

Tamil Nadu –
Strengthening Coastal Resilience and the Economy
Project
(TN-SHORE)

Environment and Social Due Diligence Report



**GREENSEA: Growing Resilient Ecosystems
through Enhancing Seagrass and Blue Carbon**



APRIL 2024

**WILD LIFE WARDEN, RAMANATHAPURAM
DEPARTMENT OF FOREST**

GOVERNMENT OF TAMIL NADU

Contents

1.0 Introduction

1.1	Project Overview.....	6
1.2	Sub-Project Description.....	7
1.3	Proposed Interventions/ Activities and Intended Outcomes.....	9
1.4	Implementation Arrangement and Schedule.....	11
1.5	Purpose of ESDD.....	11
1.6	Approach and Methodology of ESDD.....	12

2.0 Institutional Framework and Capacity Assessment

2.1	Policy and Legal Framework.....	14
2.2	Description of Institutional Framework.....	15

3.0 Assessment of Environmental and Social Conditions

3.1	Physical Environment.....	17
3.2	Protected Area.....	20
3.3	Social Environment.....	21
3.4	Cultural Environment.....	26

4.0 Activity Wise Environment & Social Screening, Risk And Impacts Identification

4.1	Sub-Project Screening.....	28
4.2	Stakeholder Consultation.....	34
4.3	Descriptive Summary of Risks & Impacts From Activities Based on Screening.....	34

Conclusion and Recommendations

5.1	Conclusions	
	5.1.1 Risk Classification.....	36
	5.1.2 National Legislation & WB ESS Applicability Screening.....	36
5.2	Recommendations	
	5.2.1 Mitigation and Management of Risks and Impacts.....	38

List of Figures

Fig. 1.1: Project Area: Gulf of Mannar	08
Fig. 1.2: Healthy Seagrass Beds	08
Fig. 1.3: Map Showing Proposed Restoration Sites in the Gulf of Mannar	10
Fig. 3.1: Google Earth Image of Gulf of Mannar	18
Fig. 3.2: Wind & Storm Surge Hazard Map	19
Fig. 3.3: Earth Quake Hazard Map	19
Fig. 3.4: Protected Areas in and around Project Area	20

List of Tables

Table 1.1: Salient Features of the Project	07
Table 3.1: Demographic Profile of Ramanathapuram District, Tamil Nadu	22
Table 3.2: Demographic Profile of Thanjavur District, Tamil Nadu	23
Table 3.3: Demographic Profile of Nagapattinam District, Tamil Nadu	23
Table 3.4: Demographic Profile of Thiruvavarur District, Tamil Nadu	24
Table 3.5: Demographic Profile of Kanniyakumari District, Tamil Nadu	24
Table 3.6: Demographic Profile of Pudukkottai District, Tamil Nadu	24
Table 3.7: Demographic Profile of Thirunelveli District, Tamil Nadu	25
Table 4.1: Summary of Risk and Impacts (SF 3)	32
Table 5.1: ESS Applicability & Triggers	37
Table 5.2: List of Mitigation Plans with Responsibility and Timelines	38

ANNEXURES

Screening Formats – Annexure 1: SF1 and Annexure 2: SF2	40 - 42
---	---------

ACRONYMS

EIA	Environmental Impact Assessment
ESDD	Environmental and Social Due Diligence
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
ESZ	Eco Sensitive Zone
GBV	Gender -Based Violence
GoI	Government of India
GRS	Grievance Redress Service
IUCN	International Union for Conservation of Nature
IA	Implementing Agency
LMP	Labor Management Plan
M&E	Monitoring and Evaluation
NPMU	National Project Management Unit
OHS	Occupational Health & Safety
PA	Protected Area
PD	Project Director
RCP	Resource Conservation Plan
RET	Rare Endangered Threatened
SC	Scheduled Caste
SEP	Stakeholder Engagement Plan
SEA	Sexual Exploitation and Abuse
SH	Sexual Harassment
SPMU	State Project Management Unit
ST	Scheduled Tribe
TORs	Terms of Reference
WB	The World Bank

GREENSEA: Growing Resilient Ecosystems through Enhancing Seagrass and Blue Carbon

Executive Summary

The Tamil Nadu - Sustainably Harnessing Ocean Resources and Blue Economy (TN-SHORE) project, supported by the World Bank, aims to enhance the resilience and sustainable utilization of coastal resources in the Gulf of Mannar, Tamil Nadu. A key component of this initiative is the restoration of degraded coastal wetlands, with a particular focus on seagrass meadows, to strengthen climate adaptation, promote resilience, and enhance livelihood sustainability.

Seagrass meadows are vital marine ecosystems that play a crucial role in carbon sequestration, biodiversity conservation, and supporting local livelihoods. However, these habitats are under threat due to various anthropogenic pressures. The project aims to plant seagrass over 15 acres and restore some of the degraded seagrass areas in the Gulf of Mannar using low-tech and cost-effective transplantation method. The restoration efforts are expected to enhance the capacity of seagrass carbon storage and provide other ecological services.

In addition to restoration activities, the project will quantify the blue carbon stock and accumulation rate in the sediments and seagrass biomass of the ecosystems. This data will contribute to a better understanding of the role of seagrass meadows in climate change mitigation and the potential for blue carbon initiatives.

The Environmental and Social Due Diligence (ESDD) report has been prepared to identify, evaluate, and manage the environmental and social risks and impacts of the sub-project. The report follows the World Bank's Environmental and Social Framework (ESF) and includes an assessment of the physical, ecological, and socio-economic conditions of the project area. It also provides a screening of potential risks and impacts, along with recommendations for mitigation and management measures.

The project is expected to have moderate environmental and social risks, which can be managed with standard Environmental and Social Management Plans (ESMPs). Key areas of focus include ensuring the sustainability of restoration activities, minimizing impacts on protected areas and biodiversity, and ensuring the health and safety of workers involved in the project. Overall, the TN-SHORE project represents a significant step towards the sustainable management of coastal resources in Tamil Nadu, with the potential to contribute to climate resilience, biodiversity conservation, and the well-being of local communities.

1.0 INTRODUCTION

1.1 Project Overview

The Tamil Nadu - Sustainably Harnessing Ocean Resources and Blue Economy (TN-SHORE) project is designed to fortify the resilience and sustainable use of coastal resources through a comprehensive, multi-faceted approach. It aims for a holistic integration across various sectors to foster a resilient and circular blue economy, empower local livelihoods, and build capacities for a more sustainable future. The project is structured around five strategically prioritized thematic investment areas, each addressing key components of coastal resource management:

Component 1: Strengthening Institutions for Integrated Coastal Management: This component is dedicated to enhancing institutional capabilities for holistic coastal zone management and governance. It aims to establish robust frameworks and systems for effective coordination and implementation of coastal management strategies.

Component 2: Shoreline Management and Coastal Protection: Focused on bolstering coastal resilience, this component invests in two critical areas: 1) Erosion Control and Management, aimed at mitigating shoreline erosion and preserving coastal integrity, and 2) Marine Biodiversity and Ecology Conservation, aimed at protecting and conserving marine ecosystems and biodiversity.

Component 3: Improving Livelihoods for Natural Resource-Dependent Communities: This component supports initiatives that promote alternative and sustainable livelihoods for communities reliant on coastal resources. Key activities include the development of nature tourism and the upgrading of fishing harbors and landing centers to enhance economic opportunities for local communities.

Component 4: Reducing Plastic Waste and Pollution through Enhanced Circularity: Addressing the issue of plastic pollution in coastal and marine environments, this component emphasizes the management and reduction of plastic waste through an ecosystem-centered approach. Activities include identifying plastic waste hotspots, investing in river system management, and establishing a digital waste exchange platform to promote plastic circularity.

Component 5: Project Management: This component covers the operational expenses of the project, including procurement, rental, and staffing, to ensure efficient and effective project implementation.

Component 6: Contingency Emergency Response Component (Zero Budget):
This component is a provision for rapid response in the event of unforeseen emergencies, enabling swift action to mitigate impacts and ensure project continuity.

Overall, the TN-SHORE project is a comprehensive initiative aimed at enhancing the ecological, economic, and social resilience of Tamil Nadu's coastal regions, contributing to the sustainable development and well-being of its communities.

1.2 Sub-Project Description

Seagrass meadows play a crucial role in the global carbon cycle, accounting for 10-15% of the ocean's organic carbon storage. They serve as vital habitats for marine organisms and are key feeding grounds for species such as the sea cow and the green turtle. Remarkably, seagrass beds can store up to 140 Mg of organic carbon per hectare, which is 40 times greater than the carbon storage capacity of terrestrial forests. This makes the blue carbon stock in seagrass beds an important asset in mitigating the effects of climate change.

However, these valuable ecosystems are under threat, primarily due to disturbances caused by boat traffic in shallow areas, leading to their degradation over time. The focus of this sub-project is to identify and restore degraded seagrass areas in the Gulf of Mannar (Table 1.1) by transplanting shoots from healthy seagrass beds nearby. Additionally, the project aims to assess the blue carbon storage potential of seagrass and its role in carbon sequestration, thereby contributing to our understanding of these ecosystems' significance in climate change mitigation.

