responsibilities of all role players, and effectively communicate environmental and social issues among them.
- Facilitate the implementation of the mitigation measures listed in ESMP by providing the technical details of project impact and providing an implementation schedule.
- Define a monitoring mechanism and identify monitoring parameters to ensure that all mitigation measures are completely and effectively implemented.

C. Institutional Arrangements and Implementation

470. This section describes the responsibilities required for the parties (EA/IAs, ESU, Project Management and Supervision Consultant (PMC), environmental and social assessment Team, Monitoring Consultants and Contractors) involved in environmental screening, implementation and/or management of environmental and social issues at subproject level.

471. The project EA will be P&DD, GoS with responsibility overall project progress and implementation of outputs 1 and 2. The two (02) implementing agencies, i.e., Sindh Irrigation Department (SID), and Sindh Forest Department (SFD will be the IAs, responsible for implementation of output 1 and 2. Two separate project implementation units (PIU) for irrigation and forestry within EA/IA will be established to implement the project on behalf of EA/IA, supported by PMC led by international specialists.

472. IAs will implement the project activities not limited to, reporting, M&E, social and environmental management, procurement, financial management, audit, and disbursements, as well as coordination with the line agencies and ADB. The PIU will be led by the Project Director (PD), who will appoint the remaining members of the PIU, which will include specialists in procurement, environmental and social management, gender, monitoring and evaluation, security, communications, and financial management. The PIU will be supported on technical matters by PMC, as well as by individual consultants to provide technical backstopping as and when necessary, particularly in the interim period between the formation of the PIUs and the onboarding of its staff. A dedicated Environmental and Social Unit (ESU) will be established within the PIU to oversee environmental and social safeguards.

473. Environmental Protection Agency (EPA) Sindh will act as the overall regulatory body for the monitoring of environmental issues of subproject development. The specific roles of key officials are described henceforth.

1. Institutional Roles and Responsibilities

474. The institutional mapping of the project components is provided below.

a. Sindh Irrigation Department (SID) and Sindh Forest Department (SFD), IAs

475. For safeguards management of the project, Sindh Irrigation Department (SID) and Sindh Forest Department (SFD), as IAs will exercise its functions through PIUs with general project execution responsibility at planning, design and implementation phases. PIUs will ensure that the subproject comply with Sindh Environmental Protection Act 2014, ADB SPS 2009 other applicable international safeguards. They will develop Environmental and Social Unit (ESU) within PIUs to oversee the environmental and social issues.

b. Project Implementation Units (PIUs)

476. IAs will exercise their functions through the PIUs which will be created for the implementation of the project. The PIUs will be responsible for the project execution and streamline the safeguards management of different subprojects with assistance and technical guidance from PMC. The PIUs will collect information and progress on environmental and social safeguards compliance through the ESU which will be tasked with day-to-day project related activities at project and subproject level. The PIU for Irrigation will be headed by a Project Director (PD) and for Forestry, it will be headed by Chief Conservator Forest

c. Environmental and Social Unit (ESU)

477. The ESU will be in nested in PIU which will manage Environmental, social and LAR tasks at the subproject level with technical assistance and guidance from the PMC. The ESU will take the ultimate responsibility for preparation, implementation and monitoring of LARPs for the subprojects to be implemented under project if applicable. The ESU will include i) Environmental Specialist (ES), ii) Resettlement Specialist, iii) Social Development Specialist, iv) Livelihood Restoration Expert, v) Stakeholder Engagement and Gender Specialist, vi) GRM Operator vii) Compensation and Finance Officer; supported by the Government Revenue staff like Tapedars and social mobilizers engaged for the project.

d. Environmental Specialist (ES)

478. The Environmental Specialist (ES) within the PIU plays a crucial governance and oversight role in ensuring environmental compliance throughout the subprojects' implementation. Environment Specialist will be responsible for supervising and coordinating with the PMC and Contractor to ensure adherence to national regulations, international environmental standards, and best practices. ES will also monitor the PMC's environmental framework, ensuring that aspects like water and air quality, noise pollution, biodiversity conservation, and soil management are effectively managed by the contractor.

479. Regular independent reviews and field inspections will be conducted to identify any non-compliance issues. Any deviations or environmental risks in Contractor operations must be flagged, with corrective actions recommended to maintain compliance. In cases where climate resilience strategies, pollution control measures etc. are not adequately implemented, Environment Specialist will work with the PMC and Contractor to rectify shortcomings. ES will serve as the primary liaison between SEPA, ADB and relevant stakeholders, ensuring smooth communication

regarding environmental matters. Reports submitted by the PMC are reviewed and consolidated before being forwarded to relevant authorities, and the specialist ensures that external audits and inspections are facilitated as required.

480. Ensuring that environmental concerns raised by communities, local authorities, and stakeholders are effectively addressed is essential for maintaining transparency and accountability. Environment Specialist will oversee the PMC's stakeholder consultation process, ensuring that local concerns and feedback are integrated into the subproject's ESMP.

481. The Environment Specialist tracks the progress of the project, ensuring compliance with ESMP and monitoring indicators, and reports to the Project Implementation Unit (PIU) and ADB on the effectiveness of ESMP.

e. Resettlement Specialist (RS)

482. The RS will play a vital role to look after the routine resettlement matters of the project and ensure implementation of resettlement activities including but not limited to preparation/updating, implementation and monitoring of LARPs at subproject level.

f. Social Development Specialist (Social Safeguards Expert)

483. The Social Development Specialist plays a crucial role in engaging with affected communities, ensuring their active participation in decision-making processes related to community issues and health and safety. This specialist provides targeted support to vulnerable groups, including women, the elderly, and indigenous populations, ensuring that their specific needs are addressed during project implementation. In addition, the role ensures adherence to the ADB Safeguard Policy Statement (SPS) 2009, guaranteeing that social safeguards are upheld throughout the environmental management process.

g. GRM Operator

484. The Grievance Redress Mechanism (GRM) Operator manages the resolution of grievances at various levels, including the local/community level, district level, and project level. Ensuring that complaints are handled transparently and in a timely manner is a key responsibility of this role. The officer works to establish a fair and accessible grievance redress system that effectively addresses the concerns of affected persons, fostering trust and accountability.

h. Project Management and Supervision Consultant (PMC)

485. PMC will provide technical expertise, monitor the execution of subproject ESMPs, and ensure that compensation, livelihood restoration, and grievance redress processes are carried out efficiently and transparently. By supporting the PIU, the PMC will facilitate the Contractor(s) to smoothly implement and comply with the ADB SPS 2009.

486. Monitoring responsibility will solely be shared by PMC. PMC includes design, supervision and monitoring consultants. PMC will support Environment Specialist and PIU for the subproject development.

- PMC will ensure that all the mitigation measures proposed for the design phase are incorporated in the design and included in the contractor(s) bidding documents.
- Monitoring consultants will conduct environmental monitoring and prepare monitoring reports and submitted to Environment Specialist. He will also ensure that construction activities will be carried out in an environmentally sound and sustainable manner.

- PMC will appoint dedicated environmental and social specialists to monitor the implementation of environmental management measures required for the project. PMC will prepare environmental monitoring reports, every six months to be delivered to PIU and ADB.
- PMC will prepare environmental screening checklists and classify the subprojects.
- PMC will prepare the safeguard document according to the subproject classification and submit to PIU and ADB for approval.
- PMC will oversee the implementation of the ESMP by Contractor(s), ensuring that all mitigation and compensation measures will be implemented according to the approved ESIA and subproject specific IEE/ESMP documents.
- PMC will share information and disclosure of environmental safeguard documents (including any Corrective Action Plans prepared in cases of change to original project design) as required.
- PMC will carry out visits to the construction sites to review the environmental performance of the Contractor(s);
- PMC will develop performance indicators and establish a robust Monitoring and Evaluation (M&E) framework to track the implementation of ESMPs. By conducting regular field verifications and assessments, the consultant will ensure that all mitigation / compensation measures are implemented and that the project remains compliant with ADB safeguards. Furthermore, the PMC will submit Semi-Annual Environmental Monitoring Reports (SAEMRs) to ADB, detailing progress, challenges, and mitigation measures.
- Responsible for strengthening the institutional capacity of PIU, government agencies, and other stakeholders. This will involve conducting training sessions on ADB's environmental safeguards, and best practices to equip project personnel with the knowledge needed to handle environmental issues effectively.
- Assist in preparing and implementing SEP to ensure that communities are well informed. For Indigenous Peoples (IP) if affected, the PMC will ensure that Free, Prior, and Informed Consent (FPIC) is obtained, ensuring that their rights and cultural values are safeguarded.
- Work closely with the PIU and grievance redress committees (GRC) to ensure that complaints from affected persons are addressed transparently and in a timely manner.

2. Subproject Contractor(s) - CC

- Subproject ESMP will be made a part of the contracts agreement and the contractor will ensure that all Project activities are in compliance with the ESMP.
- Construction Contractor will hire adequate numbers of HSE officers to be present at site for implementation of health and safety measures and environmental mitigation measures.

a. Asian Development Bank (ADB)

487. ADB will periodically review project and ESMPs implementation status as well as provide clearance for contract awards and the signing/initiation of civil works on the project.

488. Main responsibilities of ADB at loan implementation stage are:

(i) Selection and mobilization of PMC with approved national and international environmental and social specialists and inclusion of costs and requirements for mitigation and compensation measures in the tender/contract documents;

(ii) Approval of safeguard documents i.e., EIAs, IEEs and ESMPs whichever is applicable and prepared by PMC; approval and endorsement and disclosure.

(iii) ADB reviews and approves SAEMRs and compliance reports.

