Inception Report on Developing Voluntary Carbon Market Project for Mangrove Plantation in Gujarat

For more information

Dr J. V. Sharma, Senior Director
Land Resources Division
T E R I
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003,
India

Tel. 2468 2100 or 2468 2111
E-mail jv.sharma@teri.res.in
Fax 2468 2144 or 2468 2145
Web www.teriin.org

Table of Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviation	Full form
AFOLU	Agriculture, Forestry, and other Land uses
AGB	Above Ground Biomass
ARR	Afforestation, Reforestation and Revegetation
BGB	Below Ground Biomass
CBO	Community Based Organization
CCBS	Climate, Community & Biodiversity Standards
CDM	Clean Development Mechanism
CERs	Carbon Emission Reductions
DBH	Diameter at Breast Height
GEC	Gujarat Ecological Committee
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
PD	Project Description
RWE	Restoration of Wetlands Ecosystems
SOC	Soil Organic Carbon
TERI	The Energy and Resources Institute
VCS	Voluntary Carbon Standards
VERs	Voluntary / Verified Emission Reduction
VNV	Value Network Ventures Advisory Services Pvt. Ltd.
WRC	Wetlands Restoration and Conservation

Introduction

The State of Gujarat has the second-largest mangrove cover in the country. Located along the western coastline of our country, Gujarat is bounded by the Arabian Sea on three sides. The coastline along Gujarat also supports a large human population that is dependent on rich coastal and marine resources and ecosystem services. An area of about 1103 sq. km of mangrove cover is present in the State. The State continuously emphasizes mangrove plantations by developing new mangrove habitats and the restoration/development of degraded mangrove habitats. Gujarat's coast is divided into five major regions: the Gulf of Kutch, the Gulf of Khambat, the Saurashtra Coast, the South Gujarat Coast, and the Rann of Kutch. However, the mangrove cover is distributed unevenly over these four regions, and Kutch has the highest mangrove cover (71.5%) in the State. Further, the Gulf of Kutch, Saurashtra, and South Gujarat (including areas of the Gulf of Khambhat and Dumas -Ubharat) have 15.6%, 0.3%, and 12.6% of the total mangrove cover of the State, respectively [1].

Mangrove habitats are susceptible to impacts of anthropogenic as well as climate change impacts. Coasts are prone to erosion, and coastal marginal communities are exposed to climate calamities. For stabilizing the coasts and minimizing the climate change impacts, 2997 hectares of area have been covered with mangrove plantation from 2021 to 2023. Mangrove trees are planted under multiple instances, and the species planted are *Avicennia sp.*, *Rhizophora sp.*, and *Ceriops sp.* The total number of seedlings planted is around 65 lakh. The plantation activities have been carried out in different locations of the Gulf of Khambat and the Gulf of Ku. Various methods have been applied to carry out the plantation activities. Methods include planting seedlings grown in the nursery, direct propagule sowing, and earthen mound plantation.

Mangrove plantations in coastal landscapes enhance productivity, profitability, diversity, and ecosystem sustainability through protection from tidal impacts and climate change. Afforestation, Reforestation, Revegetation, and Restoration of Wetland Ecosystems (ARR-RWE) enhance the storage of carbon and qualify as an afforestation practice as defined in the Kyoto Protocol. Whenever, there is any degradation of mangroves, the fringe communities cannot recover from the impact and do not get any benefit for the protection of the forest. However, through carbon sequestration and locking carbon as biomass, ARR-RWE activity can supplement additional income to the local marginal communities by selling carbon credits in the carbon markets, enabling risk reduction and contributing towards climate resilience.

The potential of carbon sequestration in mangrove plantation locations of Bharuch, Surat, and Kachchh districts is estimated to be around 1.1 million tons of CO_2 equivalent for a crediting period of 30 years. The marginal fisherman communities could get an additional financial benefits every five year of interval in addition to the ecosystem services on the basis of existing carbon prices in the voluntary market. The carbon finance project will enhance the community's income and help the State of Gujarat move towards carbon neutrality.

[1] https://forests.gujarat.gov.in/mangrove-conserv.htm#:~:text=The%20mangrove%20cover%20of%20the,71.5%25)%20of%20the%20State.

Project Area

The study area is situated in the State of Gujarat and distributed over parcels of land within three districts namely Bharuch, Surat, and Kachchh.

The project area is distributed across multiple villages and Tehsils—the list of project areas around tehsils and villages are mentioned in the table below.

Table 1: Name of Project Area, Village, Tehsil, and District

S. No.	Project Area	Village	Tehsil	District
1	Kantiyajal and Aliya Beyt	Ambheta	Hansot	Bharuch
		Kantiyajal		
2	Karanj	Karanj	Olpad	Surat
3	Satsida Bet, Kandla	Satsida Bet, Kandla	Gandhidham	Kachchh

The location and size of the polygons vary in numbers. The year of plantation and size of the polygons are given in Table 2.

Table 2: Plantation Year, Area, and Location

Plantation Year	Area of Plantation (in Hectare)	Plantation Location
2021-2022	1999	Kantiyajal and Aliya Bet
2022-2023	998	Kantiyajal and Aliya Bet Karanj , and Satsida Bet,Kandla

Table 3: Plantation Polygons and Their Location

Polygon	Location	Year	Area (ha)	Lat	Long
1,2,3	Aliya Bet	2021-22	322	21°29'57.40"N	72°38'28.81"E
			243	21°31'59.18"N	72°38'9.24"E
			433	1°31'36.19"N	72°38'49.04"E
4,5,6	Morkantha		322	21°28'5.90"N	72°38'56.64"E
			243	21°26'37.18"N	72°38'9.68"E
			436	21°26'0.63"N	72°38'22.53"E

Polygon	Location	Year	Area (ha)	Lat	Long
7	Aaliya Bet	2022-23	438	21°32'34.70"N	72°36'59.89"E
8	Kantiyajal		451	21°27'14.88"N	72°37'15.83"E
9	Satsaida Bet		109	22°59'35.71"N	70°14'50.10"E

The plantation polygons of area 2997 ha for the years 2021-22 to 2022-23 are depicted below:

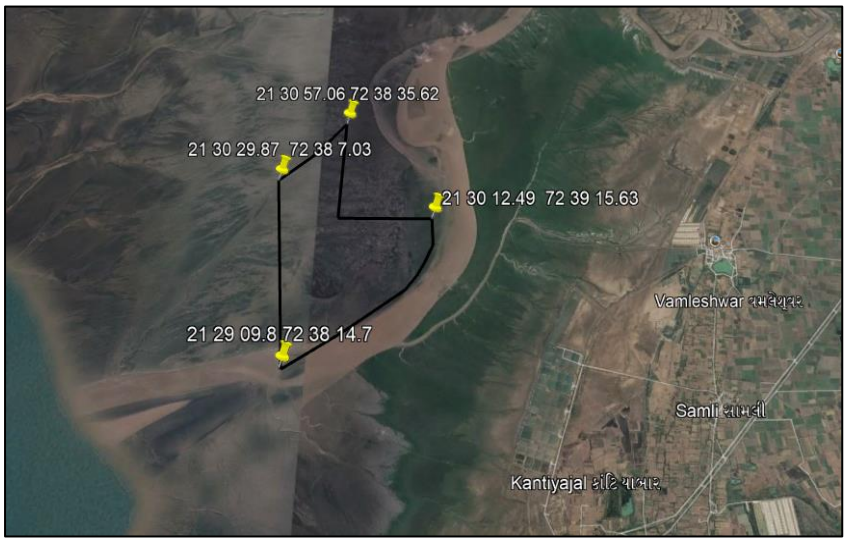

Figure 1: 2021-22 Plantation of 322 Ha in Aliya Bet

Figure 2: 2021-22 Plantation Plot of 322 Ha in Morakantha

Figure 3: 2021-22 Plantation Plot of 243 Ha in Aliya Bet

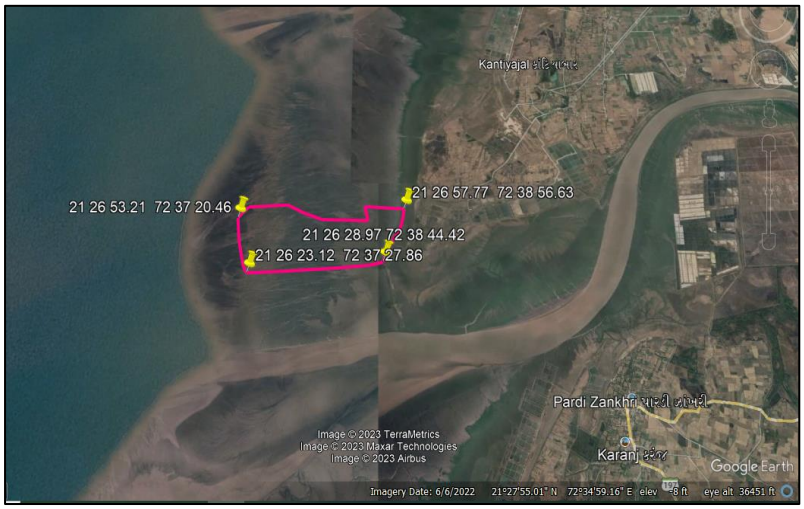

Figure 4: 2021-22 Plantation Plot of 243 Ha in Morakantha

Figure 5: 2021-22 Plantation Plot of 433 Ha in Aliya Bet

Figure 6: 2021-22 Plantation Plot of 436 Ha in Aliya Bet

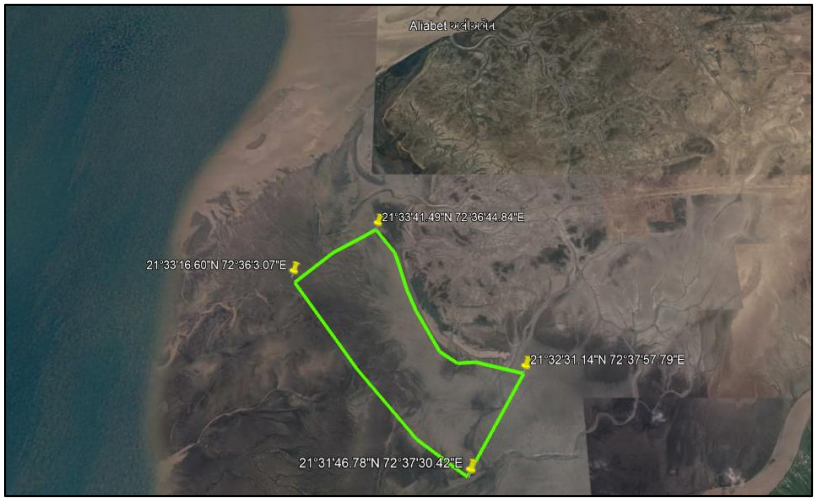

Figure 7: 2022-23 Plantation Plot of 438 Ha in Aliya Bet

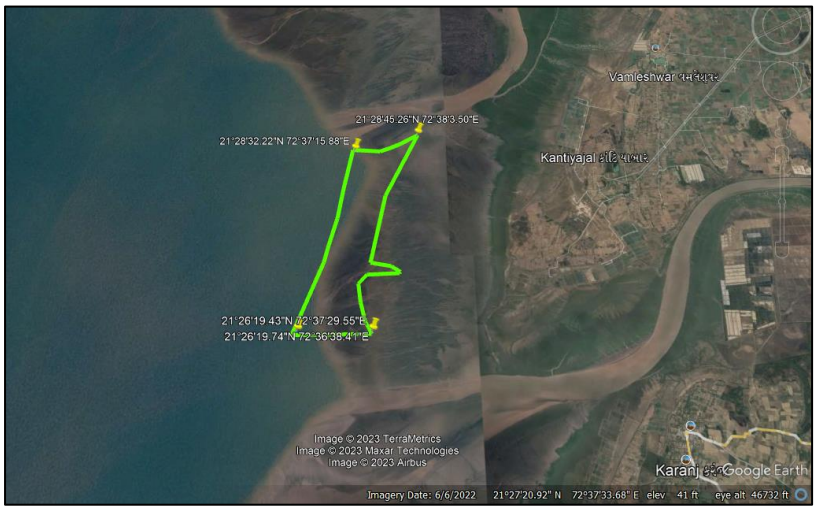

Figure 8: 2022-23 Plantation Plot of 451 Ha in Kantiyajal

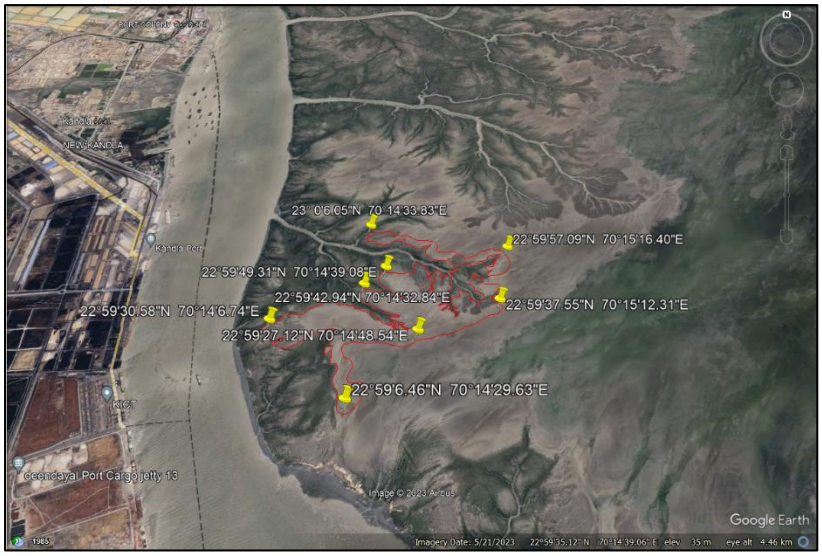

Figure 9: 2022-23 Plantation of 108.82 Ha in Satsida Bet

The plantation sites are distributed over three major river basins formed by rivers, namely Narmada, Tapi, and Rann of Kutch. The rivers are West flowing and fall in the Arabian Sea. These basins are as follows,

Table 4: District, River Basin, River flow, and Coastal Zone

S. No.	District	River Basin	Flow of Rivers	Coastal Zone
1	Bharuch	Narmada Basin	West	West Coast; Arabian Sea
2	Surat	Tapi Basin		
3	Kachchh	Kutch Basin		

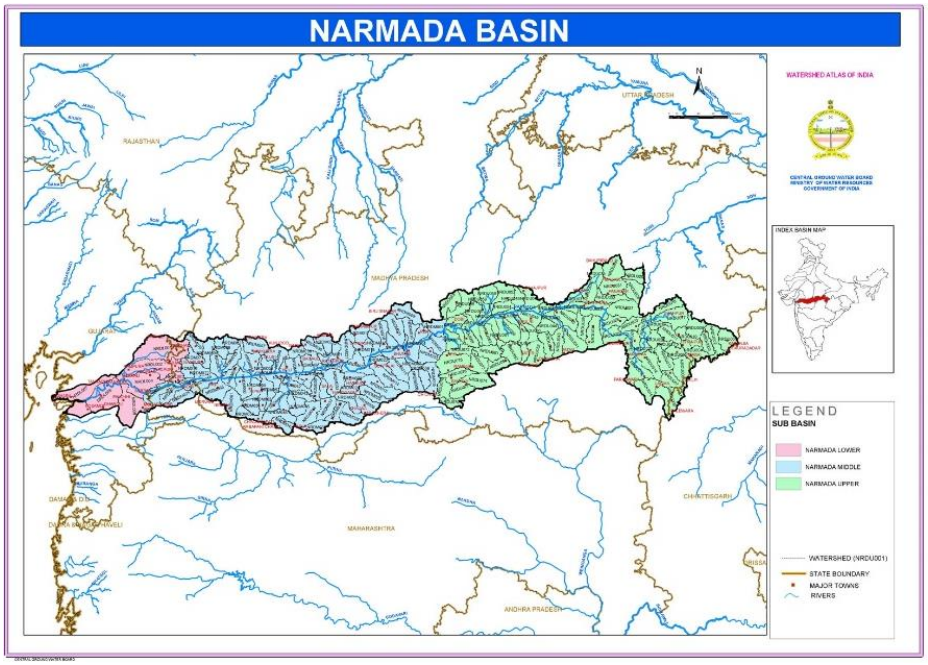

Figure 10: Basin of River Narmada

(http://cgwb.gov.in/watershed/Maps/NARMADA.jpg)