Table 1.1: Key Attributes of the Seagrass Restoration Project

Salient Features of the Project	
State	Tamil Nadu
Location of the Project Sites	Coast of Gulf of Mannar Extends from Rameswaram Island in the north to Kanyakumari in the south. Restoration Sites - Tuticorin region: 05 acres - Keelakarai region: 05 acres. - Mandapam region: 05 acres
Total Area for Restoration/Plantation	15 Acres
Latitude- Longitude	08° 47' to 09° 15' N Latitude and 78° 12' to 79° 14' E Longitude
Coastal Regulation Zone	As per the CRZ 2011/ 2019 Notification, the intervention area, being the seabed, falls within CRZ IV A.

This table outlines the key features of the seagrass restoration project, including the locations and areas designated for restoration, as well as the geographical and regulatory context. The Figure 1.1 illustrates the geographic location of the project area, encompassing the restoration sites within the Gulf of Mannar region. The map provides a visual representation of the extent and distribution of the areas targeted for seagrass restoration. The Figure1.2 showcases a healthy seagrass bed, serving as a reference for the desired outcome of the restoration efforts. The image highlights the dense and vibrant seagrass meadows that the project aims to replicate in the degraded areas

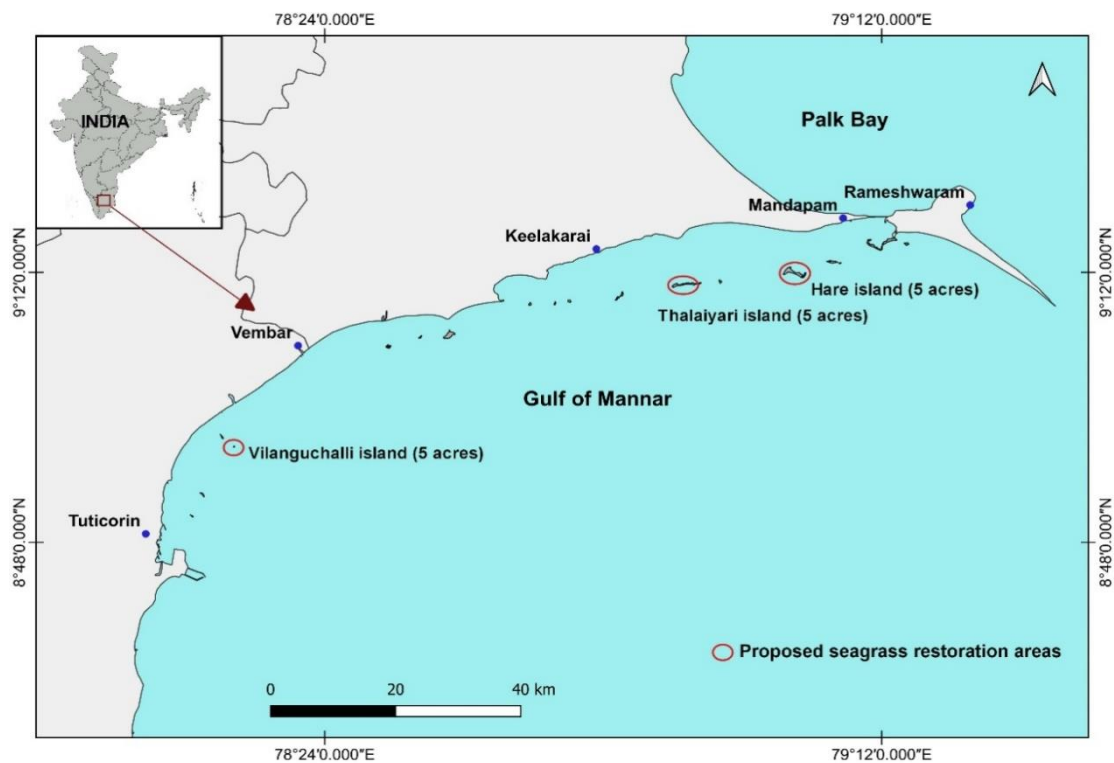


Fig. 1.1: Map of the Project Area in the Gulf of Mannar



Fig. 1.2: Illustration of Healthy Seagrass Beds

1.3 Proposed Interventions, Activities, and Intended Outcomes

The TN-SHORE project's seagrass restoration initiative is structured around a series of carefully planned interventions and activities, aimed at rejuvenating degraded seagrass meadows and enhancing their ecological services. The proposed actions and their anticipated outcomes are outlined as follows:

1.3.1 Restoration of Degraded Seagrass Areas:

Objective: To plant 15 acres of new seagrass and restore degraded seagrass areas in the Gulf of Mannar region, thereby enhancing the area's capacity for carbon storage and supporting other ecological functions.

Locations:

Gulf of Mannar:

- Tuticorin region: 05 Acre
- Keelakarai region: 05 Acre
- Mandapam region: 05 Acre

Key Activities:

- i. Identification of restoration and donor sites based on assessments of seagrass cover, shoot density, macrofauna density, and fish density.
- ii. Manual transplantation of seagrass sprigs using PVC pipes, which involves the construction of PVC frames, collection of seagrass shoots from donor sites, tying of seagrass shoots to PVC frames using jute ropes, transporting the frames to restoration sites, and securing them on the seafloor.
- iii. Ongoing monitoring and maintenance, including periodic habitat mapping and removal of debris such as solid wastes, torn nets, and seaweed.

1.3.2 Analysis of Blue Carbon Stock Variability:

Objective: To investigate the variation in blue carbon stock according to the percentage cover of seagrasses at selected sites within the Gulf of Mannar

Key Activities:

- Collection of data on annual blue carbon stock in seagrass beds based on varying seagrass percentage cover.

1.3.3 Measurement of Annual Carbon Storage Capacity:

Objective: To determine the annual carbon storage capacity of restored seagrass beds by comparing pre- and post-transplantation measurements.

Key Activities:

- Collection of data on seasonal blue carbon stock in restored seagrass beds.

Intended Outcomes:

- Planting 15 acres of seagrass and restoring some of the degraded seagrass areas in the Gulf of Mannar region.
- Enhanced understanding of seagrass cover, shoot density, macrofauna, and fish populations in restoration sites.
- Establishment of a comprehensive baseline dataset on the total blue carbon stock and accumulation rate in the Gulf of Mannar ecosystem.
- Insights into the variation of blue carbon stock based on seagrass percentage cover in the Gulf of Mannar.
- Detailed assessment of blue carbon sequestration by restored seagrass areas in the Gulf of Mannar.

Through these concerted efforts, the project aims to revitalize critical marine habitats, contribute to climate change mitigation, and provide a model for sustainable coastal resource management.

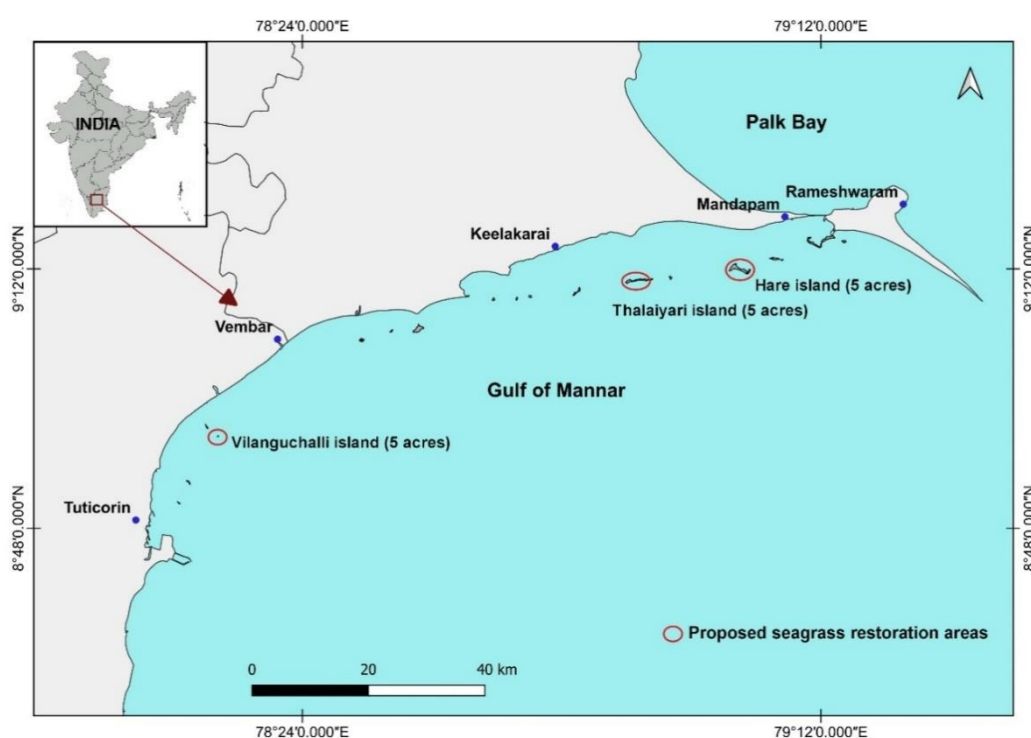


Fig.1.3: Map Showing Proposed Plantation/Restoration Sites in Gulf of Mannar

1.4 Implementation Arrangements and Schedule

The implementation of the seagrass restoration project is planned over a four-year period, encompassing comprehensive planning, site selection, and data collection phases. The schedule is designed to ensure systematic progress and effective monitoring of project milestones.