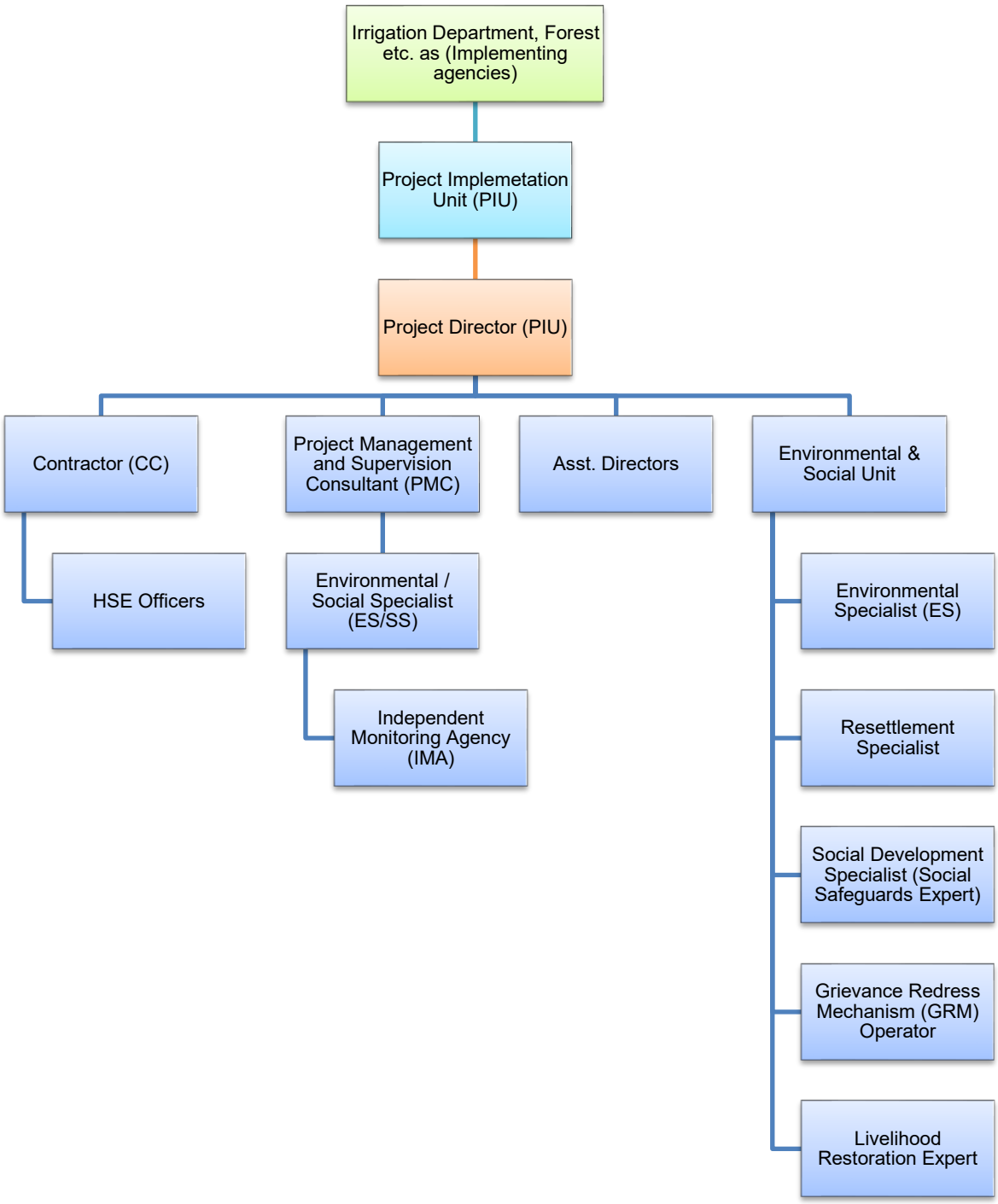


Figure VII-1: Organizational setup for the implementation and monitoring of ESMP

D. CAPACITY BUILDING FOR ESMP IMPLEMENTATION

489. Institutional capacity and development are fundamental to the successful implementation of the environmental and social management plan (ESMP) developed for all three categories of subprojects. A well-structured institutional framework ensures that the Project Implementation Units (PIUs) and Environmental Safeguards Units are adequately equipped to implement the mitigation measures proposed under ESMP. Strengthening these institutions will enhance efficiency and transparency, allowing for better management of resources and stakeholder

engagement. This document discusses the key capacity-building measures for both the PIU and the Environmental and Social Unit (ESU) within its structure.

1. Institutional Strengthening of PIU

490. The PIU serves as the central entity for subproject specific IEE/ESMP implementation. To enhance its institutional capacity, key measures will be undertaken, including specialized training programs on dust abatement, occupational health and safety, noise reduction, community health and safety, water quality, ecological preservation, tree plantation, and mitigation strategies. Workshops will focus on avoidance, mitigation, compensation, and the adoption of necessary engineering and administrative controls, with adequate budget allocation for managing environmental and social impacts. Additionally, human resource capacity will be strengthened through the recruitment and training of personnel with expertise in environmental and social safeguards.

491. To ensure smooth operations, financial and technical assistance will be provided to the PIU. A robust monitoring and evaluation framework with key performance indicators (KPIs) will be developed to assess the effectiveness of subproject specific IEE/ESMP implementation. Periodic evaluations and impact assessments will ensure compliance with national and international safeguards, promoting transparency and accountability.

2. Establishment and Strengthening of the Social Unit under PIU

492. A dedicated Environmental and Social Unit (ESU) will be established within the PIU to oversee environmental and social safeguards. The ESU will be responsible for managing environmental and social risks while conducting meaningful consultations with communities, affected persons (APs), beneficiaries, government agencies, NGOs, and other key stakeholders. Transparency and inclusivity will be central to all decision-making processes, ensuring that stakeholder issues are effectively addressed.

493. A structured, multi-tiered approach will be adopted for the timely resolution of grievances related to environmental and social issues through the established GRM. Environmental and social concerns will be handled separately, with dedicated personnel assigned to resolve specific grievances efficiently.

3. Coordination and Collaboration

494. Effective coordination and collaboration among the PIU, ESU, and relevant stakeholders are crucial for the successful execution of ESIA. To facilitate this, regular interagency coordination meetings will be held with government departments, local authorities, and NGOs to streamline risk management and mitigation /compensation activities. Additionally, knowledge-sharing initiatives, such as cross-learning events and exposure visits, will be conducted to enhance institutional expertise and learning from best practices.

E. MONITORING AND REPORTING

495. Monitoring, evaluation, and reporting will play a critical role in ensuring that the objectives of ESIA are achieved in compliance with the ADB SPS 2009. These mechanisms will be essential for tracking progress, identifying gaps, and ensuring that mitigation and compensation measures are implemented as planned as per the ESMP.

496. This section identifies the roles and responsibilities of project staff involved in environmental monitoring of each subproject, and lists the parameters that will be used in the monitoring process.

497. The main objectives of environmental and social monitoring will be to:

- Monitor the actual subproject impact on physical, biological and socio-economic receptors. This will indicate the adequacy of the subproject ESMP.
- Recommend Corrective Action Plans for any unforeseen impact or where the impact level exceeds that anticipated in the ESMP.
- Ensure compliance with legal and community obligations including safety on construction sites.
- Monitor the rehabilitation of borrow areas and the restoration of the construction campsite as described in the ESMP.
- Ensure the safe disposal of excess construction materials.

498. The main objectives of monitoring during the operation phase will be to:

- Appraise the adequacy of the ESMP with respect to the project's long-term impacts on the site's physical, biological and socio-economic environment.
- Evaluate the effectiveness of the mitigation measures proposed in the ESMP, and recommend improvements in the ESMP, if necessary.
- Compile periodic accident data to support analyses that will help minimize future risks.
- Monitor the survival rate of site plantations.

1. Internal Monitoring Arrangements

499. The ES shall be the key person to ensure environmental monitoring with the assistance of community representatives.

2. Contractor and PMC (Environment Specialists)

500. Contractor will be responsible for carrying out day to day monitoring whereas the Environment Specialist will carry out periodic and routine monitoring. Environmental monitoring methods and parameters will include:

- A weekly check of noise levels using a portable noise meter operated near major construction equipment and machinery.
- Visual checks of exhaust emissions from equipment and vehicles on a daily basis.
- Visual checks of airborne dust on temporary access roads, material stockpiles, disturbed soil, and haul tracks.

501. The Environment Specialist will further be required to:

- Systematically observe the activities carried out by the contractors or any other person associated with the project.
- Verify that the activities carried out comply with the ESMP.
- Maintain a record of all incidents of environmental significance as well as related actions and corrective measures.

3. External Monitoring

502. External monitoring will be carried out by an **Independent Monitoring Agency (IMA)** or a third-party evaluator engaged by the PMC in consultation with PIU and ADB. The purpose of external monitoring will be to provide an independent assessment of ESMP implementation and to verify whether environmental and social measure are implemented in totality. This monitoring will also evaluate the effectiveness of controls while conduct instrumental monitoring to ensure compliance

to applicable standards. External monitoring reports will be submitted to ADB semi-annually or annually, depending on the scope and severity of project impacts.

4. Environmental Training

503. An environmental training program will be prepared to address the need of contractor's site staff as well as PIU field staff and build their capacity to effectively implement project-specific ESMP. Environment Specialist (ES) will assist PIU to organize training for their staff and to help them establish system /infrastructure for future sustainability. In addition to the training arranged and imparted by the ES for complete project team, the contractor will also plan small training sessions for workers involved in specific jobs. Cost of trainings and mitigation measures will be deemed included in contract cost.

5. Reporting Mechanisms

504. Monthly Progress Reports will be prepared by CC and submitted to the PIU to track progress. Semi-Annual Monitoring Reports will be developed by the PMC and submitted to ADB to evaluate compliance with ESMP provisions. Additionally, External Monitoring Reports will be compiled by the Independent Monitoring Agency (IMA) to provide an objective evaluation and compliance reporting. Upon project completion, a Completion Report will be submitted, confirming that all activities have been finalized in accordance with ADB's requirements.

Table VII-1: Environmental management matrix – Siting and Design Phase

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
Encroachment on Historical/Cultural/Archaeological Sites	Possible discovery of heritage resources	• Chance Find" procedures for protection of any tangible cultural heritage (archeological) discovery during construction phase are developed and provided in **Annex III**.	Chance find procedure implemented	During construction	CC	Internal: ES(PMC) External: IMA
Biodiversity and Ecological Resources	To minimize vegetation cover loss To minimize impact on local fauna	• The vegetation cover loss shall be minimized and tree cutting will be avoided as much as possible. • Compensatory plantation of trees which need to be cut down, shall be provided. • The compensatory plantation of trees will be done along the existing ROW at the edge of the embankments of subprojects after rehabilitation. • In addition, the contractor will establish his campsite on waste /barren land rather than green or agriculturally productive land, in order to minimize the clearing of vegetation. • Contractor will be responsible for the monitoring and protection of tree cover. • Mitigation measures proposed for Intrusion in Protected Areas / IBAs are: • An overseeing committee comprising Sindh Forest Department (SFD) and	Tree compensation at a ratio of 5 trees planted for 1 tree cut. Monitoring and protection of trees Tree plantation plan prepared Monitoring of fauna along the drains and subproject sites Enforcement of no hunting no trapping policy	Implementation of tree plantation plan at project site. Compensatory Plantation after construction During construction	IAs / CC	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		Sindh Wildlife Department (SWD) as main stakeholder with Deputy Commissioners (DCs) of that area and proponent who will look after the subproject during construction. • Construction work shall be initiated with the consent of SFD and SWD in all ecologically sensitive areas. SFD and SWD nominated officials shall be part of the monitoring team. • Wildlife critical areas / core areas should be avoided including feeding grounds, watering holes, ravines etc. • Vehicle speeds will be regulated and monitored to avoid excessive dust emissions. • Periodic counseling will be provided to drivers on mitigation measures related to off-road travel and speeds limits. • Off-road travel should be avoided in sensitive areas as much as possible and observance of this should be monitored during construction. • During construction movement of construction equipment will be restricted to work areas only to avoid unnecessary disturbance to soils in the project area.				