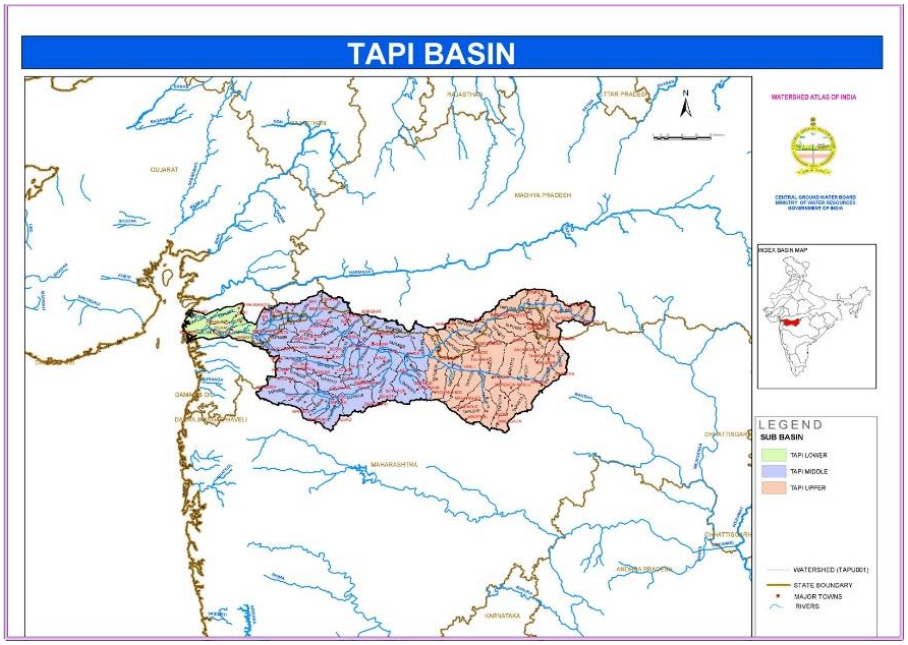

Figure 11: Basin of River Tapi

(http://cgwb.gov.in/watershed/Maps/TAPI.jpg)

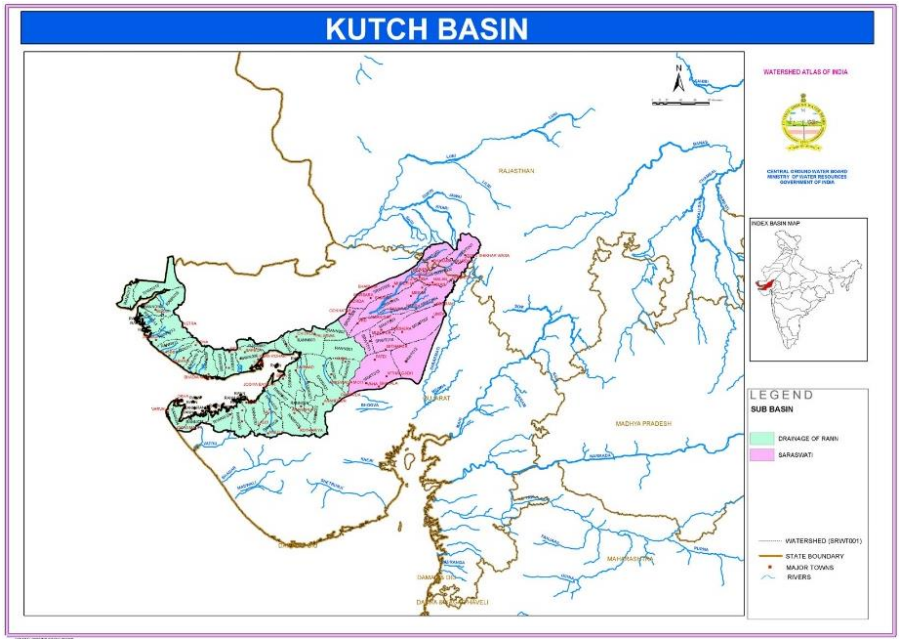

Figure 12: Basin of Rann of Kutch

(http://cgwb.gov.in/watershed/Maps/KUTCH.jpg)

Clustering the project area

The project area of mangrove plantations undertaken for this project will be considered for developing a single carbon finance project.

Project Beneficiaries and Plantation Details

There are two types of beneficiaries in this project. The direct beneficiaries include the members of 6 Community Based Organizations (CBOs) of Bharuch (4 CBOs), Surat (1 CBO), and Kachchh (1 CBO) districts of Gujarat. The project will benefit the local fisherman communities, which are indirect beneficiaries in the neighboring villages. The CBOs are,

District	Name of CBO
Bharuch	Morkantha Paryavaran Vikas Vyavasthapan Samiti; Aliya Beyt Paryavaran Vikas Vyavasthapan Samiti; Aliya Beyt Mahila Paryavaran Punahsthapan Mandal; Kantiyajal Mahila Paryavaran Punahsthapan Mandal.
Surat	Karanj Tavar Vikas Samiti
Kachchh	Rampar Dariyakanta Vistar Vikas Samiti

Types of Mangrove Species Planted

The tree species planted on the coasts of Gujarat are all '**True Mangrove**' species. True Mangroves are woody plants, facultative or obligate halophytes (Wang et al, 2011)[2]. The details of the species used for the plantation are provided in the table below:

Table 5: Planted Species, Their Productivity, and Spacing

S. No	Botanical Name	Common Name	*Average Annual Productivity	Spacing
1	*Avicennia sp.*	White mangrove	6.13 t. ha-1. yr-1[3]	2.5 m × 2.5 m 400 mounds/Ha
2	*Rhizophora sp.*	Asiatic mangrove	5.85 t .ha-1 .yr-1[4]	1.25 m ×1.25 m 2 m × 2 m 2.5 m × 2 m
3	*Ceriops sp.*	Indian mangrove	10.9 t .ha-1. yr-1[5]	2.5 m × 2 m

Project Interventions in Gujarat Mangroves

ARR-RWE Activities: Plantation activities have been carried out in the developed mudflats of Bharuch, Surat, and Kachchh district of Gujarat. Since 2021-22, around 65 lakh saplings of 3 different mangrove species have been planted.

Geo-Location details of discrete parcels of plantation are shown in the map below,

[2] Wang, W., Yan, Z., You, S., Zhang, Y., Chen, L., & Lin, G. (2011). Mangroves: obligate or facultative halophytes? A review. *Trees*, *25*, 953-963.

[3] https://www.sciencedirect.com/science/article/abs/pii/S2352485523001263

[4] https://www.sciencedirect.com/science/article/abs/pii/S2352485523001263

[5] https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands_Supplement_Entire_Report.pdf

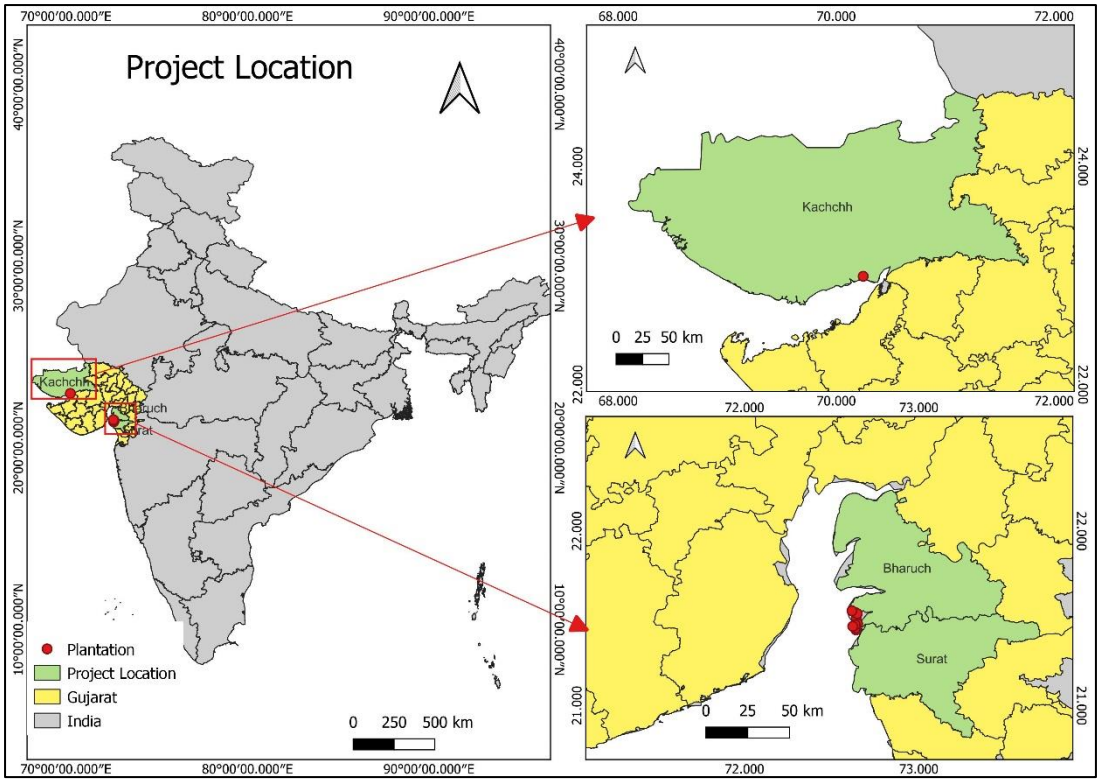

Figure 13: Maps of Project Instances

Estimated emissions reduction

The project accounts for the current emissions based on *ex-ante* calculations considering number of plants, productivity of mangrove species, and area covered under the plantation). The TERI team will calculate the actual value of the emission reduction during the project.