Implementation Timeline:

1. Project Inception: 1st July 2024
Commencement of project activities, including detailed planning, identification of sample collection and restoration sites, and baseline data collection.
2. Completion of 1st Annual Cycle: 31st December 2024
Evaluation of initial restoration efforts and data analysis.
3. Completion of 2nd Annual Cycle: 31st December 2025
Continued restoration activities and data collection, with adaptive management strategies applied as needed.
4. Midterm Review: June 2025
Comprehensive review of project progress, challenges, and adjustments to implementation strategies.
5. Completion of 3rd Annual Cycle: 31st December 2026
Further expansion of restoration efforts and ongoing data analysis.
6. Completion of 4th Annual Cycle: 31st December 2027
Finalization of restoration activities and completion of data collection.
7. Final Review: January 2028
Assessment of project outcomes, analysis of data, and preparation of final reports.

Implementation Duration: 4 Years (48 Months)

Throughout the project duration, regular monitoring and evaluation will be conducted to ensure adherence to the schedule and to assess the effectiveness of the restoration efforts. The implementation arrangements are designed to facilitate a structured and phased approach to achieving the project's objectives, with a focus on enhancing the ecological integrity of seagrass meadows and contributing to the sustainable management of coastal resources.

1.5 Purpose of ESDD

The overarching objective of the ESDD for the "Strengthening Coastal Resilience and the Economy" project, classified as Substantial Risk by the World Bank's internal Environment and Social Risk Classification, is to provide a robust

framework for decision-making regarding environmental and social aspects of the sub-project. The ESDD aims to:

- a. **Identify, Evaluate, and Manage Risks:** Assess and manage environmental and social risks and impacts in alignment with the Environmental and Social Standards (ESSs) of the World Bank's Environmental and Social Framework (ESMF).
- b. **Adopt a Mitigation Hierarchy:** Implement a structured approach to addressing environmental and social risks and impacts, encompassing anticipation and avoidance, minimization or reduction to acceptable levels, mitigation of minimized or reduced risks and impacts, and compensation or offsetting of significant residual impacts where technically and financially feasible.
- c. **Address Differential Impacts:** Identify and address the differentiated impacts on disadvantaged or vulnerable groups, and develop targeted measures to mitigate such impacts.
- d. **Assess Institutional Frameworks:** Evaluate the relevance and applicability of environmental and social institutions, systems, laws, regulations, and procedures in the context of project assessment, development, and implementation, identifying any existing gaps.
- e. **Enhance Capacity for Risk Management:** Assess the borrower's existing capacity to manage environmental and social risks and identify areas where capacity enhancement is required.
- f. **Determine ESIA or ESMP Requirements:** Based on the categorization of environmental and social risks and impacts, decide whether an Environmental and Social Impact Assessment (ESIA) conducted by an independent third-party agency or a generic Environmental and Social Management Plan (ESMP) customized to mitigate risks and impacts is necessary.

Through the ESDD process, the project aims to ensure that environmental and social considerations are effectively integrated into project planning and implementation, contributing to sustainable and resilient development outcomes.

1.6 Approach and Methodology of ESDD

The Environmental and Social Due Diligence (ESDD) for the sub-project employs a comprehensive and systematic approach to ensure thorough identification,

assessment, and management of environmental and social risks and impacts. The methodology encompasses the following steps:

- i. **Project Information Review:** Analyze detailed information about the sub-project, including the proposed interventions, their scale, and locations, to assess the magnitude of potential environmental and social (E&S) risks and impacts.
- ii. **Regulatory Compliance Assessment:** Evaluate the relevance and applicability of national and state legal requirements, as well as the World Bank's Environmental and Social Framework (ESF) policies, standards, and directives. Conduct a preliminary assessment to determine the applicability of legal requirements and the ESS framework (ESS 2-8).
- iii. **Site Visits:** Conduct field visits to gain an in-depth understanding of the baseline environmental and social settings, the proposed activities under the sub-project, their locations, and any sensitivities associated with these areas.
- iv. **Baseline Data Collection:** Compile key baseline data essential for impact assessment, including land use patterns, the presence of protected areas in the vicinity, and the identification of indigenous (scheduled tribe) or vulnerable populations in the immediate area of the proposed interventions.
- v. **Institutional Assessment:** Perform an institutional assessment to identify existing capacities and any gaps in managing E&S risks and impacts effectively.
- vi. **Stakeholder Engagement:** Conduct preliminary consultations with stakeholders to identify potential stakeholders, provide information about the proposed interventions, address issues and concerns, and determine appropriate mechanisms for ongoing engagement.
- vii. **Environmental and Social Screening:** Conduct activity-wise environmental and social screening to identify risks and impacts. Based on the findings, classify the sub-project according to its risk level (low, moderate, substantial, or high) and recommend corresponding plans or measures to address the identified risks and impacts.

Through this structured approach, the ESDD aims to ensure that environmental and social considerations are integrated into the sub-project's planning and implementation processes, contributing to sustainable and responsible project outcomes.

2.0 INSTITUTIONAL FRAMEWORK AND CAPACITY ASSESSMENT

2.1 Policy and Legal Framework

India boasts a comprehensive environmental and social regulatory framework, the applicability of which varies based on the nature and location of the work. Legislation can broadly be categorized into four domains: environmental, forest, wildlife conservation, and social. An in-depth analysis of regulations within these categories has been conducted to ascertain their relevance to the proposed project. Additionally, the compatibility of the World Bank's Environmental and Social Framework (ESF), which includes 10 Environmental and Social Standards (ESS1 to ESS10), with the proposed project's rehabilitation proposals and specific standards has been evaluated. A comparative analysis of national environmental and social regulations vis-à-vis the World Bank's ESS, accompanied by a gap analysis, is elaborated in the Environmental and Social Management Framework (ESMF).

The proposed project aligns with various national and international policies and legislation. The National Environment Policy 2006, for instance, aims to safeguard and conserve critical ecological systems and resources, along with invaluable natural and man-made heritages essential for life-support, livelihoods, economic growth, and overall well-being. Seagrass beds, as significant marine ecosystems, are a focal point of the project, which endeavours to understand, conserve, and restore them.

India's commitment to the Convention on Biological Diversity (CBD) further underscores the importance of this project. The government has enacted several legislations, including the Wildlife Protection Act (1972), Environmental Protection Act (1986), Forest Conservation Act (1980), Water (Prevention and Control of Pollution) Act (1974), Biological Diversity Act (2002), and National Green Tribunal Act (2010), to mitigate environmental damage. These policies and legislations are pertinent to the project's objectives of conserving seagrass ecosystems and their associated biodiversity.

Moreover, the project contributes to several United Nations Sustainable Development Goals (SDGs):

The estimation of the total blue carbon stock in the seagrass ecosystems of the Gulf of Mannar aligns with SDG 14.5, which focuses on the conservation of seagrass ecosystems through the best available scientific information. It also supports SDG 14.8 by enhancing scientific knowledge about the carbon storage capacity of seagrass ecosystems, thereby promoting the contribution of seagrass beds to the country's advancement.

The rehabilitation of seagrass beds along the Gulf of Mannar addresses SDG 14.2 by restoring seagrass ecosystems and strengthening their resilience. It also contributes to SDG 14.3 by mitigating the negative effects of climate change, such as ocean acidification, through the restoration of seagrass ecosystems.

The project's alignment with national and international policies, legislation, and SDGs underscores its significance in promoting environmental conservation and sustainable development.

2.2 Description of Institutional Framework

The institutional framework for the coordination, management, and monitoring of the World Bank Project "Tamil Nadu - Sustainably Harnessing Ocean Resources and Blue Economy (TN SHORE)" is structured as follows:

Lead Implementation Agency:

The project will be spearheaded by the Department of Environment, Climate Change and Forests, Government of Tamil Nadu, ensuring alignment with state environmental policies and objectives.

Tamil Nadu Green Climate Company (TNGCC):

- TNGCC, under the leadership of the Additional Chief Secretary of the Department of Environment, Climate Change and Forests, plays a central role in project oversight. The organization is governed by a Board of Directors consisting of Secretaries from key line departments.
- TNGCC is already at the forefront of three significant government initiatives: the Tamil Nadu Climate Change Mission, the Green Tamil Nadu Mission, and the Tamil Nadu Wetland Mission. It will now also spearhead the SHORE project as the "Tamil Nadu Coastal Restoration Mission," acting as the State Project Management Unit (SPMU) for TN-SHORE.
- The SPMU will be led by a Chief Mission Director and will comprise internal staff from the Forest Department, supported by a multidisciplinary team of technical experts (including environmental and social specialists), finance professionals, procurement experts, and project administration consultants.

Project Nodal Agency:

- The Principal Chief Conservation of Forests, Chief Wildlife Warden, along with Wildlife Warden, Ramanthapuram will serve as the primary point of contact and coordination for the project.