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• Botanists trained in the identification of plant species will accompany the construction crews whilst they operate in critical habitats. • The monitoring team will have wildlife expert familiar with the behavior of endangered species in order to observe the effects of construction of drainage on wildlife. • A 'no-hunting, no-trapping, no-harassment' policy will be strictly enforced at the construction sites; • Strict administrative measures will be taken against any illegal animal hunting and poaching in such areas for anyone associated with the construction activities; • Night work during construction in ecologically sensitive areas will be prohibited, night traveling will not be allowed unless absolutely necessary. • All mitigations related to minimizing noise will be adhered to. • Lights used at the construction sites and campsites will be kept to the minimum required. • Firewood, woody plants and shrubs will not be used as fuel during construction.				

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• Promote the sustainable use of natural resources for the local communities living in and around the protected areas. • Reducing campsite effluents entering into the protected areas without treatment.				
Resettlement of DPs	To reduce the IR impacts as well as compensate the DPs accordingly	• Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them. • Valuation and compensation of affected assets of community should be in line with LARF/Sub-project LARPs and considered before the field activities. • Community consultations shall be carried out before commencement of construction.	Implementation of LARPs	During design / preconstruction	IAs	Internal: SS(PMC) External: IMA

Table VII-2: Environmental management matrix – Construction Phase

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		•				
		•				
Increased erosion and sedimentation in water Channels	Avoid erosion of soil and avoid reaching the sediments to Indus Delta	• To minimize erosion and sediment transport, excavation and earthworks should be scheduled during the low-flow winter season, avoiding peak monsoon periods. Implementing the project in a phased manner by working on small sections at a time instead of large-scale, simultaneous interventions will help reduce the volume of mobilized sediments. • Silt barriers and sediment traps should be installed to capture suspended sediments before they enter receiving waters. The use of fast-growing native vegetation along embankments will stabilize soil and reduce erosion. Riprap and geotextiles should be applied along embankments and vulnerable sections to prevent erosion, while turf reinforcement mats can provide temporary stabilization until vegetation is established. • Regular turbidity and suspended sediment level monitoring should be conducted in affected water bodies. Temporary sedimentation basins can be constructed to allow suspended	Work along water channels and water bodies Storage of construction material	During construction at water courses	CC	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		particles to settle before water re-enters the channels. Before entering sediment discharge in Indus Delta, silt curtains or cofferdams should be used to contain sedimentation, while low-impact excavation techniques will help minimize direct disturbances to water bodies. • Proper disposal of dredged material should be ensured by transporting sediments to designated areas away from water bodies to prevent re-mobilization. Controlled dewatering methods, such as filtration systems or sediment bags, should be employed before discharging dewatered materials back into the watercourse. • To reduce sediment loss, critical sections should be partially lined or protected with erosion-resistant materials. High-risk erosion zones should be stabilized using gabions or retaining walls, and controlled water flow should be maintained during excavation to minimize excessive scouring. • Environmental training should be provided to construction workers on erosion control practices and sediment management. Local communities and stakeholders should				

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		be informed about project activities to minimize disruptions and ensure transparency.				
Alteration of Surface Water Hydrology and Drainage	No diversion of existing water channel take place Water channel closure will be adequately planned	• It is proposed that the water courses shall be diverted within the existing ROW to ensure a dry bed under the existing section or allied structure and to avoid the closure of water channels. However, if diversion is not possible, an approach using bulkhead gates are recommended to avoid the need for construction of cofferdams and thereby need for closure of the canals. • To minimize disruption to irrigation and drainage, rehabilitation works should be executed in a phased manner, ensuring that only small sections of water channels are closed at a time. Staggered construction across different sections of the command area will prevent large-scale water flow disruptions and allow continuous water supply to farmlands. • Temporary bypass channels or pipe culverts can be installed to maintain water flow while work is being carried out in sections. Partial closures should be prioritized over full canal shutdowns to balance rehabilitation needs with agricultural water requirements.	Maintain the drainage ability Maintain the water supply ability Phased construction	During construction at water courses	CC	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• Construction activities that require temporary closures should be scheduled during periods of low irrigation demand, such as the post-harvest season or the winter months when water requirements are minimal. Coordination with local agricultural stakeholders will help identify the most suitable timing for construction to minimize disruptions. • For irrigation canal, temporary water diversion structures such as flexible pipes or lined ditches should be installed to provide an alternate water supply route to affected farmlands. For drainage channels, temporary pumping systems should be used to prevent waterlogging and ensure uninterrupted drainage of excess water from agricultural fields. • Regular communication with farmers and local communities should be maintained to ensure that stakeholders are aware of the construction schedule and potential impacts. • Advance notifications should be provided to allow farmers to plan their irrigation schedules accordingly. CC must maintain coordination with Irrigation department to ensure that				

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		mitigation measures are effectively implemented.				
Water Quality - (surface and ground) contamination	To avoid lubricants, solid waste, asphalt contamination to ground and water resources.	• CC of subprojects shall be responsible to take suitable preventive measures while using construction material that may result in contamination of ground and water resources like lubricants, solid waste, fuel. • Construction camps will be proposed at least 100m away from water channels. • Fuel and oil storage areas shall be proposed at least 100m away from water channels and be provided with a concrete platform and be bounded so that any fuel leakage is stored on site. • These storage areas should be equipped with spill containment measures such as drip trays, absorbent pads, and containment barriers. • Handling of lubricants and fuel should be done using appropriate pumps and leak-proof containers to minimize the risk of accidental spills. • Care will need to be taken in handling the materials so that wastage does not enter the watercourses.	Water quality of surface and groundwater Compliance of SEQS/IFC/WHO guidelines Siting of construction campsite Storage of fuel and oil Refueling of construction vehicle Construction alongside of canals and water channels	During construction at construction site and camp site	CC	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• Refueling should wherever possible be carried out at the fuel storage area and not be permitted adjacent to water channels. • Regular maintenance and inspections should be conducted for all heavy machinery and project vehicles to ensure there are no leaks. Any equipment found with leaks should be immediately repaired before being used on-site. Oil pans or spill trays should be placed under parked or idle machinery to capture any drips or leaks. • On inspection paths, asphalt should not be applied during rain so as to avoid it being washed into watercourses. • A spill response plan should be developed and implemented, with emergency spill kits readily available at all work sites. These kits should include absorbent materials such as sand, sawdust, or commercial absorbents, along with containment booms for water bodies. Workers should be trained on spill response procedures, including immediate containment, cleanup, and proper disposal of contaminated materials.				

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• Used oil, lubricants, and oily waste should be handled and disposed by SEPA approved contractor. Disposal in open fields, canals, or drains must be strictly prohibited.				
Waste management	To minimize the impacts from solid waste and properly dispose construction waste	• A Comprehensive Waste Management Plan for Construction phase will be developed by CC. • A dedicated waste contractor will be hired by the CC who will collect and dispose the waste in environment friendly manner. • CC will develop the site-specific waste management plan. • Debris and excavated soil generated will be reused in raising embankments subject to the suitability of the material and the approval of PMC-ES, or otherwise safely disposed of in barren land approved by ES. • When a campsite developed for construction works is no longer required, CC will need to remove the structures and also excavate and remove any contaminated soil. • Proper solid waste areas of adequate capacity will be designated at campsite site to cater to daily waste generation.	Construction waste generation, amount and type, method of disposal	During construction at construction site and camp site	CC / Waste Contractor	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• Care must be taken to prevent wastes giving rise to secondary environmental problems, such as odors or soil and groundwater contamination through rainwater leaching. • All workers handling wastes shall use proper PPE • All wastes generated at facilities shall be categorized in two major categories (i.e., Hazardous wastes and Nonhazardous wastes). • Recyclable waste will be sent to waste recycling contractor • Compostable and inert waste will be disposed of in nearby empty land designated for landfilling by local municipal authority. • Hazardous waste will be disposed of or incinerated by SEPA designated incinerator hired by CC.				
Climate and Air Quality	To minimize the impacts created due to dust formation and exhaust emissions from construction vehicles and activities	• In consultation with PMC, the Contractor(s) will be required to have a dust abatement program that includes spraying water on the construction sections near villages and towns. • Periodic monitoring of dust will be required by the CC and SEQS / IFC	Ambient air quality near construction site Exhaust emissions from construction vehicles	During construction at construction site and camp site	CC	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		guidelines for ambient air quality will be complied. • Labor will be provided with dust masks. • Bulk cement delivery rather than bags should be used wherever possible so as to reduce dust emissions and eventual problems with disposing of the large number of bags. • Materials will need to be stored close to the construction sections. • The Contractor will be required to maintain dust abatement procedures for the following: (i) where construction sections and access areas pass through villages and (ii) at sections where workers are employed. • Visual daily monitoring of dust emissions will be required by the Contractor(s). • All vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition in order to minimize emission of pollutants.	Compliance of SEQS/IFC/WHO guidelines Water sprinkling to reduce dust			

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• The stack height of the generators will be vented through vertical stacks to minimize exposure at ground level. • It should be ensured that exhausts from these equipment and vehicles comply with relevant SEQS/IFC/WHO guidelines. • Excessive engine idling should be discouraged and machinery causing excessive pollution (i.e., visible clouds of smoke) should be banned from sites.				
Noise impacts	• To reduce construction noise and vibration as far as practicable through the implementation of appropriate management procedures, including use of low noise equipment and management of construction hours.	• It shall be ensured that; (i) machinery is adequately silenced and (ii) machinery and pile driving operations close to villages and urban areas should be restricted to daylight hours a schedule agreed to between the contractor and the local communities. • Mufflers or silencers should be mandatory to be equipped by all project-related vehicles. • Additionally, employment of manual labor will reduce the need for many of the machinery operations. • Periodic monitoring of noise will be required by the CC and SEQS / IFC guidelines for noise levels will be complied.	Ambient noise near construction site Compliance of SEQS/IFC/WHO guidelines Provision of noise abatement devices	During construction at construction site	CC	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
Construction interference with Pre-existing Roads	To reduce safety hazards for traffic movement on existing roads	• Rehabilitation works along drains will be undertaken in sections and the period of rehabilitation is considerably short. • A traffic diversion plan will be introduced by CC to manage smooth flow of vehicular traffic and to avoid nuisance to commuters. • Sign postings, warning signs, diversion signs and barriers will be installed to alert public of all potential hazards including limited access to construction sites. • Construction of segment intersecting existing roads should be carefully planned and scheduled and when the traffic movement is minimal e.g., early morning. •	Traffic diversion Road intersections Planning and scheduling of construction work	During construction at construction site	CC	Internal: ES/SS(PMC) External: IMA
Health and Safety Concerns	• To provide adequate management of camp site through training of workers and compliance with international safety practices.	• Campsites shall be located at least 100m away from water courses and 300 m away from settlement. • Campsites and construction areas will need to be provided with septic sanitation facilities and potable water. • No untreated human waste should be allowed to enter water channels where it can affect downstream water quality and human health.	Number of construction labor, working environment Health and safety at workplace	During construction at construction site and camp site	CC	Internal: ES(PMC) External: IMA

