Deendayal Port Authority
(Erstwhile :Deendayal Port Trust)

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Office of the Dy.CE & EMC (i/c),
ANNEX, Administrative Office
Gandhidham - Kutch
Pin – 370 201.

ISO 9001 – 2015 &
ISO 14001 –2015 Certified Port

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EG/WK/4751/Part (Revamping – EC onwards /108 **Dated:** 07/04/2025

To,
Director (Environment) & Member Secretary
Gujarat Coastal Zone Management Authority,
Forest & Environment Department,,
Govt. of Gujarat,,
Block No.14, 8th floor,
Sachivalaya, Gandhinagar – 382 010.

Sub: "Augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA Through Modernisation of Existing Pipeline Network at Oil Jetty Area, Deendayal Port Trust, Kandla – **Pointwise Compliances of the conditions stipulated in CRZ recommendation.**

Ref.:
1. CRZ Recommendation letter issued by the Director (Environment) & Member Secretary, GCZMA, Forest & Environment Department, GoG dated 25/08/2022
2. DPA letter no. EG/WK/4751/Part (Revamping – EC onwards /101 dated 29/07/2024
3. DPA letter no. EG/WK/4751/Part (Revamping – EC onwards /22 dated 03/02/2025

Sir,

It is requested to kindly refer above cited reference for the said subject.

In this connection, it is to state that, the Gujarat Coastal Zone Management Authority vide above referred letter dated 25/8/2022 had recommended the subject of Deendayal Port Authority. Subsequently, the MoEF&CC, GoI had accorded the Environmental & CRZ Clearance vide letter dated 01/01/2024 for the above, project activities recommended by the GCZMA.

Now, Environmental and CRZ Clearance has been accorded by the MoEF&CC, GOI vide letter dated 01/01/2024 as per the recommendation of the GCZMA.

In the said clearance letter in the Para B. Sub IX Miscellaneous under condition no. iv MoEF&CC, GOI has stipulated the condition that, " *The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal"*

Further, in the said clearance letter in the Para A in specific conditions mentioned at Sr no. ii it is mentioned that "*All the recommendations and conditions specified by the Gujarat State Coastal Zone Management Authority (GCZMA) vide letter No ENV-10-2021-41-T dated 25th August, 2022 shall be complied with"*

.....Cont.....

Accordingly, point wise compliance of the conditions stipulated in the GCZMA recommendation has been prepared for onward submission.

Additionally, compliance report of the stipulated conditions mentioned in the EC & CRZ Clearance granted by the MoEF & CC, GOI dated 01/01/2024 (Period October 2024 to March 2025) is uploaded in the PARIVESH 2 PORTAL of the MoEF&CC,GoI along with the point wise compliance of the conditions stipulated in the GCZMA .

Further, we are submitting herewith soft copy of the point wise compliance of the conditions stipulated in the GCZMA through e-mail in ID: gczma.crz@gmail.com

This has the approval of Chief Engineer, Deendayal Port Authority.

Yours faithfully,

02/6/25

Encl.: As above

Dy. Chief Engineer & EMC(I/c)
Deendayal Port Authority

Copy, to:

1)Shri Amardeep Raju,
Scientist E Ministry of Environment, Forest and Climate Change,
& Member Secretary (EAC – Infra 1),
Indira Paryavaran Bhawan,
3rd Floor, Vayu Wing, Jor Bagh Road,
Aliganj, New Delhi- 110 003;
E-mail: ad.raju@nic.in

COMPLIANCE REPORT (for the period up to March 2025)

Subject: Status of Compliance with the conditions stipulated By Gujarat State Coastal Zone Management Authority, Gandhinagar, in CRZ Recommendation Letter granted for "**Augmentation of liquid handling capacity from 8 MMTPA to 23.8 MMTPA through modernization of existing pipeline network at oil jetty area of Deendayal Port Trust** ".

CRZ Recommendations: Letter No. ENV-I0-2021-41-T dated 25 August 2022, of Director (Environment) & Member Secretary, GCZMA, Forest & Environment Department, GoG.