Different mangrove tree species in the study area have different productivity, but the productivity of the mangrove ecosystem is relatively high. Mangrove seedlings/saplings, when it reaches maturity, develop a complex root system and sequester carbon. The *ex-ante* calculations will be considered for developing the PD while performing the study.

The emissions reductions for the period of 30 years have been estimated to be 1.1 million tonnes.

Table 6: Table of Estimated ERs (For 30 Years)[6]

Year	Annual CO_2 Sequestration in Tonnes (Upto 30 Years)
1st	**0**
2nd	**-20,636**
3rd	**-30,866**
4th	**-30,866**
5th	**-34,105**
6th	**-40,033**
7th	**-40,033**
8th	**-40,033**
9th	**-40,033**
10th	**-40,033**
11th	**-40,033**
12th	**-40,033**
13th	**-40,033**
14th	**-40,033**
15th	**-40,033**

[6] **Note:** In mangrove ecosystems the ERs are calculated as emission removal, and hence, as per methodology '–ve' sign denotes the sequestration.

Year	Annual CO_2 Sequestration in Tonnes (Upto 30 Years)
16th	**-40,033**
17th	**-40,033**
18th	**-40,033**
19th	**-40,033**
20th	**-40,033**
21th	**-40,033**
22th	**-40,033**
23rd	**-40,033**
14th	**-40,033**
25th	**-40,033**
26th	**-40,033**
27th	**-40,033**
28th	**-40,033**
29th	**-40,033**
30th	**-40,033**
Total ERs	**-1,117,290**
Annual Average ERs	**-37,243**

The total estimated emission reduction for the project is -1,117,290 tCO_2e. Thus, the estimated average annual ERs is -37,243 tCO_2e. The removal rate is 12.43 tCO_2e/ha.

Preferred Voluntary Carbon Markets

Carbon offset markets are considered an important part of the solution to the climate crisis because of their economic and environmental efficiency and their potential to deliver sustainability co-benefits through technology transfer and capacity building. Carbon offset markets exist both under compliance schemes and as voluntary programs. Voluntary Carbon Markets have greater opportunities to diversify and evolve to provide carbon finance for various activities, resulting in emission reduction and enhancing carbon sequestration. Often the voluntary standards are compared with reference to compliance standards in terms of their processes, criteria, market share, and credibility. The following points compare important features of major voluntary carbon markets.

VERRA is the most accepted standard for the study based on the specifications of all the carbon offset standards.

VERRA is considered to be a universal and base quality standard.

- It has decreased administrative expenses and burdens.
- It has the highest market share.
- It has an organized process for the registry.

A suitable methodology supported by VERRA standards will be considered for developing the Project Description to apply for carbon credits. VERRA standards have a Verified Carbon Standard (VCS) program to reduce GHG emissions. The guidance provided by the VCS program for securing carbon finance will thus be followed.

Methodology

Selection of Methodology

Based on a detailed review of the literature, the project's requirements and applicability have been identified to develop a feasible project using the best possible methodologies. A series of methodologies were reviewed, present under VCS and non-VCS methodologies.

Further, based on the project's specificity and discussion with VNV, it has been decided that the VCS methodology,"**VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v2.0,**" and associated tools will be adopted during the project.

Table 7: Comparative Analysis of Available Methodologies for Mangrove Plantation Projects in context of Gujarat Mangrove

Parameters / Method	**VM0033**	**VM0007**
	VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v2.0	VM0007 REDD+ Methodology Framework (REDD+MF), v1.6
Applicability conditions	1) Project activities which restore tidal wetlands (including seagrass meadows, per this methodology's definition of tidal wetland) are eligible. 2) Creating, restoring, and/or managing hydrological conditions. 3) (Re-) Introducing native plant communities is being carried out under the project. 4) Altering sediment supply. 5) Improving management practice.	**Afforestation, Reforestation, and Re-vegetation activities (ARR).** 1) Projects may be stand-alone Reduced Emissions from Afforestation, Reforestation and Revegetation (ARR) and/or WRC. 2) Projects may combine WRC with ARR in a single area, in which case they must apply concomitantly the procedures for both categories provided in this methodology, unless, in the case of stand-alone ARR on wetlands. 3) The project area is non-forest land or land with degraded forest 4) In strata with drained organic soil, ARR activities must be combined with rewetting.
Eligibility criteria	1) Project activities do not qualify as IFM or REDD.	1) Improved forest management (IFM) is not covered under this methodology.

Parameters / Method	VM0033	VM0007
	2) Baseline activities do not include commercial forestry. 3) Project activities do not lower the water table, and the project do not convert open water to tidal wetlands or improves the hydrological connection to impounded waters. 4) Hydrological connectivity of the project area with adjacent areas does not lead to a significant increase in GHG emissions outside the project area. 5) Project activities do not include the burning of organic soil. 6) Nitrogen fertilizer(s), such as chemical fertilizer or manure, is not applied in the project area during the project crediting period.	2) Nitrogen/chemical fertilizers/manure cannot be used in the project during the crediting period. 3) Project Activities lower the water table, unless the project converts open water to tidal wetlands, or improves the hydrological connections to impound waters 4) Hydrological connectivity of the project area with adjacent areas leads to a significant increase in GHG emissions outside the project area. 5) Project activities include the burning of organic soil.

Signing of MoUs

Bilateral MoUs between GEC & TERI and VNV & TERI have been executed to finalize the activities of the project, timelines, and necessary roles and responsibilities of each partner in the project.

Development of Institutional Mechanism

An institutional mechanism will be developed during the project to implement, manage, and monitor project activities. Carbon Finance Management Committee will be developed to manage the carbon finance projects of the particular area with the Member Secretary of GEC as the chairman and Senior Manager (Projects) as the member secretary. The Chairperson of 6 CBO (Community Based Organisation) along with Manager Ecology, Manager Project, Manager Costal, and Manager Social of Gujarat Ecological Commission (GEC) shall also be part of the carbon finance management committee. The management committee, headed by the member secretary, will monitor and coordinate with the participating CBOs. The CBO-level management committee, led by the Senior Manager (Projects), the Manager (Ecology, Projects, Coastal & Social), and the chairperson of 6 CBOs, will monitor and coordinate with the participating CBOs. The committee at the CBO level will also ensure that the benefits accrued through this project will directly reach the communities.

The details regarding the institutional mechanism developed are as follows:

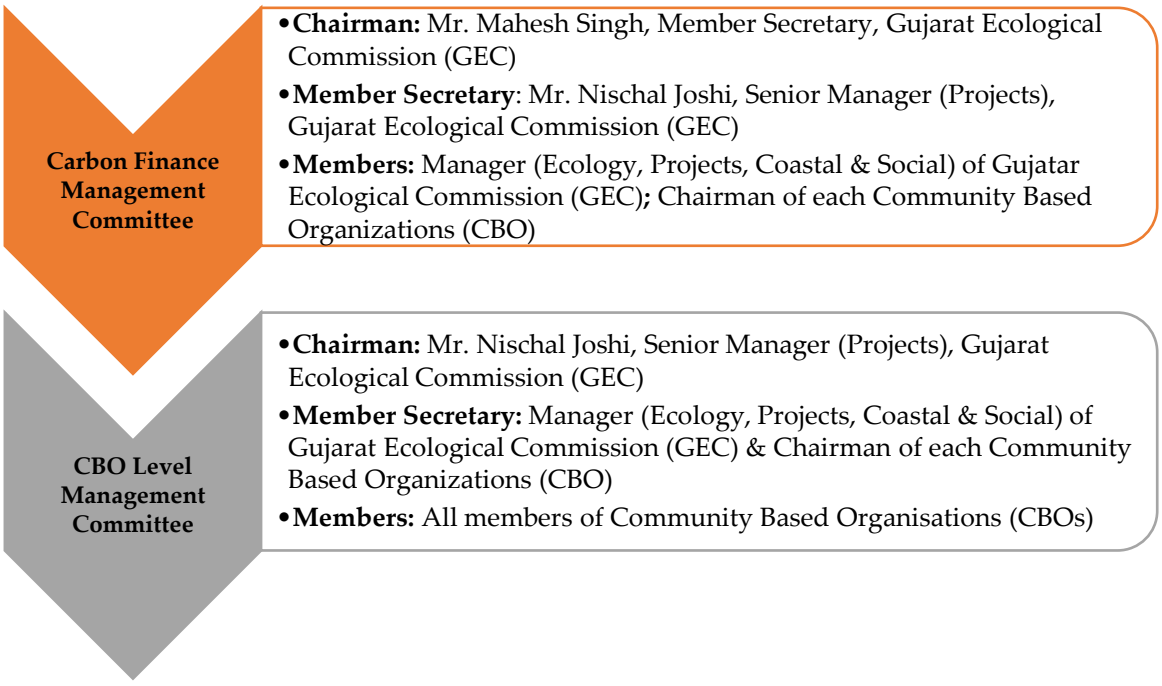

Figure 14: Flow-Chart of Institutional Mechanism

Stakeholder Consultations

Detailed stakeholder consultation workshops would be conducted with the CBOs to apprise the village fishermen of the project area. The consultations would be undertaken through a detailed procedure in which the advertisement would be floated through a local newspaper for the community living in and around the coastal zones for better outreach. The consultations would be kept more in a discussion mode rather than a consultation mode. All the queries and comments received from the fisherman villages would be duly documented, and their doubts would be cleared. The stakeholders would be apprised of details on the project, timelines, institutional mechanisms, payment terms, and other benefits.

Pipeline Listing Process

The Verra registry contains a project pipeline that lists projects before they are registered. Thus, the Voluntary Carbon Market Project for Mangrove Plantation under Carbon Credit Scheme in Gujarat shall first be listed on the project pipeline before the opening meeting between the validation/verification body and the project proponent. Pipeline projects shall be listed as either '**Under Development**' or '**Under Validation**'. The projects to be listed as '**Under Development**' needs a '**Draft Project Description**'. For listing representation while the project to be listed as '**Under Validation**' needs a complete '**Project Description**', Proof of validation contracting, and listing representation.

Development of Draft Project Description (PD)

A draft Project Description (PD) shall include drafts of sections of project details and methodology of the VCS Project Description Template. At this step, indicators are sufficient (e.g., the proposed approach for demonstrating additionality or establishing project ownership rather than the full rationale and evidence that will be submitted for validation).

The contents of the draft project description include the following:

Sl. No.	Section
1	**Project Details**
1.1	**Summary Description of the Project**
1.2	**Sectoral Scope and Project Type** The project is classified under Sectoral Scope 14 of the VCS: Agriculture, Forestry, and Other Land Uses (AFLOU) and operates as an Afforestation, Reforestation, and Revegetation (ARR) project type.
1.3	**Project Eligibility** The project shall comply with all rules and requirements stated in the following documents: • Verified Carbon Standard (VCS) Program Guide Version 4.3 • VCS Standard, Version 4.4 • VCS Methodology Requirements, Version 4.3 • AFOLU Non-Permanence Risk Tool, Version 4.0
1.4	**Project Design** The proposed project has been designed to include multiple installations of an activity. The project is an ARR-RWE project as defined under the VCS (VCS Standard 4.4). The project applies '**VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v2.0**', which is eligible.
1.5	**Project Proponent** Name: Mr. Mahesh Singh, IFS, Member Secretary, Gujarat Ecology Commission, Govt. of Gujarat. **Address:** 1st Floor, Block 18, Udhyog Bhavan, Sector 11, Gandhinagar, Gujarat 382011. **Telephone No.** 23257656 **E-mail ID:** ms.gecgujarat@gmail.com
1.6	**Other Entities Involved** 1) Value Network Ventures Advisory Services Pvt. Ltd. (VNV Pvt. Ltd.), 10 Anson Road, #29-07 International Plaza, Singapore – 079903.

Sl. No.	Section
	2) The Energy and Resources Institute (TERI), 6C, Darbari Seth Block, Habitat Place, Lodhi Road, New Delhi 110003.
1.7	**Ownership** The project proponent shall act on behalf of the CBOs and fisherman village groups. GEC shall sign a contractual agreement after due process of consultation and consent seeking.
1.8	**Project Start Date** 1st June 2021
1.9	**Project Crediting Period** The project crediting would be for 30 years.
1.10	**Project Scale and Estimated GHG Emission Reductions or Removals** Project is a Large Scale Project and Net estimated ERs is 1,117,290 CO_2e.
2	**Description of Project Activity**
2.1	**Project Location** The project location and geographic boundaries, including a set of geodetic coordinates, will be indicated. Coordinates may be submitted separately as a KML file.
2.2	**Conditions Prior to Project Initiation** The conditions existing prior to project initiation will be described. This will include the present and prior environmental conditions of the project area, including appropriate information on the climate, hydrology, topography, relevant historical conditions, soils, vegetation, and ecosystems.
2.3	**Compliance with Laws, Statutes, and Other Regulatory Frameworks** Compliance of the project with all and any relevant local, regional, and national laws, statutes, and regulatory frameworks will be demonstrated.
3	**Application of Methodology**
3.1	**Title and Reference of Methodology** Title: VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v2.0
3.2	**Applicability of Methodology**
3.3	**Project of Boundary**

Sl. No.	Section
	The project boundary will be defined, and relevant GHG sources, sinks, and reservoirs for the project and baseline scenarios shall be identified.
3.4	**Baseline Scenario** The baseline scenario will be identified in accordance with the procedure set out in the applied methodology and any relevant tools.
3.5	**Additionality** In accordance with the methodology, the demonstration of additionality shall be carried out with the Methodological tool '**VMD0052: Demonstration of additionality of tidal wetland restoration and conservation project activities (ADD-AM), v2.0**' in its latest version.

A Listing Representation

A listing representation (as per the template for the listing representation provided by VERRA) will be submitted along with the draft PD during the pipeline listing process. The listing representation will be properly executed as a deed per applicable local laws and the organization's constitutional documents (e.g., signature by directors and requirement of organization seals).

Training and Capacity Building for the Measurement of 3 Pools of Carbon and Development of Project Document

The professionals involved with the project proponent (i.e., Gujarat Ecological Commission) and the Community Based Organizations (CBOs) formed under the project must receive effective and well-structured capacity-building training on the latest skills and techniques related to biomass assessment and carbon stock assessment. A well-structured training program will be conducted for GEC officials and the CBOs to measure three pools of carbon stock in the mangrove plantation plots.

The capacity-building training will assist the stakeholders involved in the project in meeting the requirements regarding carbon inventory methods that would, in turn, assess the contribution of mangroves in the sequestration of atmospheric carbon. Such carbon stock assessment training is important and is applied to obtaining carbon finance from Voluntary carbon markets.

Considering these long-term objectives, the following activities will be conducted in consultation with Gujarat Ecological Commission (GEC):

1) Preparation of two day programme

(1 day class + 1 day field work for the personnels)

2) Capacity building of the staff of the GEC and CBOs to assess 3 pools of carbon stock for mangroves namely

i- Above Ground Biomass (AGB)

ii- Below Ground` Biomass (BGB), and

iii- Soil Organic Carbon

3) Capacity building of GEC professionals & CBO members through - training program on remote sensing, GIS, GPS monitoring of vegetation dynamics, preparation of project document (PD), information to trade the carbon credit under VCS and other possible carbon markets.

4) A detailed Training Manual for GEC professionals and CBOs on methodology for carbon stock assessment.

Baseline Preparation

Baseline emissions include all emissions that would have happened in the project area in the absence of the implementation of the project. This is the case with the ARR components of the project. Combined activities (i.e., ARR with a WRC component) must develop a unique baseline considering peat or tidal wetland soils as the SOC pool and incorporating the resulting emission estimates into the calculation of emissions and carbon stock changes of the ARR activities.

The exercise will undertake a more quantitative assessment of different (and additional) parameters, as mentioned in the below table, through the development and implementation of activities (i.e., stakeholder consultations and literature-based study).