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
	• Minimization of safety and health risks	• Offset double pit toilets with pour flush are recommended over a high platform. In this type, toilet is connected with leaching pits (stone lined) which act as a partial trickling filter and hence the water that escapes is bacteriologically less/not harmful. Once a pit is filled, the second one comes in use and the first is emptied over time. • Sludge after emptying the tanks/pits should be landfilled at proper location, covered with soil and left for degradation. • Employment of local labor will reduce the hazards of exacerbating malaria and dengue fever. Also, local labor can reduce this concern as these people will return to their villages at night and act in accordance with accepted community norms. • The project site will be fenced and trespassing will not be permitted. • The contractor will ensure good liaison with local communities and will facilitate their mobility. • Display the project activities clearly for the adjacent communities.	Campsite living environment and safety Provision of PPE Generation of wastewater from campsite Interaction of labor with community Hiring of local labor Hazards and risk analysis for a planned work Emergency and first aid services			

Environmental Concern	Objectives	Recommended Mitigation Measures	Performance Indicator	Timing & Location to implement	Implementation Responsibility	Monitoring Responsibility
		• Use safety signage and written instructions for workers and communities to ensure their safety. • Labor Health and Safety Plan will be prepared by the Contractor.				
Loss of Agricultural Land for Borrow Pits	Avoid burrow material from existing agriculture lands Use of approved burrow sites	• The Contractor will ensure that borrow material /earth-fill will be obtained within RoW or approved borrow sites. • Natural areas with high elevation can be utilized for source of borrow material /earth-fill but not those areas which are existing agriculture areas.	Approved burrow sites with documentation	During construction at construction site	CC	Internal: SS(PMC) External: IMA

Table VII-3: Environmental Monitoring Plan for Construction Phase

Monitoring Area	Parameters to monitor	No. of Samples	Standard	Location	Frequency	Total No. of Samples***	Responsibility
Ambient Air Quality	CO, SO_2, NO, NO_2, PM_{10}, $PM_{2.5}$, SPM, Pb, O_3	02*	SEQS and IFC/ WHO standards	Near each construction segment	Quarterly	26	IMA
Ambient Noise	L_{Aeq}	02*	SEQS and IFC/ WHO standards	Near each construction segment	Quarterly	26	IMA
Generators and Construction Machinery Noise Monitoring	L_{Aeq}	02	SEQS and IFC/ WHO standards	Two random samples at campsite	Quarterly	26	IMA
Generator Exhaust Emissions	CO, NOx, Smoke, Particulate Matter, SO_2	01	SEQS and IFC/ WHO standards	One sample from campsite	Quarterly	13	IMA
Vehicle Exhaust Emissions	CO, Smoke	05**	SEQS and IFC / WHO standards	05 random vehicle samples	Quarterly	65	IMA
Surface water quality	pH, TSS, BOD5, DO, COD, Nitrate (NO^{3-}), PTOT, Coliform Bacteria.	02	OECD / WWF / WHO	Two random samples from construction segments	Quarterly	26	IMA
Drinking Water Quality	Color, pH, Turbidity, Total Hardness, Sulfate, Chloride, TDS, Ammonia (as NH_4), Coliform, Nitrate (NO^{3-}), Nitrite (NO^{2-}), Cyanide, Mercury (Hg), Arsenic (As), Zinc (Zn), Antimony (Sb), Nickel (Ni), Selenium (Se), Cadmium (Cd), Total Chromium, Lead (Pb), Total Coliforms, Fecal Coli forms (E. Coli), Taste, Odor, Fluoride.	01	SEQS and IFC / WHO standards	One sample from campsite	Quarterly	13	IMA
Construction camp wastewater quality	Temperature, pH, BOD5, COD, TDS, TSS, Chloride, Sulfate, Fluoride, Phenols, Mercury (Hg), Ammonia (as NH_3), Coliform, Hardness, Nitrate (NO^{3-}), Sulfide, Total Toxic Metals, Oil and Grease and Cyanide	01	SEQS and IFC / WHO standards	One sample from septic tank of campsite	Quarterly	13	IMA
Solid Waste / Waste Disposal	Solid waste quality and quantity and disposal methods/locations - Visual checks to assess the situation	-		At campsite / construction corridors	Monitor the implementation	-	IMA

Monitoring Area	Parameters to monitor	No. of Samples	Standard	Location	Frequency	Total No. of Samples***	Responsibility
					on quarterly basis		
HSE	A complete code of Health, Safety and Environment (HSE) shall be developed	-		All Construction Areas	Monitor the implementation on quarterly	-	IMA
	Ensure state of the Art and International Standards for Safety of terminal, storage facility and all other installation to prevent any safety related hazard.	-				-	

* It is envisaged that the construction is undertaken in sections, hence, it is assumed that each time, work will be underway at least two sections simultaneously, therefore, the number of points for ambient air and noise are taken as 02.

** it is also assumed that at least 05 vehicles operating simultaneously along these construction sections.

*** Considering 13 subprojects which requires sampling and instrumental monitoring

F. Estimated Budget for the Implementation of EMP

505. The budget for the implementation of the environmental safeguards and ESMP includes the costs of monitoring such as laboratory costs, monitoring visits, training costs, and equipment. The ESMP implementation cost as per **PC-1 document is 2% of the total project cost i.e., USD 1,833,738 (PKR. 513,446,681/-)**.

G. GRIEVANCE REDRESS MECHANISM

1. Introduction

506. A Grievance Redress Mechanism (GRM) is a system that allows not only grievances, but also queries, suggestions, positive feedback, and concerns of project-affected parties related to the environmental and social performance of a Project to be submitted and responded to in a timely manner.

507. A Grievance Redress Mechanism (GRM) will be designed and established, to respond to queries or clarifications about the Program, resolve problems with implementation, and addressing complaints and grievances. The GRM will directly focus on and seek to resolve complaints (and requests for information or clarification) that pertain to outputs, activities, and processes undertaken by the Project.

508. The GRM is an essential component of the SCRP, designed to address both environmental and social concerns arising during Project implementation. The Team will develop a fully comprehensive GRM, which will include the establishment of grievance redress committees and procedures for receiving, processing, and resolving complaints. The GRM will be aligned with Pakistan's national regulations and will ensure transparent and timely resolution of issues raised by affected communities, particularly regarding environmental impacts or resettlement concerns. This mechanism will be crucial for maintaining project accountability, promoting community participation, and ensuring that grievances are effectively handled in a fair and accessible manner. The GRM will be effective, efficient, fast, easily accessible, fair, transparent, anonymous, gender-sensitive, free, compatible with human rights, based on dialogue and involvement. It must allow all concerned parties, including the Implementing Agency, to draw lessons from Program implementation.

2. Overview of Project GRM

a. Grievance Redress Procedure

509. A set of procedures for receiving, recording, and handling complaints has been defined in the following subsections. This following section relates specifically to a gender-based violence (GBV) in the grievance redressal mechanism (GRM). This includes procedures for recording, registering, and categorizing grievances; conducting an initial assessment of grievances, referring grievances to appropriate levels or persons, determining the resolution process, making decisions, including parameters and standards for accurate and consistent decision-making, notifying complainants and other affected parties of eligibility, the resolution process, and outcomes, along with tracking, documentation, monitoring, and evaluation.

b. Scope and eligibility

- The GRM will receive and redress all complaints and grievance related to the Program that are formally brought to the GRM by the person and group of persons who have a grievance because of the Project's adverse impact on him/her and them.

- For instance, the following categories of queries or complaints can be eligible to seize the GRM:
- Request for information, comment or suggestion.
- Violation of rights or non-performance of obligations.
- Grievances or offenses involving a violation of law.
- Complaints on negative environmental and social impacts which are not mitigated properly.
- Complaints from adversely affected people by way of land issues, discrimination, exclusion, etc.
- Complaints about biodiversity being affected adversely, and
- Complaints against Project staff, members of Project committees, consultants, and others involved in Project implementation.
- Complaints against gender-based violation (see below).
- Complaints relating to harassment at workplace based on cast, religion or cultural practices.

510. The GRM does not replace and is complementary to the legal framework applicable in the Project jurisdiction of both Sindh and Pakistan. Additional GRMs can be put in place in relation to specific Project activities, such as works, resettlement / livelihoods and other social, environmental and other restoration plans.

c. Procedure

511. The Project will identify and ensure proper training of a GRM focal point and reasonable capacity-building of Program team members to the principles, tools and processes of the GRM.

512. The proposed grievance procedure is set out below in Figure VII-2.

513. The Grievance Redress Mechanism will have to cover at least the following aspects, some of them to be updated from the present guidelines:

- Eligibility criteria (issues of grievance and types of complainants),
- Detailed procedure,
- Methodology for addressing the grievances,
- Delays, milestones and deadlines of the process,
- Alternatives in case of refusal,
- Specific procedures and tools for vulnerable groups and individuals,
- Specific procedures and tools for cases of gender-based violence and harassment (see next paragraph).