**Note: Based on the recommendation of* the GCZMA, MoEF&CC, GoI *had accorded Environmental & CRZ Clearance vide letter dated 01/01/2024*

Sr. No.	Conditions in CRZ Recommendation Letter	Compliance
	Specific Conditions	
1	Project proponent unit shall scrap of existing 125 pipelines and remaining 42 pipelines may be maintain while 84 new pipeline will be laid.	It is assured that due care is being taken while scrapping of existing 125 pipelines.
2	Project proponent shall carry out proposed activities, replacement & revamping of existing pipeline network at oil jetty area and no new land shall be use.	Activities of replacement & revamping is being carried out at the existing oil jetty area and no new land is used.
3	Project proponent shall obtain consent to establish for their proposed expansion from 8 MMTPA to 23.08 MMTPA from GPCB.	The Consent to Establish (CTE) from the GPCB had already been obtained vide CTE amendment (CTE 115467) granted by the GPCB vide letter no. PC/CCA-KUTCH-812(5)/GPCB ID 28494/609592 dated 23/12/2021 with a validity period 11/2/2026 A copy of same had already been submitted along with compliance report submitted on 29/07/2024.
4	Project proponent shall not carry out any construction activities or any activities till obtaining CRZ Clearance from MoEF&CC, new Delhi	DPA has already received CRZ recommendation from GCZMA vide letter no. ENV-10-2021-41-T cell dated 25/08/2022. Additionally, DPA has also received EC and CRZ clearance from MoEF&CC vide file no. letter F. No. 10-26/2018-IA-III dated 01/01/2024.
5	Project Proponent shall adhere to all recommendation given by MECON Ltd. Ranchi, Jharkhand.	It is assured that, recommendation given by MECON Ltd. Ranchi, Jharkhand is being adhered to
6	Project Proponent shall adhere to undertaking dated 25.01.202	It is assured that, undertaking dated 25/01/202 being adhered to.
7	Project Proponent shall carry out Mangrove Plantation in 50 Ha area with consultant of concern District Forest Office of District and Gujarat Ecology commission. Necessary report in this regard may be submitted periodically to this office.	DPA has assigned the work for the "Mangrove Plantation in an area of 50 Ha for the Deendayal Port Authority to GUIDE, bhuj vide work order dated 10/06/2024. A copy of final report is attached herewith as **Annexure A** Additionally, as per the As per the directions of the GCZMA and MoEF&CC GoI, to date, DPA has undertaken a Mangrove Plantation in an area of 1600 Hectares since the year 2005
8	Project Proponent shall strictly adhere to all conditions of Terms of Reference issued by MoEF&CC, GOI vide F.No. 10-26/2018-IA-III dated 14/06/2018.	DPA has already received the EC and CRZ clearance from MoEF&CC vide file no. letter F. No. 10-26/2018-IA-III dated 01/01/2024. A copy of same had already been submitted along with compliance report submitted on 29/07/2024
9	Project Proponent shall strictly adhere to all conditions of Amendment Terms of Reference issued by MoEF&CC, GOI vide F.No. 10-26/2018-IA-III dated 11/06/2020.	

ANNEXURE A
Final Report – Mangrove Plantation in 50 ha area

FINAL REPORT

for the Project entitled

Mangrove Plantation in an area of 50 Hectares for Deendayal Port Authority, Kandla

(As per EC & CRZ Clearance Dt.01.01.2024. Annexure-B, Specific condition No.7)

DPA Work order No. EG/WK/4751/Part (Revamping-EC onwards)/69. Dt. 10.06.2024

Submitted by

Gujarat Institute of Desert Ecology

Mundra Road, Bhuj-370 001

Dist: Kachchh, Gujarat, India

Submitted to

Deendayal Port Authority
Gandhidham- 370201
Dist: Kachchh, Gujarat-, India

February
2025

Gujarat Institute of Desert Ecology

Certificate

This is state that the Final Report for project entitled "**Mangrove Plantation in an area of 50 Hectares for Deendayal Port Authority, Kandla**" has been prepared in line with the Work order issued by the Deendayal Port Authority Vide. Ref. No. EG/WK/4751/Part (Revamping-EC onwards)/69. Dt.10.06.2024. In order to comply with the stipulated condition of the EC & CRZ Clearance dated 1/1/2024 read with CRZ Recommendation dated 25/8/2023 - Condition no.7.

The work order is for a period of Nine months (10.06.2024 - 09.03.2025) for the above-mentioned study.

Authorized Signatory

DIRECTOR
Gujarat Institute of Desert Ecology
Bhuj - Kachchh.