Project Implementing Agency:

- Wildlife Warden, Ramanthapuram will implement the project by engaging the consulting firm. Wildlife Warden, Ramanthapuram will be responsible for executing the project's on-ground activities and ensuring adherence to the planned objectives and timelines.

This institutional framework is designed to ensure effective project implementation, leveraging the expertise and resources of various stakeholders to achieve the desired outcomes in coastal resource management and environmental conservation.

3.0. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL CONDITIONS

This section provides an in-depth analysis of the physical, ecological, and socio-economic conditions of the project area and its immediate surroundings. The assessment is based on secondary data and direct observations made during site visits.

3.1 Physical Environment

3.1.1. Land Use and Land Cover:

The land use and land cover of the coastal regions encompassing the Gulf of Mannar have been meticulously analyzed using satellite imagery from Google Earth. The findings are illustrated in Figures 3.1 and 3.2. Key observations include:

Urbanization: The coastal areas exhibit varying degrees of urbanization, with several densely populated zones interspersed along the coastline. These urban centers are characterized by residential, commercial, and industrial developments.

Industrial Activity: The region hosts a range of industries, contributing to the economic growth of the area. However, industrial activities also pose potential environmental challenges, necessitating careful management and monitoring.

Salt Pans: A significant feature of the coastal landscape is the presence of salt pans, which are used for salt production. These areas are typically devoid of vegetation and can have implications for local biodiversity and water quality.

Aquaculture Farms: Aquaculture is a prominent economic activity in the region, with numerous farms dotting the coastline. While providing livelihood opportunities, aquaculture operations must be sustainably managed to prevent negative impacts on the marine environment.

The land use and land cover patterns provide crucial insights into the physical characteristics of the project area and inform the development of appropriate environmental management strategies. It is essential to balance economic activities with environmental conservation to ensure the long-term sustainability of the coastal ecosystem.

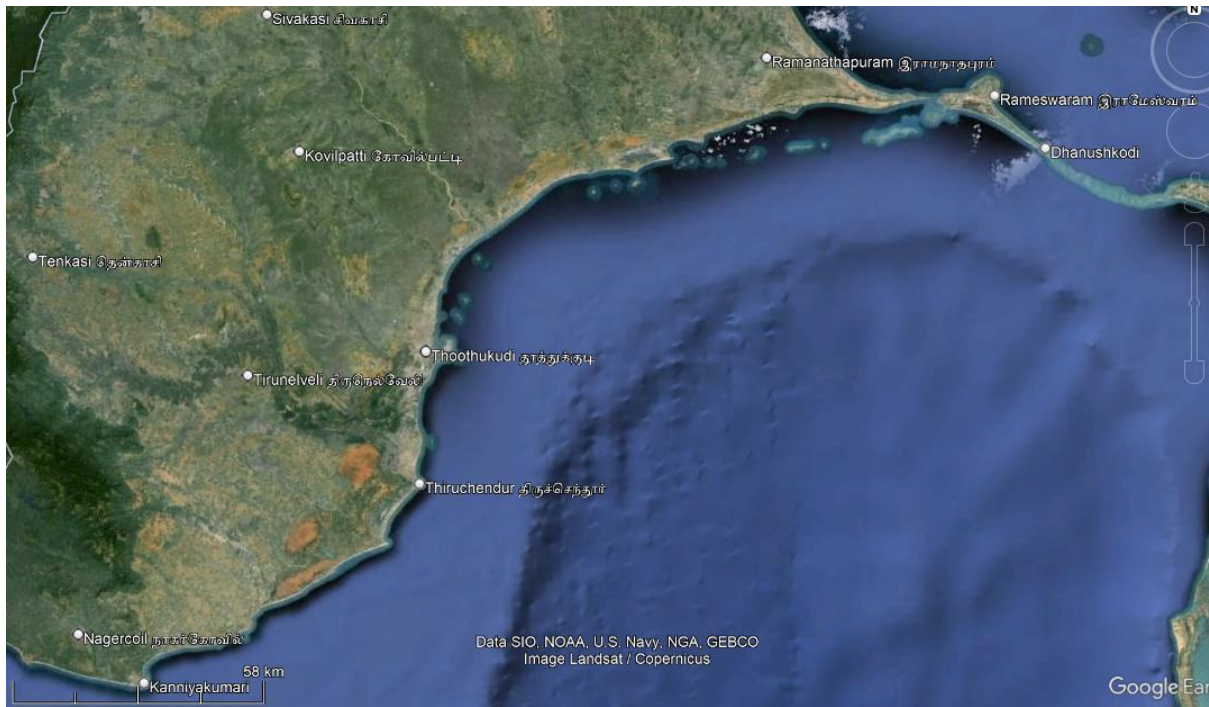


Fig. 3.1: Google Earth Image of Gulf of Mannar

3.1.2 Natural Hazards:

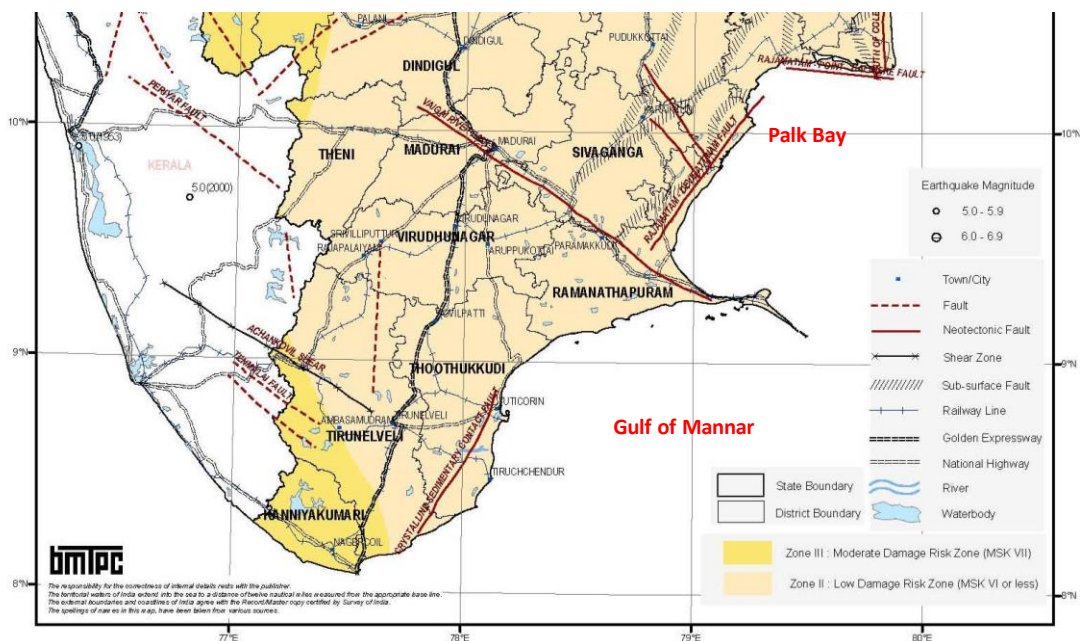
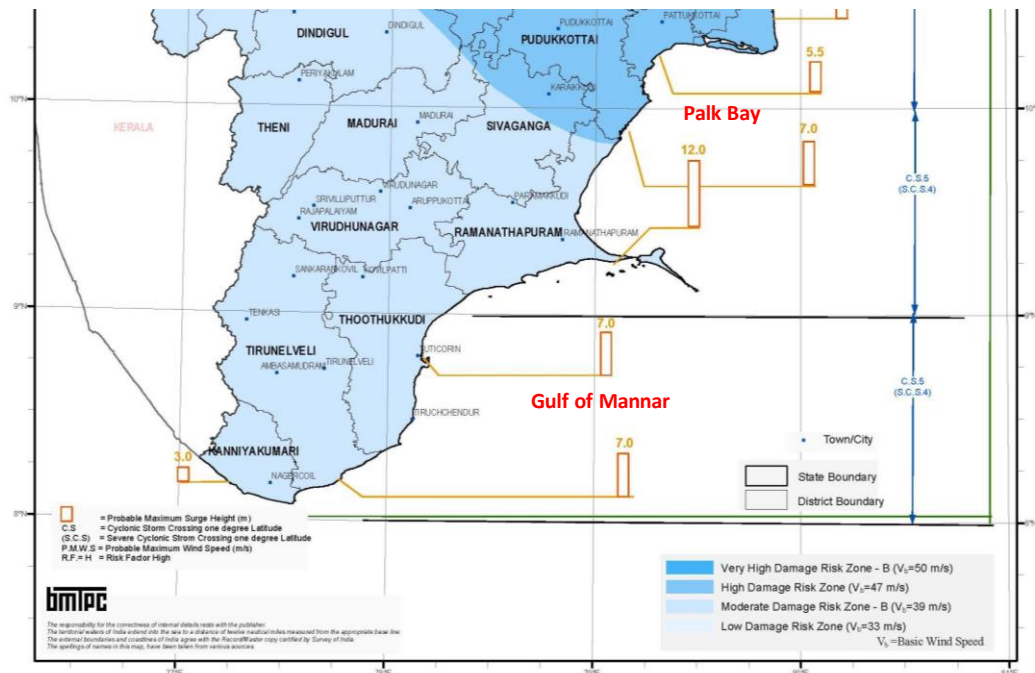
The Gulf of Mannar area is susceptible to various natural hazards, which pose significant challenges to both the environment and the communities residing in these areas. An understanding of these hazards is crucial for effective risk management and disaster preparedness.