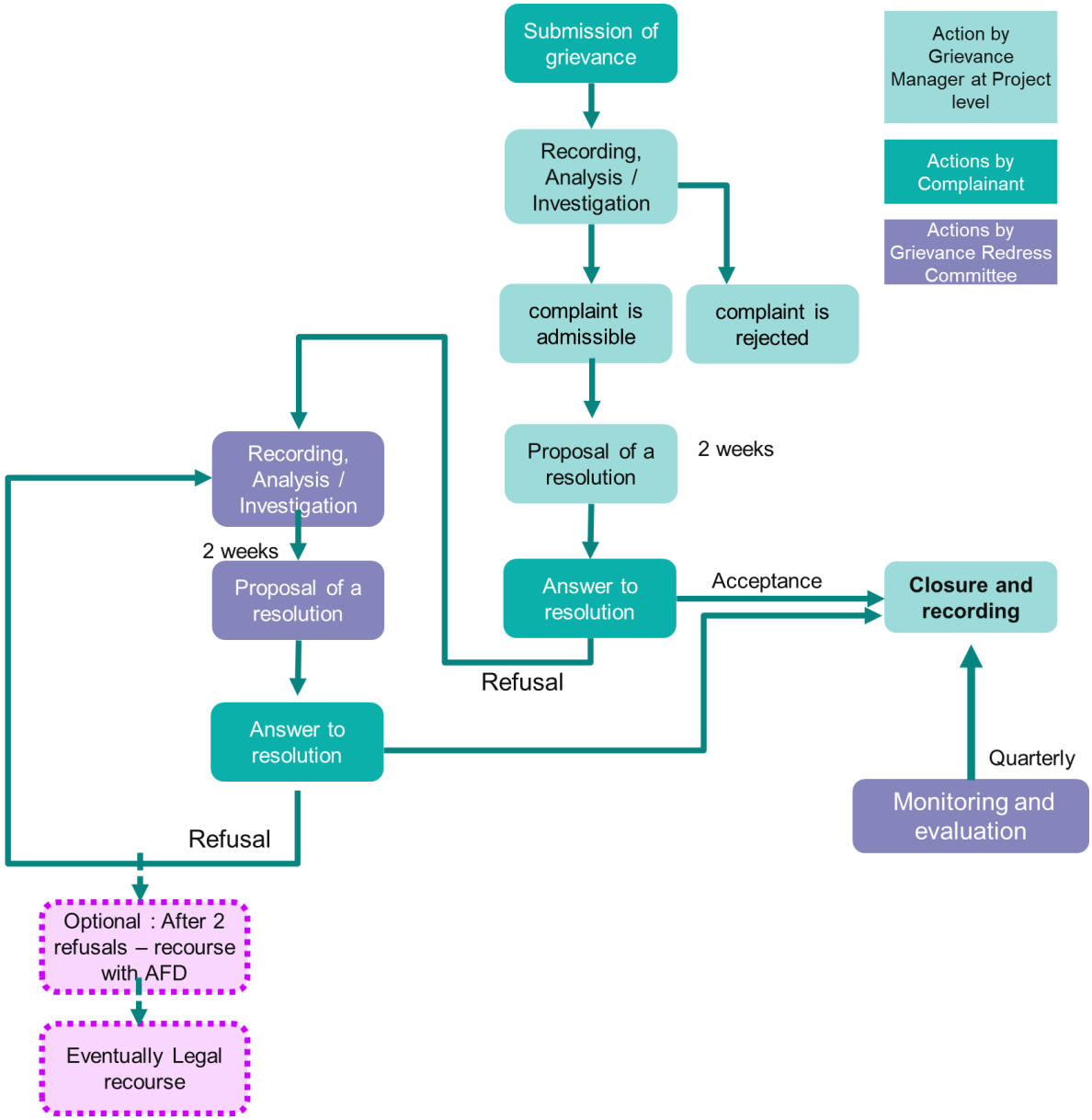


Figure VII-2: SCRP GRM Procedure

d. Disclosure

514. The internal and external stakeholders may not be aware of the different arrangements of registering their complaints.

- The GRM board explaining the redress tiers will be displayed at site in local language,
- Distribution of brochure and pamphlets informing duration and nature of work,
- Display of Focal point or Nodal person's name in the GRM Board,
- Location of tools like grievance collection boxes at strategic locations,
- Modes of communication available (email/website/letter/direct complaint)
- Details of Grievance Redress Committee and its members.
- Specific cases of GBV, SEAH, and VAC

3. Complaints of GBV, SEA/SH & VAC

515. Gender-based violence (GBV) is a violation of human rights. Nearly six in ten women around the world suffer some kind of violence in their lifetime, whether physical or sexual (UN Women, 2019b). Although countries have been encouraged by international and regional legal entities to take steps to fight the problem, GBV continues to occur worldwide in many forms, ranging from domestic violence to sexual abuse, to more severe forms such as honor killings, acid attacks, and other forms of femicide. The global prevalence of GBV indicates that the issue is yet to fully be tackled, which has far-reaching consequences. Studies reveal that GBV leads to physical injuries, disability, and death, and victims also suffer mental and psychological disorders. According to a World Bank study (Nata Duvvury, 2013), some women fear GBV more than war or cancer.

516. The Team is committed to addressing any Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH) and Violence Against Children (VAC) related grievances across all Project-supported activities and subproject sites. A survivor-centered approach will be adopted under which the survivor's safety, confidentiality, choices, needs, and well-being will remain central. The SEA/SH and VAC complaints will be addressed in the following manner:

517. **Accessibility:** A SEA/SH and VAC GRM will be accessible to all potential complainants from affected persons and households at subproject sites. Complainants can lodge complaints using multiple access points to register issues and incidents. Adequate information about the existence and operations of GBV complaints will be provided to the communities in the Sindhi and Urdu language. A parallel and integrated system will allow for scrambled and identity-protected voice recording for those wishing to lodge a complaint who may be illiterate or unable to register complaints in writing.

518. **Safety:** The safety and security of the survivor, his/her family, and the people who have assisted them to register a complaint, must be the first priority for all actors. Individuals who disclose an incident of GBV or other misconduct are often at a high risk of further violence from the perpetrator(s) or from others around them. The survivor's physical and psychological safety as well as that of their family must always remain a priority, and survivors must be involved in all decision-making related to their case including proceeding with legal action.

519. **Confidentiality:** Confidentiality is the primary imperative of the GRM process and will be maintained, as much as possible, with respect to any GBV/SEA/SH and VAC complaint, and only those who need to know about such a complaint will be advised of its existence. Information gathered about the allegation will not be shared with persons or entities unless there is explicit permission granted by the complainant. Confidentiality will cover all information in a complaint that may lead to the identification of a specific incident or those affected by the allegation. This applies to the survivor and witnesses, but also the identity of the alleged perpetrator. Confidentiality is key to protecting survivors' and witnesses' safety. Information-sharing will take place on a strictly need-to-know basis, limited to essential information, and based on pre-established information-sharing protocols which are in line with best practices for the handling of GBV/SH/SEA/VAC cases. Reports of grievances to the Grievance Redress Committee shall only include an anonymized summary of allegations based on pre-established information-sharing protocols.

520. **Survivor-centered approach:** All prevention and response actions must balance the respect for due process with the requirements of a survivor-centered approach under which the survivor's safety, confidentiality, choices, needs, and well-being remain central.

521. **Respect:** The survivor's rights, needs, and wishes will be respected at all levels, and all actions will be taken with her/his consent or the consent of the parents/legal guardians in case of a minor.

522. **Non-discrimination:** Survivors of violence will receive equal and fair treatment regardless of their age, gender, race, religion, nationality, language, ethnicity, socio-economic status, or any other characteristic.

523. Considerations regarding children and persons with physical and/or intellectual disabilities: When the survivor is a child, actions in the best interest of the child will be held as the governing principle. Children are considered incapable of providing consent because they do not have the ability and/or experience to anticipate the implications of an action, and they may not understand or be empowered to exercise their right to refuse. A child is anyone under the age of 18 under national and provincial laws who cannot give free and voluntary consent. Additional considerations and protective safeguards may also apply where the complainant or survivor is a person with physical and/or intellectual disabilities.

a. Procedures of Addressing Grievances on GBV, SEA, SH and VAC

524. The GRM for GBV, SEA, SH, and VAC will require a dedicated and specific system to receive, manage, and resolve such complaints. The (i) Stakeholder Engagement and Gender Specialist and (ii) Resettlement Specialist, will be central to this system as the focal points for all complaints and grievances related to GBV, SEA and SH. The Team Leader has previously prepared GRM processes in Pakistan and will be responsible for tracking and managing such complaints, and will be provided training from a certified and reputable organization focusing on issues of GBV and VAC. Any additional staff will be provided adequate training on handling and documentation of complaints related to gender-based violence, sexual exploitation and abuse, and sexual harassment, and covering referral mechanisms to related service providers. All grievances related to GBV, SEA, and SH will be managed by a dedicated GBV, SEA, SH and VAC sub-committee specifically set up for this purpose. The members of the committee will also need to be well-trained to manage such complaints.

b. GBV, SEA/SH and VAC Committee

525. The SEA/SH and VAC Committee will be responsible for: Assessing the complaint to establish whether an act of SEA/SH or VAC has been committed. Confirming whether the alleged perpetrator is associated with the Project; and Agreeing upon a plan of action including sanctions to be imposed, in consultation with the employer of the alleged perpetrator. The committee will comprise of four individuals, at least one of whom will be a woman.

c. Response Protocol

526. **Step 1:** A survivor may either directly report an incident using any of the means (phone, email, office address) to access GRM, or choose to report to an individual whom she/he trusts such as a family member, a friend, another member of the community, a service provider, or community leader.

527. **Step 2:** Upon receipt of a complaint, the GRM Operator will register the case in the GRM. The GRM Operator/s will inform the PIU focal Points, who will in turn inform the ADB of any SEA/SH or VAC complaint/allegation, within 48 hours of receiving such a complaint. When the allegation is received directly from the survivor or parent/legal guardian in the case of a minor, the GRM Operator/s will record their account of the incident and assist them by referring them to GBV service provider(s) for support immediately. If the complainant is not the survivor, the complainant should be encouraged to ask the survivor to come forward by explaining to them the potential benefits of doing so, either alone or with the person reporting to the GRM. If there is a genuine concern about the safety of the survivor, the GRM Operator may try to directly approach them, and refer them to the relevant GBV service provider.

528. The GRM Operator/s will refer any survivor reporting abuse or violence through the Project grievance mechanism to a relevant service provider, regardless of whether the perpetrator is known to be associated with the Project or not. The reason for this is that it may not be possible to know the specific details about the perpetrator at the time the complaint is launched, or at the time that support services start; and once they begin, a survivor should continue to receive care and have access to them. Further, due to increased awareness activities in the Project-affected communities, survivors may seek services through the Project, whether the perpetrator is associated with the Project or not.

529. The GRM Operator should have knowledge on:

- How to access said services,
- Who to contact,
- Financial support that may be provided, and
- Available options for assistance within and outside of the GRM.

530. Upon receipt of a complaint and prior to referral or any third-party disclosure of the case, the GRM must ensure that consent is taken from the survivor. For this purpose, a standard form may be used as appended.

531. **Step 3:** If the survivor or parent/legal guardian in case of a minor wishes to file a formal complaint, the GRM Operator will send the case to the SEA/SH and VAC Committee. As mentioned above, the Committee will review the available information and assess if it constitutes an act of SEA/SH or VAC. Further, it will establish whether there is a link with the Project. If the findings reveal that an incident has taken place by an individual associated with the Project, the Committee will inform the appropriate party/ employer of the alleged perpetrator of the allegation. The Committee will share their recommendations with the employer of the perpetrator, and a course of action (including disciplinary action) will be agreed upon within two weeks of receiving the complaint. Subsequently, the employer will be responsible to take the agreed disciplinary action within 30 days of the receipt of the complaint. Any sanctions imposed should be proportionate to the violation; and in accordance with the national/provincial legislation. In instances where it is necessary to report the case to local authorities in line with national or provincial laws, the Committee will refer the case with the consent of the survivor or parent/ legal guardian, for further investigation and criminal proceedings.