Gujarat Institute of Desert Ecology Bhuj

Institute

PO. Box No. 83, Opp. Changleshwar Temple, Mundra Road, Bhuj (Kachchh) - 370 001, Gujarat (India)
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Project Team

Project Coordinator: Dr. V. Vijay Kumar, Director

Project Personnel

Principal Investigator

Dr. B. Balaji Prasath, Senior Scientist

Co-Investigator

Dr. Kapilkumar Ingle, Project Scientist-II

Team Members

Dr. L. Prabhadevi, Advisor

Mr. Dayesh Parmar, Senior Scientific Officer

Mr. Ketan Kumar Yogi, Junior Research Fellow

Contents

Snapshot of the Project," Mangrove Plantation in an area of 50 Hectares for Deendayal Port Authority, Kandla"

S.No	Components of the Study	Remarks
1	Deendayal Port letter sanctioning the project	EG/WK/4751/Part (Revamping-EC onwards)/69, dated 10.06.2024
2	Duration of the project	Nine months (10.06.2024 - 09.03.2025)
3.	Location of Mangrove Plantation Site	The location finalized for mangrove plantation is shown in Figure 1. Suitable site was selected based on water and sediment quality, intertidal fauna, and propagules.
4.	Total Area	50 Hectares
5.	EC & CRZ Clearance Reference	As per EC & CRZ Clearance Dt. 01.01.2024, Annexure-B, Specific condition No. 7
6	**Field Studies**	
6a	Site Overview	Inspection to understand site conditions and potential risks (e.g., grazing).
6b	Geographical Patterns	Study existing mangrove species to determine their distribution and identify suitable planting locations.
6c	Landscape Assessment	The stability of the root system of existing mangroves were be examined.
7	**Plantation Techniques**	
7a	Raised Bed Method (Otla Method)	Create earthen mounts to plant 15-30 seeds; suitable for areas with low to moderate water currents.
7b	Transplantation of Nursery Raised Saplings	Grow saplings in polythene bags; nature for 3-4 months before transplanting; higher success rate

1. Background of the study

Mangroves are among the most productive ecosystems, providing various ecosystem services and resources to both the ocean environment and humankind. This unique ecosystem occurs in the tropics and subtropics, where land meets the oceans, often bordering estuaries and backwaters. Mangrove forests have the remarkable ability to rise upward in place or move landward or seaward in response to sea level changes (Woodroffe *et al*. 2016). Mangroves typically grow on wet, muddy substrates with minimal water fluctuations, specifically in the mudflat regions of tropical and subtropical areas. These are dense forests of trees and shrubs that are tolerant to salt, usually flourishing in tidal areas. The importance derived from these forests is critical, including coastal protection, biodiversity conservation, and climate change mitigation. All mangroves produce fertilizer from rotting litter fall and root growth deceiving ambient water sediment. Mangrove ecosystems support various plant and animal species, breeding, nursery and feeding grounds for numerous marine and terrestrial organisms. Despite their ecological importance, mangrove forests face different threats such as deforestation, pollution, and climate change. Specific measures have been taken towards conserving these valuable ecosystems including them into biosphere reserves and Ramsar sites.

According to the Forest Survey of India (FSI, 2019), the global mangrove cover is approximately 14.79 million hectares. Asia leads with 5.55 million hectares, followed by Africa with 3.24 million hectares, North and Central America with 2.57 million hectares, and South America with 2.13 million hectares. South Asia has the highest mangrove area, constituting about 6.8% of the world's total mangrove cover. Anthropogenic pressures have reduced global range of these forests to less than even half of their original total cover throughout the globe as mentioned by Ragavan *et al.* (2016) while Singh (2020) observed that almost 75% of the tropical coast has been taken up by mangrove forests. India's mangrove ecosystems are incredibly important, covering around 4,992 km^2, which makes up about 0.15% of the country's total land area. Despite occupying a relatively small fraction of India's geographical area, mangroves are hotspots of biological activity, supporting a wide range of flora and fauna. They help in sequestering carbon, thus mitigating climate change effects. Major mangrove areas in India include the Sundarbans in West Bengal, which is the largest mangrove forest in the world.

The present study on "Mangrove Plantation in an area of 50 Hectares for Deendayal Port Authority, Kandla" is being conducted to comply with the specific conditions outlined in the EC & CRZ Clearance dated 01.01.2024 and CRZ Recommendation condition no. 7 as given in Annexure B.