Cyclonic Winds: The coastal areas of the Gulf of Mannar and the adjoining Palk Bay are frequently affected by cyclonic winds, particularly during the monsoon season. These winds can cause substantial damage to infrastructure, ecosystems, and livelihoods. The Gulf of Mannar is classified as a Wind-Moderate Damage Risk Zone, indicating a moderate likelihood of wind-related damage.

Wind Damage Risk Zones: The risk of wind damage varies within the region. The southern part of Palk Bay is also categorized as a Wind-Moderate Damage Risk Zone, while the northern part faces a higher risk and is designated as a Wind-High Damage Risk Zone. This variation in risk levels necessitates tailored approaches to wind hazard mitigation and resilience building.

Seismic Activity: The entire project area falls within Earthquake Zone II, which is considered a Low Damage Risk Zone. Addressing these natural hazards requires a comprehensive strategy that includes hazard mapping, early warning systems,

community awareness and preparedness programs, and the integration of hazard-resistant design principles in infrastructure development. By proactively managing these risks, the project can contribute to the overall resilience of the Gulf of Mannar region



3.2 Protected Area

The seabed project site is classified as a tidal area within CRZ IV A, signifying its ecological significance and the need for stringent environmental management. The project area is distinguished by a rich mosaic of marine and coastal ecosystems, each playing a crucial role in maintaining biodiversity and ecological balance



Fig. 3.4: Protected Areas in and around Project Area

Mangrove Areas: The region contains mangrove forests, which are important habitats for various marine species, offer protection against coastal erosion, and contribute to carbon sequestration.

Turtle Nesting Grounds: The sandy shores within the project area are important nesting sites for sea turtles. These areas are crucial for the conservation of these endangered species and require careful management to ensure their protection.

Seagrass Areas: Seagrass meadows are among the most productive marine ecosystems, providing habitat, nursery grounds, and food for numerous marine species, including the endangered dugong.

Dugong habitation areas : the dugongs are found in both the Gulf of Mannar and Palk Bay highlighting the importance of these regions for the conservation of this vulnerable marine mammal, which is listed as a Schedule I species under the Wildlife Protection Act, 1972.

Coral Reefs: The project area encompasses portions of the Gulf of Mannar Marine National Park, known for its diverse coral reef ecosystems. These reefs are biodiversity hotspots and are essential for the health of marine life and local fisheries.

Estuaries: The project area includes vital estuaries such as Vellar, Manimuthar, Vaigai, Gundar, Vaipar, and Thamirabarni. These estuarine systems are critical for maintaining the ecological balance, supporting fisheries, and providing livelihoods for local communities.

Biosphere Reserve: The Gulf of Mannar Biosphere Reserve, encompassing part of the project area, is recognized for its unique biodiversity and ecological significance. It is a priority area for conservation and sustainable management.

Gulf of Mannar Marine National Park: The Proposed sites for seagrass restoration are located in the Gulf of Mannar Marine National Park.

The project area's proximity to maritime borders with Sri Lanka, particularly in the Gulf of Mannar and Palk Bay, adds an international dimension to the conservation efforts. However, the project interventions are focused on coastal areas well within Indian territory, ensuring no transboundary issues.

The project's location within these protected and ecologically sensitive areas underscores the need for environmentally responsible practices and a strong emphasis on conservation. It is imperative that the project's implementation aligns with the protection and enhancement of these critical habitats and species.

3.3 Social Environment

The social fabric of the project area, encompassing the Gulf of Mannar is intricately linked to the coastal and marine environment. The project sites are situated in Tuticorin and Ramanathapuram districts of Tamil Nadu. These districts exhibit a diverse range of social and economic dynamics, which are essential to consider for the successful implementation of the project.

3.3.1 Fishing Communities:

The Gulf of Mannar is renowned for their vibrant fishing communities. The entire region is an active fishing zone, with numerous fishing villages dotting the coastline. These communities rely heavily on fishing for their livelihoods and are deeply connected to the health of the marine ecosystem.

The area hosts several small fishing harbors, such as Mandapam and Tuticorin which serve as critical points for landing and processing fish. Additionally, larger

fishing ports in Mandapam and Tuticorin play a significant role in the regional fishing industry.

3.3.2 Industrial and Commercial Activities:

Tuticorin stands out as a major commercial hub within the region, housing a significant port that facilitates a wide range of industrial and commercial activities. The presence of power plants and various industries contributes to the economic vibrancy of the area.

While these activities are pivotal for economic development, they also pose challenges in terms of environmental sustainability. One of the concerns is water pollution, primarily attributed to industrial discharges. However, it is noted that the pollution level is moderate, with dissolved oxygen levels remaining adequate for the survival of aquatic organisms, indicating that the situation is not yet critical but requires ongoing monitoring and management.

3.3.3. Demographic Profile:

The coastal districts in the vicinity of the project area exhibit diverse demographic characteristics. (Tables 3.1 to 3.7) The demographic profiles of these districts, including population distribution, literacy rates, employment patterns, and social composition, are crucial for understanding the social context and for tailoring project interventions to address the needs and aspirations of the local communities.

In summary, the social environment of the project area is characterized by a strong dependence on marine resources, dynamic fishing and industrial activities, and diverse demographic features. Recognizing and integrating these social dimensions into the project planning and implementation process is essential for ensuring that the project not only achieves its environmental objectives but also contributes to the social and economic well-being of the local communities.

Table 3.1: Demographic Profile of Ramanathapuram District, Tamil Nadu

No. of Households	323,905	Population Growth(2001-11)	13.96%
Total Population	1,353,445	Population (0-6 age)	140644
Male	682,658	Boys (0-6 age)	71705
Female	670,787	Girls (0-6 age)	68939
Sex Ratio	983	Sex Ratio (0-6)	961
Population (SC)	249,008 (18.4%)	Population (ST)	1,105 (0.1%)
Male	125,015	Male	559
Female	123,993	Female	546
Literates	978,946	Literacy Rate	80.72%
Male	536,487	Male	78.59%
Female	442,459	Female	65.96%
No. of Total Workers	602,977	Cultivators	149,959 (24.66%)

Male		Agricultural Labours	103,592 (17.03%)
Female		Household Industrial Workers	18,546 (3.05%)
No. of Main Workers	486,150 (80.6%)	Other Workers	214,053 (35.20%)
No. of Marginal Workers	116,827 (19.4%)		
<i>Source: Census of India, 2011</i>			

Table 3.2: Demographic Profile of Thanjavur District, Tamil Nadu

No. of Households	605,363	Population Growth(2001-11)	8.56%
Total Population	2,405,890	Population (0-6 age)	238,598
Male	1,223,474	Boys (0-6 age)	121,949
Female	670,787	Girls (0-6 age)	116,649
Sex Ratio	1,035	Sex Ratio (0-6)	957
Population (SC)	455,062 (18.4%)	Population (ST)*	3,561 (0.1%)
Male	225,859	Male	1,739
Female	229,203	Female	1,822
Literates	1,790,998	Literacy Rate	80.09%
Male	944,264	Male	86.77%
Female	846,734	Female	73.44%
No. of Total Workers	974,079	Cultivators	117,321 (12.04%)
Male		Agricultural Labours	327,673 (33.69%)
Female		Household Industrial Workers	26,430 (2.71%)
No. of Main Workers	834,484 (85.66%)	Other Workers	363,060 (37.27%)
No. of Marginal Workers	139,595 (14.33%)		
<i>Source: Census of India, 2011 * Only district wise information is available and not location wise.</i>			

Table 3.3: Demographic Profile of Nagapattinam District, Tamil Nadu

No. of Households	413,837	Population Growth (2001-11)	8.57%
Total Population	1,616,450	Population (0-6 age)	165,245
Male	798,127	Boys (0-6 age)	84,335
Female	818,323	Girls (0-6 age)	80,910
Sex Ratio	1,025	Sex Ratio (0-6)	959
Population (SC)	509,767 (31.5%)	Population (ST)	3,756 (0.2%)
Male	252,332	Male	1,847
Female	257,435	Female	1,909
Literates	403,442	Literacy Rate	83.59%
Male	157,211	Male	80.3%
Female	246,231	Female	69.91%
No. of Total Workers	671,994	Cultivators	54,329 (8.08%)

Male	461,174	Agricultural Labours	216,353(32.19%
Female	210,820	Household Industrial Workers	7,925 (1.40%)
No. of Main Workers	486,328 (72.4%)	Other Workers	207,721 (89.04%)
No. of Marginal Workers	185,666 (27.6%)		
<i>Source: Census of India, 2011 * Only district wise information is available and not location wise.</i>			