532. **Step 4:** Where the survivors decide to file a formal complaint, it is important to keep the survivors or parents/legal guardians of minors informed about the progress of the case. In such instances, the GRM Operator will inform the survivor when the case has been sent to SEA/SH and VAC Committee for review, and when the matter has been sent to the employer for disciplinary action. Alternatively, the survivor or parent/legal guardian may decide to approach the employer directly or pursue legal action through a referral partner.

533. **Step 5:** Once the necessary disciplinary action has been taken, or legal action has been initiated the case will be closed in the GRM. The results of the process, whether it is sanctions imposed by the employer or initiation of legal proceedings, will be logged in the GRM. The Social/Gender/Safeguard Specialist, Representatives of ADB and other senior Team Members will be informed of the closure of the case, as per the agreed communication protocols.

4. GRM Monitoring and Reporting

534. The Team will establish a Monitoring Unit which will devise a complete Project monitoring plan and schedule in accordance with Project implementation activities.

VIII. CONCLUSION

535. The reconstruction / rehabilitation of drains and canal under Output 1 and NbS under Output 2 is likely to have minimal and limited impacts of temporary nature and of short duration, limited to the construction activities, which will be mitigated as per the mitigation plan laid down in the above section. Since the Project involves construction at the existing alignments and RoW of drains, the environmental impacts will be limited to the construction limits of subprojects.

536. Environmental Performance Monitoring will be an integral part of the Project to ensure that:

- The structures and materials conform to recommended standards and follow standard practice of civil works.
- Environmentally sound materials and goods are selected, with priority being accorded to products meeting national and international standards.
- Monitoring will be required for the assurance of no damage to community owned assets like houses, shops, crops, trees, road over bridges, drain inlets, fishing jetties etc.
- Trees located on the embankments, NIP / IP, if needed to be cut down, a compensatory plantation will be provided.
- Construction camps are to be located at minimum distance of 300m from existing settlements, built-up areas.
- Dust abatement program needs to be implemented that includes spraying water along alignments close to villages, past houses and shops.
- Emergency and safety plan will be built by contractor/PIU for bridges and roads near canals and waterways.
- Grievance Redress Mechanism will be implemented by CC to ensure that community complains are recorded appropriately.

537. The environmental safeguards will have to be monitored by concerned agencies, including Environment Specialist ES (PMC) and PIU.

538. Careful implementation of the EMP will ensure that environmental impacts are managed adequately and CC and PIU will meet all local statutory requirements and ADB SPS 2009.

Annexures

Annex I: Sindh Environmental Quality Standards (SEQS)

Sindh Environmental Quality Standards (SEQS)

With the SEP Act, 2014 the Sindh EPA revised the Environmental Quality Standards (EQS) with full consultation of the private sector, industrialist, trade and business associations and NGOs and approval of Sindh Environmental Protection Council has developed Sindh Environmental Industrial Wastewater, Effluent, Domestic Sewerage, Industrial Air Emission, Ambient Air, Noise for vehicles, Air Emissions for Vehicles and Drinking Water Quality Standards 2015, vide Notification No.EPA/TECH/739/2014.

Sindh Environmental Quality Standard for Ambient Air			
Pollutant	**Time-weighted average**	**Concentration in Ambient Air**	**Method of measurement**
Sulfur Dioxide (SO_2)	Annual Average*	80µgm^3	Ultraviolet Fluorescence Method
	24 hours**	120µgm^3	
Oxides of Nitrogen as (NO)	Annual Average*	40µgm^3	Gas Phase Chemiluminescence
	24 hours**	40µgm^3	
Oxides of Nitrogen as (NO_2)	Annual Average*	40µgm^3	Gas Phase Chemiluminescence
	24 hours**	80µgm^3	
O_3	1 hour	130µgm^3	Non dispersive UV absorption Methods
Suspended Particulate Matter (SPM)	Annual Average*	360µgm^3	High volume Sampling, (Average flow rate not less than 1.1m^3/minute)
	24 hours**	500µgm^3	
Respirable Particulate Matter (PM10)	Annual Average*	120µgm^3	B Ray absorption method
	24 hours**	150µgm^3	
Respirable Particulate Matter (PM2.5)	Annual Average*	40µgm^3	B Ray absorption method
	24 hours**	75µgm^3	
Lead (Pb)	Annual Average*	1µgm^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5µgm^3	
Carbon Monoxide (CO)	8hours**	5mg/m^3	Non Dispersive Infra Red (NDIR) Methods
	1hours	10mg/m^3	
*Annual arithmetic means of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.			
**24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.			

The Motor Vehicle Noise		
Parameter	**Standards (maximum permissible limit)**	**Measuring method**

Noise	85dB(A)	Sound-meter at 7.5meter from the source

Sindh Environmental Quality Standard for Noise					
S. No.	**Category of Area / Zone**	**Effective from 1st January, 2015**		**Effective from 1st January, 2015**	
		Limit it in dB(A) Leq*			
		Day Time	Night Time	Day Time	Night Time
1	Residential area (A)	65	50	55	45
2	Commercial area (B)	70	60	65	55
3	Industrial area (C)	80	75	75	65
4	Silence Zone (D)	55	45	50	45
Note: 1	Day time hours: 6.00 a. m to 10.00 p. m				
2	Night time hours: 10.00 p. m to 6.00p. m				
3	Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.				
4	Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.				
*dB(A)Leq	Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.				

Sindh Environmental Quality Standard for Municipal & Liquid Industrial Effluents					
S. #	Parameter	Into Inland Waters	Into Sewage Treatment	Into Sea	unit
1	Temperature or Temp. increase	<3	<3	<3	°C
2	pH value (H^+)	6-9	6-9	6-9	
3	Biological Oxygen Demand $(BOD)_5$ at 20°C	80	250	80	mg/l
4	Chemical Oxygen Demand (COD)	150	400	400	mg/l
5	Total Suspended Solids (TSS)	200	400	200	mg/l
6	Total Dissolved Solids (TDS)	3500	3500	3500	mg/l
7	Oil and Grease	10	10	10	mg/l
8	Phenolic Compounds (as Phenol)	0.1	0.3	0.3	mg/l
9	Chloride (as Cl^-)	1000	1000	SC	mg/l
10	Fluoride (as F^-)	10	10	10	mg/l
11	Cyanide (as CN^-) total	1.0	1.0	1.0	mg/l
12	An-ionic detergents (as MBAS)	20	20	20	mg/l
13	Sulphate (SO_4^{2-})	600	1000	SC	mg/l
14	Sulphide (S^{2-})	1.0	1.0	1.0	mg/l
15	Ammonia (NH_3)	40	40	40	mg/l
16	Pesticides	0.15	0.15	0.15	mg/l
17	Cadmium	0.1	0.1	0.1	mg/l
18	Chromium (trivalent and hexavalent)	1.0	1.0	1.0	mg/l
19	Copper	1.0	1.0	1.0	mg/l
20	Lead	0.5	0.5	0.5	mg/l
21	Mercury	0.01	0.01	0.01	mg/l
22	Selenium	0.5	0.5	0.5	mg/l
23	Nickel	1.0	1.0	1.0	mg/l
24	Silver	1.0	1.0	1.0	mg/l
25	Total toxic metals	2.0	2.0	2.0	mg/l
26	Zinc	5.0	5.0	5.0	mg/l
27	Arsenic	1.0	1.0	1.0	mg/l
28	Barium	1.5	1.5	1.5	mg/l
29	Iron	8.0	8.0	8.0	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6.0	6.0	6.0	mg/l

32	Chlorine	1.0	1.0	1.0	mg/l

Sindh Environmental Quality Standards for Drinking Waters (mg/l)

S.#	Properties / Parameters	Standard Values for Pakistan	S.#	Properties / Parameters	Standard Values for Pakistan
Bacterial			Chemical		
1	All water intended for drinking (E.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Essential Inorganics (mg/liter)		
			3	Aluminum (Al) mg/l	≤ 0.2
			4	Antimony (Sb)	≤ 0.005
2	Treated water entering the distribution system (Ecoli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	5	Arsenic (As)	≤ 0.05
			6	Barium (Ba)	0.7
			7	Boron (B)	0.3
3	Treated water in the distribution system (E. coli or thermo tolerant coliform and total coliform bacteria)	Must not be Detectable in any 100 ml sample. In case of large supplies, where sufficient samples are examined, must not be resent in 95% of the samples taken throughout any 12-month period.	8	Cadmium (Cd)	0.01
			9	Chloride (Cl-)	< 250
			10	Chromium (Cr)	≤ 0.05
			11	Copper (Cu)	2
			Organic (mg/L)		
			12	Phenolic compounds	<0.0002
			Toxic Inorganics (mg/liter)		
			13	Cyanide (CN)-	≤ 0.05
			14	Fluoride (F)	≤ 1.5
			15	Lead (Pb)	≤ 0.05
			16	Manganese (Mn)	≤ 0.5
Physical			17	Mercury (Hg)	≤ 0.001
4	Color	< 15 TCU	18	Nickel (Ni)	≤ 0.02
5	Taste	Non-objectionable/ Acceptable	19	Nitrate (NO_3)-	≤ 50
6	Odor	Non-objectionable/ Acceptable	20	Nitrite (NO2)-	≤ 3
7	Turbidity	< 5 NTU	21	Selenium (Se)	≤ 0.01
8	Total Hardness as $CaCO_3$	< 500 mg/l	22	Residual Chlorine	0.2-0.5 At consumer end 0.5-1.5 at source
9	TDS	<1000			
10	pH	6.5-8.5			
Radioactive					
11	Alpha Emitters bq/L	0.1	23	Zinc (Zn)	5.0
12	Beta emitters	1			

Annex II: Waste Management Plan - General Guidelines

Waste Management Plan – General Guidelines

Preamble:

1. This Waste Management Plan has been prepared to facilitate Civil Works Contractors and is part of Environmental Compliance Documentation required this ESIA study.

2. The Construction Contractor (CC) will prepare its own site-specific waste management plan and submit to PIU through PMC for approval prior to commencement of works.

Table A: Contractor Details	
Name of Contractor Company	
Registration Number of Contractor Company	
Address	
Contact Details	
Contact Telephone number	
Nominated Person for this Package:	
Nominated Person Contact Details	
Nominated Person Telephone number	

Table B: Package Details			
Subproject No.		Subproject Name	
District:		Taulka:	
Resident Engineer / Focal Person			
Name			
Contact Details			

Part C: Waste Management Plan

3. The **Objective** of having a Site-Specific Waste Management Plan by the Contractor Company is to provide guidelines for the handling, transportation, storage, management and disposal of all types of waste anticipated from project activities from the generation to the final disposal of waste.

Requirements

4. The Construction Contractor shall ensure that environment is clean and free from all sorts of accumulating pollution by implementing a waste management plan.

5. The Construction Contractor shall submit pictures of campsite prior to and post completion of rehabilitation / reconstruction works to ensure that the condition of the campsite at the time of handing over after completion of subproject is as good or better than the original condition.