Spatial Boundary demarcation

The project area (PA) will be identified and selected. As per the methodology VM0033, the final demarcation of these areas will be done with the help of local stakeholders.

Carbon Pools

In the forest ecosystem, enormous amounts of carbon is stored, which is classified in three pools as given by IPCC Good Practice Guidance 2006. Major eligible carbon pools for ARR-RWE project are Above Ground Biomass (AGB), Below Ground Biomass (BGB), and Soil Organic Carbon (SOC).

Based on the Methodology VM0033, the Carbon Pools to be included/ excluded from the Project Boundary for ARR-RWE (WRC is covered under ARR) activities are listed below:

Carbon Pools		Whether Selected	Justification/Explanation
Baseline	Above-ground biomass	Yes	Major Carbon Pool significantly increases in the case of the establishment or presence of tree vegetation. It must be included.
	Aboveground non-tree biomass	No	Excluded as non-tree biomass is not present in the activity region.
	Below-ground biomass	Yes	Major carbon pool may significantly increase. Below-ground biomass in the baseline scenario must be included.
	Litter	No	Litter biomass is not present as the location has displacement due to tidal activity. So, this pool has been conservatively excluded.
	Deadwood	No	Conservatively Excluded. As there is no displacement of dead wood in the project area, the carbon stock is assumed not to increase as a conservative approach.
	Soil organic carbon	Yes	Carbon stock as SOC in these pools will increase due to the implementation of the project activity and hence included as a major pool.
	Wood Products	No	No such use and extraction occur in the project region. Hence this pool has been conservatively excluded.
Project	Above-ground biomass	Yes	Major Carbon Pool, subjected to increase with the project activity.
	Aboveground non-tree biomass	No	Excluded Conservatively as not thought as a major pool.
	Below-ground biomass	Yes	Major carbon pool may significantly increase. Below-ground biomass in the project must be included as it will increase with the above ground biomass pool.

Carbon Pools		Whether Selected	Justification/Explanation
	Litter	No	Due to tidal activity and high turnover, the pool is conservatively excluded from accounting.
	Deadwood	No	Conservatively Excluded. As there is no displacement of dead wood in the project area, the carbon stock is assumed not to increase as a conservative approach.
	Soil organic carbon	Yes	Major Carbon Pool, subject to increase with the project activity.
	Wood Products	No	Conservatively Excluded. There is no harvesting or production of wood products in the project location.

Estimation of 3 pools of Carbon

The detailed methodology for the assessment of total carbon stocks of the mangrove plantations of Gujarat is as follows:

Delineation of Project Boundaries

There are many tools available for identifying and delineating the project boundaries, such as satellite imagery, aerial photographs, and topographic maps. For preparing basemap for the project site, geo coordinates in the satellite imageries and topographical sheets will be collected. With the help of these geo-coordinates, basemap for project site will be prepared. Each base map will include the details of the project areas, such as different land use categories, forest types, water bodies, open land, agricultural land, etc. On the basis of these base maps, project areas will be delineated. The project areas of each site will be verified in the field during the ground truthing. Further, project boundaries will be clearly demarcated to facilitate accurate measuring, monitoring, accounting, and verification of the project activities.

Stratification, Mapping, and Sampling Design

The project area would be divided into homogenous strata based on various deciding factors, i.e., year of plantation, species composition, soil types, ecology, and canopy density through preliminary field survey and further through satellite imagery analysis.

Estimating the number of Sample Plots

To estimate the number of sample plots, the A/R Methodological Tool "**Calculation of the number of sample plots for measurements within A/R CDM project activities**", **Version 02.1.0,** will be applied. For carbon finance mechanisms, this tool can be used universally as this tool has no internal applicability conditions. This tool applies the following assumptions: (a)

Approximate value of the area of each stratum within the project boundary is known; (b) Approximate value of the variance of biomass stocks in each stratum is known from a preliminary sample, existing data related to the project area, or existing data related to a similar area; (c) The project area is stratified into one or more strata.

The number of sample plots required to estimate biomass stocks within the project boundary is calculated iteratively. In the first iteration, the number of sample plots for the project area is calculated as:

$$n = \frac{N \times t_{VAL^2} \times (\sum_i w_i \times s_i)^2}{N \times E^2 + t_{VAL^2} \times \sum_i w_i \times s_i^2}$$

Where:

n: Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless.

N: Total number of possible sample plots within the project boundary (i.e., the sampling space or the population); dimensionless.

t_{VAL} : Two-sided Student's t-value, at infinite degrees of freedom, for the required confidence level; dimensionless.

w_i : Relative weight of the area of stratum i (i.e., the area of the stratum *i* divided by the project area); dimensionless.

s_i: Estimated standard deviation of biomass stock in stratum *i*; t d.m. (or t d.m. ha-1).

E: Acceptable margin of error (i.e., one-half the confidence interval) in the estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha-1), i.e., in the units used for s_i.

i: 1, 2, 3, ….. biomass stock estimation strata within the project boundary.

In lieu of calculating the statistically significant number of sample plots, a preliminary data collection and physical measurement of vegetation will be carried out. Measurement of height and girth of plants will be taken randomly from the distributed sample plots of size 31.62m x 31.62m dimension. Then requisite calculations will be done to estimate the biomass, carbon stock, and CO_2e.

The number of sample plots can also be assessed by using the value of the Standard Deviation of different states, which is readily available in the ISFR report, 2021.

Laying Out of Permanent Sample Plots

For laying out the sample plots, stratified random samplings will be done in all 3 districts covering all the stratum. The number of sample plots to be laid out will be calculated, and locations will be identified in the field. The geo-coordinates of each sample plot for all the sites will be recorded with the help of Global Positioning System (GPS) tracking and digitized in the satellite imageries of each respective site.

Grains of rice are randomly spread on the map of the plot, and wherever the grains fall, that area is taken as a sample plot. The plots are square and 31.62 m 31.62 m in size, having a total area of 0.1 ha. The point where the grains falls is taken as the center point of the square sample

plot. The post-stratification map is created with the help of the GIS after the first monitoring to concentrate on the possible changes in the project boundary.

Centre points of all plots must be marked permanently in the field.

Calculating above-ground and below-ground carbon stock would be carried out by referencing IPCC Good Practices guidelines and volume equations prepared by FSI (ISFR, 2019) or from peer-reviewed secondary literature-based allometric equations/species-based productivity.

The figure below provides a picture of the permanent nested sample plot being laid out in the requisite number at the selected project sites.

Soil sample cores will be collected from the two opposite corners of the permanent sample plot. A Highly depth-aggregated sampling technique by Kauffman et al. (2011)[7] and Donato et al. (2011)[8] will be used with mangrove soil samples at depth ranges of 0-15 cm, 15-30 cm, 30-50 cm, 50 -100 cm, and >100 cm (Howard et al., 2014).[9] These sampling intervals are deemed adequate for mangroves as the amount of carbon varies with depth.

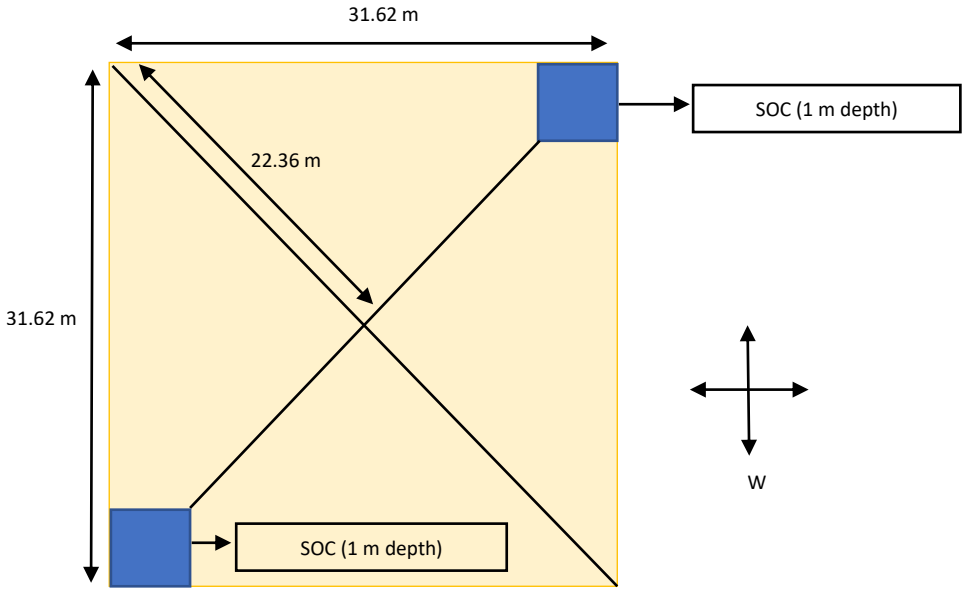

Figure 15: Sample Plot for Estimation of Carbon Pools

[7] Kauffman, J.B., Heider, C., Cole, T., Dwire, K.A., Donato, D.C. 2011 Ecosystem C pools of Micronesian mangrove forests: implications of land use and climate change. Wetlands 31: 343-352.
[8] Donato, D. C., Kauffman, J. B., Mackenzie, R. A., Ainsworth, A., & Pfleeger, A. Z. (2012). Whole-island carbon stocks in the tropical Pacific: Implications for mangrove conservation and upland restoration. Journal of environmental management, 97, 89-96.
[9] Howard, J., Hoyt, S., Isensee, K., Pidgeon, E., Telszewski, M. (eds.) (2014). Coastal Blue Carbon: Methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrass meadows. Conservation International, Intergovernmental Oceanographic Commission of UNESCO, International Union for Conservation of Nature. Arlington, Virginia, USA.