Table 3.4: Demographic Profile of Thiruvavarur District, Tamil Nadu

No. of Households	327,219	Population Growth (2001-11)	8.43%
Total Population	1,264,277	Population (0-6 age)	121,973
Male	626,693	Boys (0-6 age)	62,280
Female	637,584	Girls (0-6 age)	59,693
Sex Ratio	1,017	Sex Ratio (0-6)	958
Population (SC)	430,927(34.1%)	Population (ST)*	3,034 (0.2%)
Male	214,717	Male	1,466
Female	216,210	Female	1,568
Literates	317,806	Literacy Rate	82.86%
Male	123,608	Male	80.28%
Female	194,198	Female	69.54%
No. of Total Workers	540,168	Cultivators	60,508 (8.08%)
Male	461,174	Agricultural Labours	200,126(32.19%
Female	210,820	Household Industrial Workers	7,264(1.40%)
No. of Main Workers	412,425(76.4%)	Other Workers	144,527(89.04%)
No. of Marginal Workers	127,743(23.6%)		
<i>Source: Census of India, 2011 * Only district wise information is available and not location wise.</i>			

Table 3.5: Demographic Profile of Kanniyakumari District, Tamil Nadu

No. of Households	483,539	Population Growth(2001-11)	11.60%
Total Population	1,870,374	Population (0-6 age)	182,350
Male	926,345	Boys (0-6 age)	92,835
Female	944,029	Girls (0-6 age)	89,515
Sex Ratio	1,019	Sex Ratio (0-6)	964
Population (SC)	74,249 (4%)	Population (ST)*	7,282 (0.4%)
Male	36,817	Male	3,554
Female	37,432	Female	3,728
Literates	1,548,738	Literacy Rate	91.75%
Male	1,266,939	Male	93.65%

Female	1,348,504	Female	89.9%
No. of Total Workers	679,620	Cultivators	12,229 (1.799%)
Male	446,895	Agricultural Labours	51,350 (7.55%)
Female	105,763	Household Industrial Workers	21,078 (3.10%)
No. of Main Workers	552,658 (81.31%)	Other Workers	468,001 (68.86%)
No. of Marginal Workers	126,962 (18.68%)		
<i>Source: Census of India, 2011 * Only district wise information is available and not location wise.</i>			

Table 3.6: Demographic Profile of Pudukkottai District, Tamil Nadu

No. of Households	387,679	Population Growth(2001-11)	11.60%
Total Population	1,618,345	Population (0-6 age)	182,350
Male	803,188	Boys (0-6 age)	91,696
Female	815,157	Girls (0-6 age)	87,992
Sex Ratio	1,015	Sex Ratio (0-6)	964
Population (SC)	284,804 (17.6%)	Population (ST)*	1,283 (0.1%)
Male	141,428	Male	647
Female	143,376	Female	636
Literates	1,110,545	Literacy Rate	77.19%
Male	608,776	Male	85.56%
Female	501,769	Female	69%
No. of Total Workers	761,693	Cultivators	192,462 (25.26%)
Male		Agricultural Labours	234,344 (30.76%)
Female		Household Industrial Workers	10,170 (1.33%)
No. of Main Workers	640,248 (84.1%)	Other Workers	203,272 (26.68%)
No. of Marginal Workers	121,445 (15.9%)		
<i>Source: Census of India, 2011 * Only district wise information is available and not location wise.</i>			

Table 3.7: Demographic Profile of Thirunelveli District, Tamil Nadu

No. of Households	815,528	Population Growth(2001-11)	12.97%
Total Population	3,077,233	Population (0-6 age)	321687
Male	1,520,912	Boys (0-6 age)	164157

Female	1,556,321	Girls (0-6 age)	157530
Sex Ratio	987	Sex Ratio (0-6)	960
Population (SC)	569,714 (6.45%)	Population (ST)*	10,270
Male	279,570	Male	5,109
Female	290,144	Female	5,161
Literates	2,273,457	Literacy Rate	82.90%
Male	1,210,710	Male	97.42%
Female	1,062,747	Female	92.99%
No. of Total Workers	1,436,454 88.5%	Cultivators	26,543 (3.8%)
Male	791,067	Agricultural Labours	64,198 (1.5%)
Female	480,340	Household Industrial Workers	13,312 (7.7%)
No. of Main Workers	1,271,407 (24.44%)	Other Workers	626,714 (1.63%)
No. of Marginal Workers	165,047 (6.31%)		
<i>Source: Census of India, 2011 * Only district wise information is available and not location wise.</i>			

3.4 Cultural Environment

The cultural landscape of the project area is enriched by its historical and religious significance, as well as its proximity to important tourist destinations. An understanding of the cultural environment is crucial for ensuring that project interventions are sensitive to the cultural heritage and values of the local communities.

Religious and Tourist Sites:

Rameshwaram Island, also known as Pamban Island, is a renowned religious and tourist site, attracting approximately 1,000 visitors daily. The island is home to the Ramanathaswamy Temple, a major pilgrimage site for Hindus, and is steeped in mythological significance.

Dhanushkoti, located at the southeastern tip of Pamban Island, is another site of historical and religious importance. Though largely abandoned after the 1964 cyclone, it continues to attract tourists and pilgrims due to its scenic beauty and its association with the epic Ramayana.

Maritime Borders with Sri Lanka:

Both Palk Bay and the Gulf of Mannar are situated along the maritime border with Sri Lanka. This geographical proximity has historical and cultural implications, as it has been a region of cultural exchange and interaction over centuries.

Impact on Heritage Sites:

The project interventions are focused on marine and coastal areas and are primarily within the sea, away from the coastal border regions. As such, they are not anticipated to have any direct impact on cultural or heritage sites. However, it is essential to ensure that any indirect effects, such as increased tourist activity or changes in the marine environment, are carefully managed to protect the cultural integrity of these sites.

The cultural environment of the project area is an integral part of its identity, with significant religious, historical, and tourist sites that contribute to its unique character. It is imperative that project planning and implementation take into account the cultural sensitivities and heritage values of the region, ensuring that the interventions are harmonious with the cultural landscape and enhance the overall well-being of the communities involved.

4.0 ACTIVITY WISE ENVIRONMENT & SOCIAL SCREENING, RISK AND IMPACTS IDENTIFICATION

The environmental and social (E&S) screening of the sub-project is a critical step in identifying and assessing potential risks and impacts associated with the proposed activities. This process is carried out in accordance with the Environmental and Social Management Framework (ESMF) and involves a structured three-step methodology:

4.1 Sub-Project Screening:

Step 1: Initial Screening (SF-1):

The first stage of screening utilizes the Screening Format 1 (SF-1) to review each proposed activity for potential E&S risks and impacts. This involves evaluating the likelihood of impacts on various aspects such as Land, Geology & Soil (LGS); Water (W); General Ecology & Biodiversity (EB); Waste, Pollution & Hazard (WPH); Protected Area (PA); Land Acquisition/Encroachment (LA); Loss of Livelihood/Household (LL); Labour (L); Cultural/Heritage (CH); Tribal Presence (T); and Gender-Based Violence (GBV) Risks (G).

Step 2: Risk/Impact Intensity Assessment (SF-2):

The second stage employs Screening Format 2 (SF-2) to assess the intensity of identified E&S risks and impacts for each activity. This assessment categorizes the risk levels as Low, Moderate, Substantial, or High, based on the severity and extent of the potential impacts.

Step 3: E&S Risk Summary (SF-3):

In the final stage, the Screening Format 3 (SF-3) is used to summarize the risk categories for all identified E&S risks and impacts. The highest risk category among these is assigned as the overall risk category for the sub-project. This comprehensive risk assessment forms the basis for recommending the appropriate risk category (Low, Moderate, Substantial, or High) for the sub-project.

Based on the outcomes of the screening exercise, the ESDD report provides recommendations for the risk category of the sub-project and outlines the necessary instruments to be prepared as part of the Environmental and Social Management Plan (ESMP). It also delineates the responsibilities and timelines for implementing the mitigation measures and managing the identified risks and impacts.

The systematic approach to E&S screening ensures that potential risks and impacts are thoroughly assessed and appropriately managed throughout the project

lifecycle, contributing to the sustainable and responsible implementation of the sub-project.

Step I Screening (Form SF-1):

The outcome of the stage screening exercise, conducted through the three-step methodology, has yielded the following outcomes:

1. **Identification of E&S Risks and Impacts:** The initial screening (SF-1) has identified potential environmental and social risks and impacts associated with the sub-project activities. These include impacts on land use, water resources, biodiversity, protected areas, and social aspects such as livelihoods and cultural heritage.
2. **Assessment of Risk/Impact Intensity:** The subsequent assessment (SF-2) has categorized the intensity of these risks and impacts as Low, Moderate, Substantial, or High. This categorization is based on the severity, extent, and reversibility of the potential impacts.
3. **Summary and Overall Risk Categorization:** The final stage (SF-3) has summarized the risk categories for all identified E&S risks and impacts. The highest risk category among these has been assigned as the overall risk category for the sub-project.

Based on the outcomes of the screening exercise, the following recommendations are made:

Risk Category: The sub-project has been assigned an overall risk category. This categorization will guide the development of mitigation measures and management strategies in the Environmental and Social Management Plan (ESMP).