6. The Construction Contractor may manage waste itself or may, if required, engage the services of any waste management company for this purpose.

7. In such a case, the Construction Contractor will ensure that all the requirements mentioned in this document is addressed appropriately.

8. The Construction Contractor will arrange visit of PIU along with PMC, if deemed necessary, to the operations area of the waste management company to evaluate the suitable of engagement of waste management firm and its disposal methods.

9. The Construction Contractor will nominate Camp site in charge / or any other person to be responsible to manage Waste in the camp site and maintain its record for submission to PIU through PMC.

10. The nominated person shall be responsible for conducting waste Audit on site. The waste audit will primarily comprise of quantification, categorization and source of waste.

11. The Construction Contractor shall monitor and mitigation all types and states of waste such as liquid, solid, organic, recyclable, hazardous/non-hazardous etc.

12. The nominated person shall make arrangements follow hierarchy during the process of management of waste.

    a. Reduce waste at source

    b. Reuse and Recycle

    c. Dispose at designated location in an environmentally friendly manner.

13. The Construction Contractor shall provide necessary equipment such as mops, brooms, dustbins etc. for effective management of waste.

14. The Construction Contractor shall ensure that environment clean, and having a waste management plan established, maintaining clear surroundings allows people to live healthy and comfortably.

15. The Construction Contractor shall ensure that no waste generated from its campsite spread beyond the limits of its camp except for the purpose of its environment friendly disposal and / or recycle / reuse.

Annex III: Chance Find Procedure

Chance Find Procedures

The purpose of this document is to address the possibility of archaeological deposits becoming exposed during ground altering activities within the project alignment and to provide protocols to follow in the case of a chance archaeological find to ensure that archaeological sites are documented and protected as required.

The Antiquities Act, 1975 and Sindh Cultural Heritage (Preservation) Act, 1994 protect Physical Cultural Resources. “Physical Cultural Resources” (as per ADB SPS 2009) are movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level.

"Chance find" procedures apply when the possible discovery of Physical Cultural Resources particularly archeological resources or random findings during the execution of civil works especially excavation for embankments along drains, were transpired for subprojects either during the screening phase or during the actual construction period.

The objectives of this Chance Find Procedure are to promote preservation of archaeological finds. It is recommended that all on site personnel and the Construction Contractor staff be informed of the Archaeological Chance Find Procedure and have access to a copy while on site.

Induction/Training

All the Construction Contractor staff, especially those working on earth movements and excavations, are to be inducted on the identification of potential heritage items/sites and the relevant actions for them with regards to this procedure during the induction and regular toolbox talks.

Procedure

In the event of finding / revealing of tangible cultural heritage resources / historic features during construction, the following procedures for identification, protection, and treatment of discovered sites or artifacts should be followed and included in the Construction Contractor bidding document.

a) Stop the construction activities in the area of the chance find;

b) Delineate the discovered site or area;

c) Secure the site to prevent any damage or loss of removable objects.

d) Immediately notify the Environment Specialist / PMC who in turn will notify the Culture, Tourism, Antiquities and Archives Department, Government of Sindh within 02 days;

e) Culture, Tourism, Antiquities and Archives Department would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures;

f) The Director or any officer authorized by him of Culture, Tourism, Antiquities and Archives Department Government of Sindh with police assistance may, after giving reasonable notice, enter into, inspect and examine any premises, place or area which or the sub-soil of which he may have reason to believe to be, or to contain an antiquity and may cause any site, building, object or any antiquity or the remains of any antiquity in such premises, place or area to be photographed, copied or reproduced by any process suitable for the purpose;

g) Record details in Incident Report and take photos of the find;

h) Decisions on how to handle the finding shall be taken by the PIU and the Culture, Tourism, Antiquities and Archives Department. This could include changes in the cross-section of drains

(such as when finding an immovable remain of cultural or archeological importance), conservation, restoration and salvage;

i) If the Department. after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government of Sindh to direct the Revenue Department to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part under the Land Acquisition Act, 1894 (I of 1894), as for a public purpose;

j) Implementation of the authority decision concerning the management of the finding shall be communicated in writing by the relevant Ministry;

k) Construction work could resume only after permission is given from the Culture, Tourism, Antiquities and Archives Department concerning safeguard of the heritage.

Record Keeping

All finds must be cataloged, photolog, copies of communication with PIU and Antiquities Department., induction/ training and recommendations/guidance, implementation reports must be recorded and reported.

These procedures must be referred to as standard provisions in the Construction Contractor contract documents. During project supervision, the Environment Specialist shall monitor the above regulations relating to the treatment of any chance find encountered. Relevant findings will be recorded in Progress Report.

Annex IV: Focus Group Discussions (FGD) Questionnaires

Male FGDs

Date: _____ Name of the Interviewer: _____			
Introduction of the Project: The Sindh Coastal Resilience Sector Project (SCRP) aims to help "reduce flood risks and build the resilience of the local infrastructure and the people," and a central outcome of "reducing risks of recurring damage to livelihoods, land, and freshwater from natural hazards and climate change in the coastal region of Sindh: Thatta, Badin, and Sujawal." The proposed project comprises three main outputs: a) Climate-resilient integrated water resources, drainage, flood risk, and coastal resilience management solutions have been developed. b) Nature-based solutions for coastal protection restored. c) Institutional and community capacity for strategic action planning will be strengthened and implemented with the support of an attached ADB technical assistance. Please see proposed subproject list at the end of the questionnaire.			
LOCATION DETAILS			
District		Village / Settlement	
Sub-division		Coordinates	
Nearby SCRP Subproject		Distance from the subproject	
Focused Group Description			
DEMOGRAPHIC AND SOCIO-CULTURAL ASPECTS			
1. Number of Households in the village			
2. Average Household Size			
3. Estimated Population			
4. Male (%)		**5. Female (%)**	
6. Major Family Structure in the village		1. Joint	2. Nuclear
7. Major Religions			
8. Major Caste/Ethnic group(s) in the village		1.	2.
		3.	4.
9. Nature of Conflicts in the village (if any) and Conflict Resolution Mechanism			
DISADVANTAGED/VULNERABLE INDIVIDUALS OR GROUPS			
10. Are there any disadvantaged / vulnerable groups in the village? (if yes, fill below)			

Disadvantaged/Vulnerable Individuals or Groups	Number or approx. percentage (%)
1. Women agriculture and livestock farmers and/or those in farming HHs	
2. Female-headed households	
3. People with special needs	
4. Indigenous Peoples	
5. Ethnic/religious/gender minorities	
6. Children and youth heads of households	
7. Casual/Informal labor force	

ECONOMIC SITUATION

11. Income-wise Major Occupations in the village (Tick only one major and one minor)

Occupation	Major	Minor	Average Monthly Compensation per household (Use Codes)	*Monetary Codes (Rs.)* *1. Less than 5.000* *2. 5.000-15.000* *3. 15.000-25.000* *4. 25.000-35.000* *5. 35.000-40.000* 6. *More than 40.000*
a) Farmer				
b) Fisherman				
c) Shepherd				
d) Wood cutting				
e) Grocery shop				
f) Pan Shop				
g) Tea Hotel				
h) Puncture Making				
i) Fuel vendor				
j) Carpenter				
k) Small Business Owner				
l) Non-earning occupation				
m) Government servant				
n) Private service				
o) Skilled labour				
p) Unskilled labour				
q) Other specify___				

12. Source-wise Average Monthly Household Expenditure

Source	Average Expenditure per household (Code)	*Monetary Codes (Rs.)* *1. Less than 5.000* *2. 5.000-15.000* *3. 15.000-25.000* *4. 25.000-35.000* *5. 35.000-40.000* 6. *More than 40.000*
a) Food		
b) Medical/Health		
c) Transport (Fuel, Fare, Maintenance)		
d) Education		
e) Construction		
f) Recreation		
g) Other		

13. People have Livestock?	1. Yes	2. No	

14. If Yes in Q. 13, then major livestock in the area

1. Goat	2. Cow	3. Camel	4. Buffalo
5. Horse	6. Donkey	7. Sheep	8. Hens

15. Major crops in the area

1. Rabi			
2. Khrif			

INFRASTRUCTURE FACILITIES / SITUATION IN THE AREA

16. Educational Facilities

Facility	Nos.	Private (1) / Government (2)
1. Primary School		
2. Middle School		
3. Secondary School		
4. Inter College		
5. Degree. College		
6. University		
7. Tech-School		
8. Madrassa		

17. Health/Medical Facilities

Facility	No.	Private (1) / Government (2)
1. Hospital		
2. Dispensary		
3. Compounder		
4. Clinic		
5. RHU		
6. BHU		
7. MCHC		
8. Hakeem		
9. Any Other		

18. Common Diseases / Illness

1. Fever / Common Cold	2. Diarrhea	3. Cholera
4. Dysentery	5. Hepatitis	6. Typhoid
7. Cardiac Disease	8. Hyper Tension	9. Diabetes
10. Lungs Diseases	11. Kidney Disease	12. Skin Disease
13. Cough	14. Malaria	15. Stomach Worms
16. Cataract / Eye Diseases	17. Any other	

19. Maternity / Delivery Cases Facilities

1. Hospital	2. Midwife	3. BHU/LHV
4. Others		

20. Veterinary Facilities in the Area	1. Yes	2. No	
21. If Yes in Q. 20, then Number of Veterinary Facilities			

UTILITIES AND AMENITIES

22. What are the main sources of Irrigation water?	
1. Canal (Name)	
2. Dug Well (private)	
3. Dug well (common)	
4. Hand pump (private)	
5. Hand pump (common)	
6. Borehole (solar/electric pump)	
7. Indus River	
23. What is the current situation and issues regarding irrigation water?	
24. What are the main sources of drinking water?	
8. Canal / drainage	
9. Bought from water vendors/tanker	
10. Dug Well (private)	
11. Dug well (common)	
12. Hand pump (private)	
13. Hand pump (common)	
14. Borehole (solar/electric pump)	
15. Indus River	
16. Any other (Specify):	
25. What is the current situation and issues regarding drinking water?	

26. Source of Energy/Light		
Source	Yes (1), No (2)	Quality of Supply (Load-Shedding etc.?)
1. Electric connection		
2. Kerosene oil		
3. Solar / Wind		
4. Generators		

27. Fuel for cooking		
Source	Yes (1), No (2)	Detail
1. Wood / Coal		
2. Natural Gas		
3. Biomass		

4. LPG Gas		

28. Telecommunication: (PTCL / Mobile Network)

Facility	Yes (1), No (2)	Usage Percentage
1. PTCL / Landline		
2. Mobile Network		

29. Access Road(s) Condition:

1. Kacha 2. Pucca 3. Shingle 4. Metaled

30. Sewerage:

1. Pit hole connected with sewerage Line
2. Pit hole not connected with sewerage line
3. Open Defecation
4. Other (Misc.) _____

31. Solid Waste Management:

1. Any Collection 2. Burning 3. Any drums provided
4. Open dumping 5. Other

32. Religious, Cultural and Recreational Facilities

Facility	Nos.
1. Autaq (Common guest room)	
2. Mosque/Church/Temple	
3. Children Park	
4. Sport ground	
5. Graveyard	
6. Others specify:	

WELFARE ORGANIZATIONS / NGOs / CBOs

33. NGOs Working in Project Area

Name of NGO	Project Name
1.	
2.	