1.1. Mangrove status in Gujarat and Gulf of Kachchh

Gujarat state has the longest coast (1650 km^2) with largest coastal area (28,000 km^2) under cover of mangroves. Gujarat mangrove ecosystem is the second largest after Sundarbans in West Bengal (ISFR 2019). Though contentious, around 15 mangrove species are reported from 13 coastal districts of Gujarat. Of these, the southern coast of Gulf of Kachchh and South Gujarat coast are important for mangrove diversity. The species *Avicennia marina* is the most populous along the Gujarat coast. Along the coastal stretch of Gulf of Kachchh (GoK) has the most considerable mangrove extent of 986 km^2 out of 1140 km^2. Kachchh district, constituting the northern coast (northern shore) of GoK alone has 798 km^2 of mangroves constituting 70% of the whole Gujarat mangroves. Waterlogged mud with low oxygen levels supports such vegetation in tropical and subtropical regions. In the Kachchh coast has various habitats such as expansive mudflats and small sandy beaches with different physico-chemical variables like extreme salinity temperature inundation factor. This vibrating ecosystem can allow the species to thrive and exhibit many adaptive modifications.

Biodiversity-oriented planting schemes aim to boost species richness through ongoing plantation and meticulous monitoring activities. Restoring mangrove ecosystems with dominant species like *Avicennia marina, Ceriops tagal,* and *Rhizophora mucronata* plays a crucial role in enhancing species diversity. By increasing the variety of plant species, these schemes not only create a more resilient and productive ecosystem but also help in providing essential resources and services to local populations, such as fish breeding habitats, wood, and other forest products. Continuous planting and monitoring ensure that these ecosystems remain healthy and sustainable, benefiting both the environment and the people living in coastal regions. Mangrove biodiversity seeks attention towards such spots on the Kachchh coast, which require supplementation of plant cover at selected sites. For instance, although successful efforts at restoring mangroves exist, the presence of *A. marina* alone in most parts corroborates the role of high salinity of the water because of limited fresh water influx annually. The arid coastal conditions lack of

continuous freshwater flow through the river inhibits the spread and growth of mangroves which are constantly exposed to tidal inundation. The plantation of mangroves as well as creation of awareness regarding the importance of mangrove and their ecosystem services are the crucial tasks to avoid such loss.

1.2. Rationale of the project

Deendayal Port Authority (DPA) has been one of India's largest ports in terms of cargo volume handled. Being located in Gujarat state on the northwest coast of India, the port is one of the biggest creek-based ports in India. In India, it is one among twelve major ports and situated at Gulf of Kachchh's tail end, Gujarat's western part. The greatest advantage of this location is a high semi-diurnal tidal range of about 6 to 7 meters which allows for sufficient draft in the dredged channels at the Port. DPA has been and still is undergoing continuous development and expansion particularly over recent times and is located in the creek environment encompassing mangroves (193.1 km^2) and mudflats (312.9 km^2).

Over the last seven decades, it should be noted that due to these vast resources available at its doorstep; the port authorities have a desire to conserve, protect and enhance these coastal habitats. The coastal belt in and around Kandla region is characterized by a network of creek systems and mudflats which are covered by sparse halophytic vegetation like scrubby to dense mangroves, creek water and salt encrusted land mass which forms the major land component. The surrounding environment in a radius of 10 km from the Port is mostly built-up areas consisting salt works, human habitations and Port related structures on west and north, creek system, mangrove formations and mudflats in the east and south.

Deendayal Port as part of the expansion of the infrastructure facility has significant movements of materials and people within the area and construction activities as well. Additionally, as part of the environmental policy intended to accomplish 50 ha mangrove plantation and the task is entrusted with the Gujarat institute of Desert ecology, Bhuj, Kachchh district Similar efforts towards conserving and preserving mangrove cover in the prospective areas have been implemented by the Deendayal Port Authority (DPA) to maintain numerous unheralded ecological services by these marine plants. Total mangrove plantation till date by DPA through several implementing agencies at Sat Saida Bet, Nakti Creek and Kantiyajal.. To ensure the project follows the

most contemporary standards and practices in the field. In accordance with the CRZ Recommendation Condition, Mr. Nischal Joshi of the Gujarat Ecology Commission (GEC) was consulted for his expert opinion during the initial stages of the work.

2. Objectives

Within the overall objective of mangrove plantation in the DPA port limits the following activity wise objectives are envisaged.

- Assess the technical suitability of the proposed land for mangrove plantation
- Assess the physico-chemical properties of soil and nearby water and tidal pattern in the proposed plantation site.
- Formulate site specific plantation strategy and execute it with the adopting appropriate techniques.