Development of ESMP: An ESMP will be prepared, outlining the specific mitigation measures, management strategies, responsibilities, and timelines for addressing the identified risks and impacts. The ESMP will serve as a key instrument for ensuring the sustainable and responsible implementation of the sub-project.

Stakeholder Engagement: Continuous engagement with stakeholders, including local communities, government authorities, and other relevant parties, will be crucial throughout the project lifecycle. This engagement will ensure that the concerns and inputs of stakeholders are considered in the decision-making process.

Monitoring and Evaluation: A robust monitoring and evaluation framework will be established to track the effectiveness of the mitigation measures and management

strategies. This framework will also facilitate adaptive management, allowing for adjustments to the ESMP as needed based on monitoring results.

In summary, the stage screening exercise has provided a comprehensive understanding of the environmental and social risks and impacts associated with the sub-project. The recommendations derived from this exercise will inform the development of the ESMP and guide the sustainable implementation of the sub-project.

The output of this screening using SF1 has been given as Annexure I.

Step II Screening (Form SF-2):

Following the initial screening, Step II involves a more detailed assessment of the potential risks and impacts associated with each sub-activity identified in Step I. This assessment utilizes Screening Format 2 (SF-2) to evaluate the extent of risk involved. The intensity of the risk/impact for each sub-activity is categorized as Low (L), Moderate (M), Substantial (S), or High (H), based on the following criteria:

- **Low (L):** Impacts that are localized, temporary, and negligible in nature.
- **Moderate (M):** Impacts that are temporary or short-term and can be reversed or controlled.
- **Substantial (S):** Impacts that cover a larger zone, are medium-term, and are partially reversible.
- **High (H):** Impacts that are significant, non-reversible, long-term, and can only be contained or compensated.

Occupational Health and Safety (OHS):

OHS is considered a substantial risk activity in most cases and is a crucial requirement for all projects, regardless of size and type. As such, OHS is not included in the screening criteria but is addressed as part of the Contractor's Environmental and Social Management Plan (ESMP).

Analysis of Risk/Impact Intensity for Sub-Activities:

The analysis of risk/impact intensity for sub-activities has identified the following activities as having Moderate Risks/Impacts:

Restoration of Degraded Seagrass Area (15 Acres along the coast in the Gulf of Mannar):

- Manual transplantation of seagrass sprigs using PVC pipes, which involves the construction of PVC frames, collection of seagrass shoots from donor sites, tying of seagrass shoots using jute ropes in PVC frames, transporting seagrass-

tied PVC frames to restoration sites, and fixing seagrass-tied PVC frames on the seafloor. There is a potential risk of accidental injury to personnel involved in these activities.

- Monitoring and maintenance activities, including periodic mapping of habitats and removal of solid wastes, torn pieces of nets, and seaweed.
- Other sub-project activities, such as field surveys for data collection, laboratory analysis, and desk research, are assessed to have an insignificant physical impact except on risk of human life while collecting seawater and seagrass samples using boats/diving

The outcomes of this screening using SF-2 are documented in Annexure II. Based on the analysis of all considerations, the summary of Risk is presented in Table 4.1 (SF-3). This comprehensive assessment forms the basis for developing targeted mitigation measures and management strategies to address the identified risks and impacts in the ESMP.

Table 4.1: Summary of Risk and Impacts of Seagrass Restoration (SF 3)

Activity	Environmental Risks				Social Risks				
	Land, Geology & Soil	General Ecology & Biodiversity	Waste, Pollution & Hazard	Protected Area (WLS, National Park etc.)	Land	Loss of Livelihood/ HH etc.	Occupational Health and safety	Labour	Tribal
1. Seagrass restoration									
Planning of Seagrass Restoration and Target Site Selection in the field	None	L	None	L	None	None	L	None	None
Fabrication of PVC Quadrats	None	None	L	None	None	None	None	L	None
Transport of PVC quadrats by barges to the site	None	None	None	None	None	L	L	L	None
Collection of Seagrass Shoots from Donor Sites	None	M	None	L	None	None	M	None	None
Manual Transplantation of sprigs/ Deployment of PVC frames tied with Seagrass shoots in the boat and deploying the frames by the divers at target sites	None	M	None	L	None	None	M	None	None
Restoration process (Monitoring and Maintenance)	None	None	L	None	None	None	M	None	None
2. Quantification of Blue Carbon Stock and Accumulation Rate in Seagrass Ecosystems of the Gulf of Mannar	None	None	None	None	None	None	L		
3. Identification of Differences in Blue Carbon Stock According to Percentage Cover of Seagrasses at Selected Sites of the Gulf of Mannar	None	None	None	None	None	None	L	None	None
4. Measurement of Annual Carbon Storage Capacity of	None	None	None	None	None	None	L	None	None

Activity	Environmental Risks				Social Risks				
	Land, Geology & Soil	General Ecology & Biodiversity	Waste, Pollution & Hazard	Protected Area (WLS, National Park etc.)	Land	Loss of Livelihood/ HH etc.	Occupational Health and safety	Labour	Tribal
Restored Seagrass Beds by Estimating Before and After Transplantation Measurements									
Overall risk is MODERATE due to the possibility of damage to healthy seagrass beds, and bottom fauna, and also a safety risk of divers as they remain under the water for prolonged periods of time.									

4.2 Stakeholder Consultation

Stakeholder consultation is a pivotal aspect of the project's implementation phase, ensuring that the perspectives and concerns of all relevant parties are considered in the project's execution. The implementation agency will actively engage with a diverse range of stakeholders, including local communities, government authorities, environmental organizations, and other interested groups, throughout the project's lifecycle.

The consultation process will be structured and inclusive, employing various methods such as public meetings, focus group discussions, surveys, and workshops to gather input and feedback. These interactions will provide valuable insights into the social, environmental, and economic implications of the project, enabling the implementation agency to address any concerns and incorporate stakeholder recommendations into project planning and decision-making.

The stakeholder consultation will be conducted in accordance with the principles of transparency, inclusivity, and responsiveness. The implementation agency will ensure that stakeholders are informed about the project's objectives, activities, and potential impacts, and that their input is given due consideration. Regular updates will be provided to stakeholders to keep them informed of the project's progress and any changes to its implementation.

Overall, stakeholder consultation will play a crucial role in enhancing the project's social acceptability, environmental sustainability, and overall success. The implementation agency is committed to promoting meaningful engagement with all stakeholders to achieve the best outcomes for the project and the communities it impacts.

4.3 Descriptive Summary of Risks and Impacts from Activities Based on Screening

The screening analysis has identified and assessed the potential environmental and social risks and impacts associated with the sub-project activities. A comprehensive summary of these risks and impacts is provided below:

Environmental Impacts and Risks:

1. **Localized and Temporary Nature:** The environmental risks and impacts associated with various project activities are categorized as **moderate**, primarily due to their localized and temporary nature. The activities are confined to selected sites within the seabed, limiting their spatial and temporal extent.

2. **Fragile Ecosystems:** Seagrass restoration activities, including manual transplantation using PVC frames, will be conducted within the ecologically sensitive and protected areas of the Gulf of Mannar and Palk Bay, which fall under CRZ IV A. These regions host fragile marine ecosystems that require careful management to prevent adverse impacts.
3. **Impact on Natural Ecosystem Processes:** The construction and deployment of PVC frames for seagrass transplantation may interfere with natural ecosystem processes on the seafloor and affect seawater quality. Additionally, there is a risk of plastic pollution associated with the use of PVC materials, which needs to be mitigated through the selection of environmentally friendly alternatives or proper disposal methods. Else, after successful transplantation, PVC frames can be removed and reused.
4. **Donor Site Selection:** The selection of donor sites for seagrass transplantation must be conducted with caution to avoid creating stress on existing seagrass habitats. Ensuring the sustainability of donor sites is crucial for the overall success of the restoration efforts.

Social Impacts and Risks:

1. **Land Acquisition and Livelihoods:** As the sub-project activities are confined to the seafloor, no impacts on land acquisition or livelihoods are anticipated. The project is designed to minimize disruptions to coastal communities and their economic activities.
2. **Cultural Heritage:** No adverse impacts on cultural heritage sites are expected, as the project vicinity does not include any identified heritage areas. However, continuous monitoring is essential to ensure that any unforeseen impacts on cultural assets are promptly addressed.
3. **Labor Engagement:** The seagrass restoration activities will involve skilled labor and divers for various tasks, including the construction of PVC frames, collection of seagrass shoots, and deployment of the frames on the seafloor. Proper training and safety measures will be implemented to ensure the well-being of the workers involved.
4. **Occupational Health and Safety Risks:** The project poses occupational health and safety risks, such as potential injuries, accidents, or fatalities during the restoration activities. These risks will be managed in accordance with established Occupational Health and Safety (OHS) guidelines, ensuring that workers are provided with safe working conditions and necessary protective equipment.

The descriptive summary highlights the need for careful planning and implementation of mitigation measures to address the identified environmental and social risks and impacts. Continuous monitoring and adaptive management will be crucial to ensure the sustainable and responsible execution of the sub-project.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

5.1.1 Risk Classification

The (ESDD) exercise has identified potential risks and impacts primarily associated with seawater, waste, pollution, ecology, biodiversity, protected areas, and land & soils (during PVC frame construction). The activities are confined to the marine environment, eliminating concerns related to land acquisition or encroachment. However, manual transplantation of seagrass sprigs using PVC pipes introduces risks related to labor engagement and environmental impacts. These risks are generally low to moderate, localized, short-term, and temporary, and can be effectively managed with a standard ESMP and guidelines.