CLIMATE RISK / VULNERABILITY

34. Is your village being prone to climate risks / vulnerabilities	1. Yes	2. No	

Climate risk / vulnerability	Impact Rating (High, Medium, Low)	Description of risk / vulnerability (1) flood level, (2) affected land, (3) loss of lives, (4) loss of houses / damage, (5) loss of livestock, (6) out-migration,(7) spread of disease, (8) infra damaged
1. Flooding due to River		
2. Flooding due to canal / drain		
3. Floods due to rain		
4. Storm surges		
5. Tropical cyclones		

6. Seawater intrusion		
7. Heat waves		
8. Changes in cropping pattern		
9. Water logging		
10. Salinity		
11. Drought		
12. Water borne diseases		
13. Smog		
14. Others:		

35. What are the current measures taken by most households in your area or a neighboring area community or Government to combat the climate related risks or disasters (including flooding, droughts, insect/pest infestations etc.)

36. How do you know when a climate related risk or disasters is coming?

37. How do you prepare for a climate related risk or disaster?

CONCERNS AND FEEDBACK OF THE RESPONDENT(S)

38.your opinion, should this subproject be implemented here? 1. Yes 2. No

If yes, then reason	code	If no, then reason	code
1. Flood protection and improved stormwater drainage	1	1. Disputes over access to, or control of, water resources	1
2. Increase in forest cover	2	2. Decrease in availability of irrigation water	2
3. Improved drainage and reduced water logging	3	3. Loss of dwelling structures	3
4. Creation of job opportunities	4	4. Loss of income	4
5. Protection from storm surges	5	5. Access issues	5
6. Increase in agriculture productivity	6	6. Loss of crops	6
7. Benefits for Women and elderly	7	7. Privacy issues	7
8. Any other (please specify)	8	8. Any other (please specify)	8
9. No response	0	0. No response	0

39. Any other concern with respect to the proposed Subproject?

_____
_

_____
_

40. What protective measures do you suggest to safeguard your interests?

_____
_

_____
_

41. In your opinion, what are some pressing needs of this area?

_____
_

_____
_

42. Would it be possible to involve inhabitants in the project design and construction? If yes, how?

_____
_

FGD PARTICIPANTS DETAILS		
Name of Respondent(s)	**Occupation**	**Cell Number(s)**

Women Focus Group Discussions (FGD) Questionnaire

Date: _____ Name of the Interviewer: _____

Introduction of the Project:

The Sindh Coastal Resilience Sector Project (SCRP) aims to help "reduce flood risks and build the resilience of the local infrastructure and the people," and a central outcome of "reducing risks of recurring damage to livelihoods, land, and freshwater from natural hazards and climate change in the coastal region of Sindh: Thatta, Badin, and Sujawal." The proposed project comprises three main outputs:

d) Climate-resilient integrated water resources, drainage, flood risk, and coastal resilience management solutions have been developed.

e) Nature-based solutions for coastal protection restored.

f) Institutional and community capacity for strategic action planning will be strengthened and implemented with the support of an attached ADB technical assistance.

Please see proposed subproject list at the end of the questionnaire.

LOCATION DETAILS			
District		Village / Settlement	
Sub-division		Coordinates	
Nearby SCRP Subproject		Distance from the subproject	
Focused Group Description			

Gender Roles and Responsibilities

1. What are the main roles and responsibilities of women related to care activities?

Roles	Involvement (%age)
Household Activities	
Income Generation Activities	
Others, specify _____	

2. What are the main roles and responsibilities of women related to agriculture?

Occupation	Major	Minor	Monthly Income (Use Codes)	*Monetary Codes (Rs.)*
r) Preparing land				*7. Less than 5.000*
s) Sowing				*8. 5.000-15.000*
t) Harvesting				*9. 15.000-25.000*
u) Picking				*10. 25.000-35.000*
v) On-farm water Management				*11. 35.000-40.000*
w) Others				12. *More than 40.000*

3. What are the main roles and responsibilities of women related to Livestock Management?

Occupation	Major	Minor	Monthly Income (Use Codes)	*Monetary Codes (Rs.)*
a) Preparing Fodder				*13. Less than 5.000*
b) Feeding animals				*14. 5.000-15.000*
c) Veterinary care				*15. 15.000-25.000*
d) Cleaning				*16. 25.000-35.000*
e) Milking cow				*17. 35.000-40.000*
				18. *More than 40.000*

f) Watering animals				
g) Others				

4. What are the main roles and responsibilities of women related to Fisheries?

Occupation	Major	Minor	Monthly Income (Use Codes)	*Monetary Codes (Rs.)*
h) Preparing and mending nets				*19. Less than 5.000* *20. 5.000-15.000* *21. 15.000-25.000* *22. 25.000-35.000* *23. 35.000-40.000* *24. More than 40.000*
i) Preparing baits and baiting hooks				
j) Fish processing and preservation				
k) Marketing and selling fish				
l) Aquaculture activities				
m) Others				

Decision Making

5. Who decides the following household matters?

Household Matter	**Decision maker**	*Codes (Rs.)*
Education (Where to send, whom to send)		*Men = 1,* *Women = 2,* *Both = 3.*
Health facilities (from where to avail)		
Number of children to have		
Children Marriages		
What HH assets to buy and sell		
Women to work outside home		

Social and Income Activities

6. Access to Income Earning Opportunities

6.1. Are you involved in Income generating activities?

i) Yes _____ii) No_____

If yes, what are common activities?

i) Stitching/Embroidery_____ ii) Livestock_____ iii) Job or farming / labor work _____ iv) Fishing_____ iv) other_____

6.2. If yes in 5.1, are you the sole earner in the family?

i) Yes _____ii) No_____

6.3. In which area, the female employees spend their salaries or earnings on?

House construction_____ Marriage of her children_____ Education _____ Kitchen _____ Livestock _____ Other _____

Support her male in agriculture to purchase agriculture inputs etc. _____ Any Other _____

7. Main challenges faced by women in accessing economic opportunities (check all that apply): [ ] Lack of skills/training - [ ] Limited access to credit - [ ] Cultural barriers - [ ] Lack of childcare facilities – [ ] limited time due to domestic and care work ; [ ] Difficulty in moving freely; [ ] Other (please specify): _____	
8. Access to Social/Financial Services and Mobility	
9. Access to Education and Skills	
9.1.	Are there any constraints for girls accessing education? What are the main constraints?
9.2.	Gender preferences for sending children to school?
9.3.	Are there any vocational centers/schools for girls/women? What kinds of training courses are available with these vocational centers?
10. Access to Health	
10.1.	Do women seek pre- and post-natal health consultations and care? If not, what are the main constraints?
10.2.	What are the main health issues for women? Any common water borne diseases in the area?
10.3.	Are there any vocational centers/schools for girls/women? What kinds of training courses are available with these vocational centers?
Women's Participation	
11. What kind of local forums (formal, informal) exist in the area where women can participate?	
12. Are there any cultural norms and social constraints refraining women to participate in the local forums?	
13. Do women participate in training programs offered by development partners (NGOs/NRSP/CSOs)? What kind of training programs has been imparted?	
VULNERABILITIES (ELDERLY, DISABLED, WIDOWS AND MINORITIES)	
14. Are there any disadvantaged / vulnerable women groups in the village? (if yes, fill below)	
Disadvantaged/Vulnerable Individuals or Groups	Number or approx. percentage (%)

8. Women agriculture and livestock farmers and/or those in farming HHs	
9. Female-headed households	
10. Women with special needs	
11. Ethnic/religious/gender minorities	
12. Elderly	

GENDER-BASED VIOLENCE AND PROTECTION

15. Have you ever faced violence from male members of the household?

Yes_____ No _____

If Yes, Type

Physical_____ Mental_____

On what type of Issues?

i) Domestic_____ ii) Economic _____ iii) Others_____

16. Are there any reported cases of gender-based violence (GBV) in the village in the past year?

[ ] Yes - [ ] No.

If yes, what types of GBV have been reported (check all that apply): - [ ] Domestic violence - [ ] Sexual harassment - [ ] Forced marriage - [ ] Other (please specify): _____

17. Are there any support services for GBV survivors in the village?

[ ] Yes - [ ] No.

If yes, please specify the type of support: _____

18. What measures are in place to prevent GBV in the village (check all that apply):

Community awareness programs - [ ] Legal support - [ ] Protection shelters - [ ]

Other (please specify): _____

DISASTER RESILIENCE AND GENDER

19. Have women been involved in disaster preparedness and response planning?

Yes_____ No _____

If yes, in what capacity (check all that apply):

[ ] Training and capacity building - [ ] Early warning systems - [ ] Community-based disaster risk management –

[ ] Other (please specify): _____

20. What specific challenges do women face during natural disasters (check all that apply):

[ ] Evacuation challenges - [ ] Lack of safe shelters - [ ] Health and sanitation issues –

[ ] Other (please specify): _____

21. What support is provided to women during natural disasters (check all that apply):

Emergency relief (food, water, medical aid) - [ ] Temporary shelters - [ ] Psychosocial support -

[ ] Other (please specify): _____

CONCERNS AND FEEDBACK OF THE WOMEN RESPONDENT(S)

22. In your opinion, should this subproject be implemented here? 1. Yes_____ 2. No_____

If yes, then reason	Response	If no, then reason	Response
1. Flood protection and improved stormwater drainage		2. Disputes over access to, or control of, water resources	
3. Increase in forest cover		4. Decrease in availability of irrigation water	
5. Improved drainage and reduced water logging		6. Loss of dwelling structures	
7. Creation of job opportunities		8. Loss of income	
9. Protection from storm surges		10. Access issues	
11. Increase in agriculture productivity		12. Loss of crops	
13. Benefits for Women and elderly		14. Privacy issues	
15. Any other (please specify)		16. Any other (please specify)	
17. No response		18. No response	

Needs and Benefits from Project

23. What do you suggest protective measures regarding the project implementation?

24. How women's participation could be ensured in the project implementation? How project interventions will benefit women?

25. What are the key recommendations for maximizing project benefits for women?

26. What are the pressing needs of women of the Project Area (Recorded by them)?

27. Any other concerns/comments

Attendance of Participants			
Name	**Age**	**Occupation**	**Education**