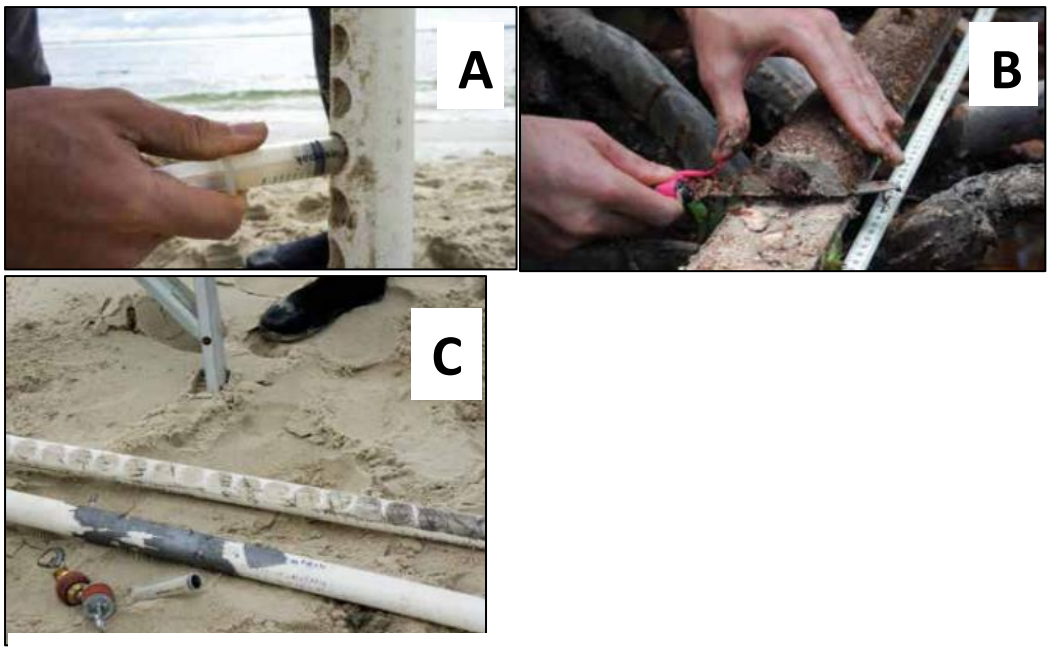

Figure 16: A. Syringe used to subsample core and B. knife used foe sub sampling C. coring devices. PVC tubes, rubber stopper, and syringe

Measurement of Above Ground and Below Ground Biomass

A seedling/sapling/tree is included in the survey if at least 50% of the main stem is rooted inside the plot or subplot perimeter. Diameter are usually measured with a measuring tape or, if a one-time rapid assessment, a Tree Caliper(s) (Kauffman and Donato, 2012)[10] or girth with the help of measuring tape. Diameter of seedling and sapling are measured at the collar height. Tree diameters are typically measured at 1.3 m above the ground, also considered as the diameter at breast height (dbh). For trees with tall buttresses exceeding 1.3 m above ground level, stem diameter is usually measured at the point directly above the buttress. For stilt-rooted species such as *Rhizophora* sp., stem diameter is often measured above the highest stilt root (Clough and Scott 1989[11], Komiyama et al. 2005[12]). For some individuals with prop roots extending well into the canopy, it is not practical or accurate to measure above the highest prop root. Then typically, tree diameter is measured above the stilt roots, where a true main stem exists. In permanent plots, it is quite important to mark the point of measurement (POM) when it is not at 1.3 m above ground level (dbh).

The Below Ground Biomass can be estimated using the IPCC default value of 0.49 in most cases of mangroves, which is a relationship between root (BGB) and Shoot (AGB), also known as the root-to-shoot ratio.

BGB = AGB X 0.49 (IPCC default value)[13]

Where:

[10] Kauffman, J. B., & Donato, D. C. (2012). *Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forests* (Vol. 86). Bogor, Indonesia: Cifor.
[11] Clough, B. F., & Scott, K. (1989). Allometric relationships for estimating above-ground biomass in six mangrove species. *Forest ecology and management*, *27*(2), 117-127.
[12] Komiyama, A., Poungparn, S., & Kato, S. (2005). Common allometric equations for estimating the tree weight of mangroves. *Journal of tropical ecology*, *21*(4), 471-477.
[13] https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands_Supplement_Entire_Report.pdf

BGB = Below-ground biomass

AGB = Above-ground biomass

Calculation of above-ground biomass, below-ground biomass, and soil organic carbon would be carried out by referencing IPCC Good Practices guidelines, Blue carbon methodologies, and allometric equations/species or ecosystem-specific productivity as suited. The biomass of trees is estimated by following a non-destructive method.

The soil organic carbon will be calculated as,

SOC = rb * d * %C,

Where

SOC = soil organic carbon stock per unit area (t/ha),

rb = soil bulk density (g/cm3) Default value

d = total depth at which the sample is taken (cm),

% C = carbon concentration.

The annual emission factor in the case of SOC for mineral soil is considered -1.62 $tCO_2/ha/yr$[14].

Measurement of Pneumatophores[15]

Pneumatophores of mangrove species can be significant structures and biomass, and unlike the stilt roots, these parts the stilt roots these parts are not included in the allometric equation of the biomass of live trees. Pneumatophore density will be determined by counting their numbers in micro plots within or immediately adjacent to the main sampling plot.

A common micro-sized sampling plot of 50*50 cm^2 is considered but the micro plot size can range from 30*30 cm^2 to 1*1 m^2. To determine biomass (Kg), pneumatophores should be collected from outside any permanent sample plots. All pneumatophores within the plot should be counted, and 50-100 samples should be collected. The samples should cover the observed size distribution and be cut at ground level. Obtain the dry mass of each pneumatophore in the laboratory and calculate the average.

***Biomass for pneumatophores (Kg)** = Average dry mass of sampled pneumatophores * number of pneumatophores in the micro plot.

***Carbon in the pneumatophore component (Kg C/m^3)** = (Estimated biomass of the pneumatophores* Carbon conversion factor (0.39))/ area of the plot (m^2)

Development of Final Project Description

The project description from the approved proposed project program using the VCS Project Description Template (Version 4.2) with the relevant sections complete, as set out in the VCS Standard (Version 4.4), will be submitted in the final stage. The following sections will be elaborated on in the final Project Description document:

[14]https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands_Supplement_Entire_Report.pdf
[15] Howard, J., Hoyt, S., Isensee, K., Telszewski, M., & Pidgeon, E. (2014). Coastal blue carbon: methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrasses.

Project Details

The Sectoral Scope and Project Type, justifying how the project is eligible under the scope of the VCS Program, details regarding the project proponents, evidence of project ownership, and duration of the project. This section shall also provide further information indicating the scale of the project and the estimated annual GHG emission reductions or removals for the project crediting period. Further, the project activities (including the technologies or measures employed) and how they will achieve net GHG emission reductions or removals will be elaborated. The project location and geographic boundaries, including a set of geodetic coordinates along with the KML files, will be provided. Conditions existing prior to project initiation will also be demonstrated in the final PD; this shall include the present and prior environmental conditions of the project area, including appropriate information on the climate, hydrology, topography, relevant historical conditions, soils, vegetation, and ecosystems. Other details for the project, such as compliance of the project with all and any relevant local, regional, and national laws, statutes, and regulatory frameworks, Participation under Other GHG Programs, any other forms of credits associated, additional information related to the project – leakage management, any commercially sensitive information, contributions of this project towards achieving SDGs will be compiled in the project details.