Accordingly, the overall risk category for this sub-project is classified as **Moderate**. Occupational Health and Safety (OHS) is identified as a substantial risk activity and is addressed separately through an OHS plan in compliance with World Bank Environmental, Health, and Safety (EHS) guidelines.

5.1.2 National Legislation and WB ESS Applicability Screening:

The analysis of the Government of India (GoI) and State legal and regulatory framework underscores the necessity for the contractor to adhere to various legislations to ensure environmental quality, occupational health and safety, and protection of workers' rights. The World Bank's Environmental and Social Framework (ESF), comprising 10 Environmental and Social Standards (ESS), is applicable based on the nature of the activities. The relevance of these standards to the sub-project is outlined in Table 5.1.

Table 5.1: Applicability of Environmental and Social Standards (ESS) and Trigger Criteria

ESS Applicability & Triggers	
ESS	Relevancy with Reasons
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	Relevant: Interventions are within fragile ecosystems (marine protected areas) and CRZ IV A, involving the transplantation of foreign materials (PVC frames) and potential disturbance to existing seagrass habitats. Involves transplanting foreign material (PVC frames) and disturbing existing seagrass habitat (collection of shoots from donor sites)
ESS2: Labour and Working Conditions	Relevant: Activities require skilled labor and divers for PVC frame construction and seagrass transplantation.
ESS3: Resource Efficiency, Pollution Prevention and Management	Relevant: The use of PVC frames poses risks of plastic pollution in the sea. However, PVC frames can be taken out from that environment and can be reused.
ESS 4: Community Health and Safety	Not Relevant: Activities are confined to seawater.
ESS 5: Land Acquisition, Restrictions on Landuse and Involuntary Resettlement	Not Relevant: The project is situated within seawater, with no land acquisition involved.
ESS 6: Biodiversity conservation and Sustainable Management of Living Natural resources	Relevant: Activities are located within CRZ IV A fragile ecosystems, with potential stress on seagrass habitats.
ESS 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Tradition Local Communities	Not Relevant
ESS 8: Cultural Heritage	Not Relevant
ESS 9: Financial Intermediaries	Not Relevant
ESS 10: Stakeholder Engagement and Information Disclosure	Relevant: Engagement with stakeholders and information disclosure are integral to the project.

5.2 Recommendations

5.2.1 Mitigation and Management of Risks and Impacts

Given that the identified risks and impacts fall into low to moderate categories, a standard ESMP customized for the sub-project has been prepared. Key recommendations include:

- a. The ESMP will provide measures for labor management and environmental quality protection in line with ESF standards ESS2 and ESS3. It will also address Occupational Health and Safety (OHS) for workers and the community as per ESS4 and World Bank Group guidelines.
- b. The Executing Consultant is responsible for submitting the Bill of Quantities (BOQ) as per the sub-project's ESMP.

The mitigation plans, aligned with relevant standards, outline responsibilities and timelines as depicted in Table 5.2.

Table 5.2: List of Mitigation Plans with Responsibility and Timelines

WB-ESS Triggered	Mitigation Instrument	Responsibility	Timelines
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	Environmental and Social Impact Assessment and Management Plan (ESIA-MP)	Consultant and Forest Department	Before mobilization of contractor
ESS2: Labour and Working Conditions	Labour Management Procedure (LMP) including Occupational Health and Safety (OHS) management plan	Consultant and Forest Department	Before mobilization of contractor
ESS3: Resource Efficiency, Pollution Prevention and Management	Pollution Management and Resource Conservation Plan	Consultant and Forest Department	Before mobilization of contractor

WB-ESS Triggered	Mitigation Instrument	Responsibility	Timelines
ESS 6: Biodiversity conservation and Sustainable Management of Living Natural resources	• Biodiversity Conservation Plan	Consultant and Forest Department	Before mobilization of contractor
ESS 10: Stakeholder Engagement Plan	• Stakeholder Engagement Plan (SEP)	Consultant and Forest Department	Before mobilization of contractor

Upon formal approval from the World Bank, the TNGCC will disclose the finalized ESDD and ESMP on its website. An executive summary of the ESMP, based on the ESDD, will be translated into the local language and made available on the TNGCC website for public access.

In summary, these recommendations aim to ensure that the sub-project is implemented in an environmentally and socially responsible manner, addressing potential risks and impacts effectively for sustainable outcomes.

Annexure-1: Form SF-1

Form SF-1

Activity and Environmental aspects	Likely Nature of Risk/Impact. Land, Geology & Soil (LGS); General Ecology & Biodiversity (EB); Waste, Pollution & Hazard (WPH); Protected Area (PA); Loss of Livelihood/ Household etc. (LL); Labour (L); Occupational Health and Safety (OHS); Culture/Heritage (CH); Tribal Presence (T);
1. Seagrass restoration	
Planning of Seagrass Restoration and Target Site Selection in the field	PA, EB, HS
Fabrication of PVC Quadrats	WPH
Transport of PVC quadrats by barge to the site	L, OHS, LL
Collection of Seagrass Shoots from Donor Sites	PA, EB, OHS
Manual Transplantation of sprigs/ Deployment of PVC frames tied with Seagrass shoots in the boat and deploying the frames by the divers at target sites	EB, OHS, WPH
Restoration Process (Monitoring and Maintenance)	OHS, WPH
2.Quantification of Blue Carbon Stock and Accumulation Rate in Seagrass Ecosystems of the Gulf of Mannar	OHS
3.Identification of Differences in Blue Carbon Stock According to Percentage Cover of Seagrasses at Selected Sites of the Gulf of Mannar	OHS
4.Measurement of Annual Carbon Storage Capacity of Restored Seagrass Beds by Estimating Before and After Transplantation Measurements	OHS

Annexure-2: Form SF-2

Form SF-2 (Output 3)

S. No	Applicable Project Component/ Construction preparatory Work-related Sub activity (As per SF-1)	Nature of Risk (Conforming to Column 3 of SF-1)	Elaborate cause (risk) and its effect (Impact) on environment /social	Risk/Impact intensity for each type of risk/impact Low (L), Moderate (M), Substantial (S), High (H)
1	2	3	4	5
1	Planning of Seagrass Restoration and Target Site Selection in the field	PA, OHS EB	Selection of donor site needs to be done properly as it may impact through creating stress on the existing seagrass habitats and other flora and fauna inhabiting the protected area. Further, there will risk to the safety of the diver when the diving equipment fails or sometimes the diver gets hit by sting rays. Seagrass habitats are protected. However, the chances of damage to the habitat are low	EB - L PA - L OHS - L
2	Fabrication of PVC Quadrats	WPH, L	Fabrication may produce plastic wastes at the site but not in significant quantity and due to the softness of PVC risk of injury to the labour is low	WPH -L L -L
3	Transport of PVC Quadrats by barge to the site	L. OHS, LL	Labours involved in loading and transport mostly remain on the boat with low chances of risk. Possibility of run over fishing nets enroute resulting in damage to the nets and affecting the day's fish catch	L -L OHS-L LL - L
4	Collection of Seagrass Shoots from Donor Sites	PA, EB, OHS	Possibility of disturbing the bottom fauna and also damaging a few healthy seagrass beds with a risk of equipment failure for the diver or sometimes getting hit by sting rays	EB - M PA - L OHS - M
5	Manual Transplantation of sprigs/ Deployment of PVC frames tied with Seagrass	EB,WPH, OHS	Disturbance to the flora and fauna of the area, pieces of ropes at times causing pollution and safety risk to the diver	EB - M WPH - L OHS – M

S. No	Applicable Project Component/ Construction preparatory Work-related Sub activity (As per SF-1)	Nature of Risk (Conforming to Column 3 of SF-1)	Elaborate cause (risk) and its effect (Impact) on environment /social	Risk/Impact intensity for each type of risk/impact Low (L), Moderate (M), Substantial (S), High (H)
	shoots in the boat and deploying the frames by the divers at target sites			
6	Restoration Process (Monitoring and Maintenance)	OHS, WPH	Risk of diving and replacement of undergrown transplants causing turbidity in the water column and possibility of pieces of nylon ropes detached from frames causing low level of pollution	OHS – M WPH -L

Note: The risk/impact categories have been expanded to include specific environmental and social aspects relevant to the project activities. The intensity of risks/impacts is categorized based on the severity and extent of potential effects.

Criteria for Risk Evaluation:

Low: Impacts are localized, temporary, and negligible.

Moderate: Impacts are temporary or short-term and can be reversed or controlled under proper management.

Substantial: Impacts are medium-term, covering a larger impact zone, and are partially reversible.

High: Impacts are significant, non-reversible, long-term, and can only be contained or compensated for.

Occupational Health and Safety (OHS): OHS risks are treated as Moderate by default, as their effects can be controlled and minimized with the adoption of defined guidelines and proper safety measures.