Safeguards

Any potential adverse environmental and socio-economic impacts arising from the project and the steps taken to mitigate them will be summarized in this section. This section will also include details of the local stakeholder consultations (e.g., dates of announcements or meetings, periods during which input was sought) conducted during the project. If applicable, any environmental impact assessments carried out with respect to the project will be included in this section. As this project falls under the category of AFLOU, AFOLU-Specific Safeguards will also be listed. Further, an action taken report on any comments received during the public comment period will be delivered.

Application of Methodology

This section shall describe and elaborate upon the methodology and related tools adopted for this study. In addition, justification regarding the applicability of the methodology will also be provided. In this section, the final project boundary will be defined, and relevant GHG sources, sinks, and reservoirs for the project and baseline scenarios shall be identified. Following which, the baseline scenario shall be identified in accordance with the procedure set out in the applied methodology and any relevant tools. The final PD shall demonstrate the additionality and the tools selected to demonstrate additionality (e.g., investment analysis or barrier analysis in the case of the CDM Tool for the demonstration and assessment of baseline, followed by project activity penetration by VMD0052 tool for additionality). Further, the deviations if any, will be demonstrated as well.

Quantification of GHG Emission Reductions and Removals

The procedure for quantification of baseline emissions and removals in accordance with the applied methodology will be described in this section. Quantification of project emissions, removals in accordance with the applied methodology, and any leakage during the project will be described. Finally, the net GHG emission reductions and removals following the equations from the selected methodology will be summarized in the desired format as in the VCS template.

Monitoring

A table with all data and parameters that are determined or available at validation and remain fixed throughout the project crediting period will be provided in this section. Further, a monitoring plan highlighting the methods for measuring, recording, storing, aggregating, collating, and reporting data and parameters will be formulated. The plan shall also include procedures for calibrating monitoring equipment, the organizational structure, responsibilities, and competencies of the personnel that will be carrying out monitoring activities.

Development of Monitoring Report

The next step for validation and verification involves the project proponent submitting documentation such as the Monitoring Report and others (e.g., Supporting documents) as required by Validation Verification Body (VVB). The monitoring report will be prepared as per the instruction and prescribed template by VERRA. The report shall include all the relevant information to describe the project, including its scope, details of the project proponent, geographic information of the project location, duration of the project, crediting period, and selected methodology. Further, AFLOU-related safeguards will be detailed. The Monitoring Report shall describe the implementation status of the project activity, where applicable, details regarding the leakage and non-permanence risk factors, etc. Methodology deviations applied during this monitoring period will also be listed and explained. All data and parameters that are determined or available at validation and remain fixed throughout the project will be listed in this report. The summary of the quantified baseline emissions and/or removals, providing sufficient information to allow the reader to reproduce the calculation, will be provided in this report. Electronic spreadsheets shall be used as an appendix to facilitate the verification of the results.

Development of the Non-Permanence Risk Report

The project shall align with the VCS AFOLU Non-Permanence Risk Tool v4.0 and subsequently develop the non-permanence risk report. The procedures for conducting the non-permanence risk analysis and buffer determination required for AFLOU projects, as listed in the 'VCS Risk Report Calculation Tool' will be followed. The risk analysis shall be conducted for the risk factors as listed in the above-mentioned tool, i.e., internal risks, external risks, and natural risks, and further into the sub-categories such as project management, financial viability, and community engagement. The project shall be evaluated against each of the risk factors in each category and sub-category as set out in sections 1, 2, and 3 of the Non-Permanence Risk Report Tool as well as the Report template. The evaluation values will assign a risk score for each risk factor following the calculation formulas to determine the risk rating. An overall risk rating percentage shall be determined based on the rating from each risk category.

The project will also incorporate the aspect of assignment and release of buffer credits. The Project Proponent shall sign legally binding contracts as per the institutional mechanism to transfer the benefits of credits for a period of 30 years. The institutional mechanism and timely flow of funds shall ensure the project's longevity for 30 years as per the VERRA non-permanence tool. The buffer credits associated with the project may be released over time as an incentive for continued verification and to recognize that certain project risk decrease.

Roles and Responsibilities

Roles and Responsibilities of GEC

- GEC shall be the project proponent.
- GEC shall provide data regarding existing mangrove species plantations of 2021-22, 2022-23, and 2023-24 and facilitate linkage with Gram Panchayats and the Communities.
- GEC shall facilitate TERI in primary and secondary data collection and monitoring systems such as sample plots and capacity building through the entire crediting periods of the project.
- GEC shall ensure that the ERs generated through this project will not be double counted under any other national-level commitment and project.

Roles and Responsibilities of VNV

- VNV will act as a funding partner.
- Support TERI in identifying the most suitable methodology in the VERRA mechanism.
- VNV shall register the project under Verified Carbon Standard (VERRA Registry).
- Conduct validation and verification of the project by appointing a third-party independent assessor.
- Undertake all the required actions on the VERRA platform.
- VNV shall conduct the transaction of carbon credits.

Roles and Responsibilities of TERI

- TERI shall act as a Carbon Development Expert.
- TERI shall identify the most suitable methodology in the VERRA mechanism for developing the carbon finance project.
- TERI, in coordination with VNV, shall register the project under Verified Carbon Standard (VERRA Registry).
- TERI, in coordination with the VNV, shall conduct validation and verification of the project by appointing a third-party independent assessor.
- TERI, in coordination with VNV, shall also provide overall facilitation for the sale of carbon credits at its discretion.
- TERI shall ensure to comply with the procedural requirements of the selected carbon market standard as well as the emission attribute adjustments that need to be made in national registries.

Other responsibilities will be as follows:

- TERI shall assist in the collation of all the data required as per standard and methodology in coordination with GEC on the number of trees and species planted in the year 2021-22, 2022-23, and 2023-24 along with their geo coordinates.
- TERI shall make efforts to identify cluster groups and develop institutional mechanisms.
- TERI shall assist in capacity building of identified stakeholders on carbon stock assessment and development of 'Project Description (PD)'.
- TERI shall assist in capacity building of the stakeholders on the preparation of the 'Monitoring Report (MR)'.
- TERI shall support the review of progress over time and the development of MR and validate PD and MR.
- TERI shall assist in the verification process.

Operational mechanism

Progress will be tracked against the engagement work plan provided in this inception report. An internal mechanism will be developed where the project execution team will be working in close collaboration with experts. The status report will be released to VNV Advisory.

Reporting mechanisms involve the collection and circulation of vital project information to keep stakeholders informed about actual performance via status reports, setbacks, accomplishments, risks, and resource utilization.

Apart from sharing the status report, a discussion will be held to provide the plan for next month and also address any issues/concerns.

These reports will, at a minimum, cover the following topics:

- Key activities carried out during the reporting period
- Key milestones achieved during the reporting period, if any
- Planned activities in the next reporting period
- Pending tasks and interventions required from stakeholders
- Key issues, if any

The following are the points of contacts for the project that would look into the day-to-day working and execution of the project within the stipulated timeframe. For the purposes of the project execution, in case there are any risks and issues that need immediate attention, the following contact can be used to resolve them.

Sl No.	Points of Contacts TERI (The Energy and Resources Institute)
1	Dr. J V Sharma, Senior Director
	Land Resources Division
	E-mail- jv.sharma@teri.res.in
	Contact No- +91-9766037493
2	Dr. Syed Arif Wali, Senior Fellow, Area Convenor
	CSLM, Land Resources Division
	E-mail- syed@teri.res.in
	Contact No- +91- 8826280073

Milestones /Timelines

S. No.	Item of Activity (work)	1st Year				2nd Year				3rd Year				4th Year			
		Quarters															
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
1	Consultation with the Project Proponent for developing carbon finance project																
2	Identification of Funding Agency																
3	Signing of MoU																
4	Preparation of Data Collection Formats																
5	Selection of Institutional Mechanism																
6	Stakeholder consultation, Training and Capacity building on 3 pools of carbon and Draft PD Development																
7	Listing of The Draft Project Description																
8	Validation of the Project and Registration of Final PD																

S. No.	Item of Activity (work)	1st Year				2nd Year				3rd Year				4th Year			
		Quarters															
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
9	Measurement of carbon pools																
10	Development of Monitoring Report and Submission of Draft MR																
11	Verification of the Project followed by addressing the comments and registration																
12	Issuance of VERs																