3. Study Area

The location finalized for mangrove plantation is shown in Figure 1, as per their suitability including water and sediment quality characteristics, occurrence of intertidal fauna, availability of propagules, signs of natural regeneration etc. Further, based on the water quality characteristics reported elsewhere, the site is better choice for the plantation of mangrove species, *A. marina*. In the studies conducted earlier, the salinity levels of this area is reported to be ranging between 35 - 40 ppt which is suitable for the selected species. The pH of the pour water is recorded to be in the range of 6.0 - 8.5. In addition to the above said criteria, plantation in general should be established in Intertidal areas where a good tidal flushing is happening atleast 15 days in a month.

Figure.1 Proposed location for Mangrove plantation activities at DPA area

4. Methodology

4.1. Field Studies

4.1.1. Site Overview:

- The inspection were provide an overall understanding of the site, not only for the plantation but also for potential risks (such as camel or cattle grazing).
- Accessibility for post-plantation monitoring were be evaluated to ensure ease of assessment.

4.1.2. Geographical Patterns:

- Existing mangrove species in the area were be studied to understand their presence and distribution.
- Geographical patterns were be analyzed to identify suitable locations for planting mangroves.

4.1.3. Landscape Assessment:

- Rainwater runoff into the creeks and the influencing zones were be observed to assess its impact on the mangrove ecosystem.
- The stability of the root system of existing mangroves were be examined.
- Sources of freshwater within the area were also be considered.

4.2. Plantation Techniques

Three methods preferred for the sake of mangrove plantation which were be as follows in this study period:

4.2.1. Raised bed method (Otla method)

- This is popular method of mangrove plantation in Gujarat useful for a few species such as *A. marina* and provide better result compare to other methods.
- In this method, earthen mounts of a specific height were be made which support to plant 15 to 30 seeds/ propagules.
- This method is suitable in the areas where the current of water is low and moderate (Plate 1).

4.2.2. Transplantation of nursery raised saplings (Poly bag method).

- This technique has higher success rate unlike other methods and therefore, nursery of the various species is required to grow the saplings (Plate 2).
- This technique is time consuming and laborious compared to direct dibbling and raised bed methods.
- On the open intertidal mudflats, the saplings were be grown in polythene bags through sowing the matured seeds or propagules.
- The saplings were be nurtured 3-4 months before transplantation and after attaining a height 30-45 cm in polythene bags.
- Site specific conditions were determining the number of saplings to be transplanted, however, 2500 saplings per ha is generally followed.
- In some occasions also nursery raised saplings were be used for gap filling and thereby increasing the survival rate of the plants table1.

After being successfully raised in the nursery, saplings between 30 and 45 cm tall should be chosen at different times to be transplanted at the intended location. Below are the specifics of the plantation's sapling height and germination period (plate 3). A total of 46 nursery beds were established, with each bed containing 800 to 1,200 polybags. Each polybag is sown with 3 to 4 seeds, facilitating optimal seedling production (Figures 8-13). In addition, otla raised method, in each bed sown 5 – 6 seeds were raised in plantation site (Figures 15-17)

Table 1: Details of sapling for plantation

Species	Germination period (days)	Germination percentage	Height (cm)of saplings
Avicennia marina	6-10	70-80	30-45
Rhizophora mucronata	30-35	50-60	60

With these methods, the extra seeds were also spreaded in the plantation area where the older trees are present and generally the area where natural regeneration of seeds happens.

5. Site visit

Before the initiation of mangrove plantation activity, a through pre-project survey was conducted to examine the proposed plantation site. In this survey, the crucial technical factors like land elevation, tidal pattern, physical and chemical properties of soil and water (by laboratory analysis), access to the site, level of protection such as cattle grazing, human disturbance and other potential risks, etc. were observed. This survey helps to decide the suitability of site for mangrove plantation in DPA port limit.

5.1. On-site observations

- The indicators of regular flooding of site by tide water was observed in on-site visit. The site area was wet and with plenty of mud which is required for plantation.
- There was no presence of very hard, dried soil surface in the site was observed anywhere.
- The presence of a few natural mangrove (*A. marina*) trees was observed around and in the plantation site which denotes the site is suitable for the plantation.
- The presence of crab holes and mudskippers holes is the indicator that the soil of the site is soft and regularly get wet due to tides.
- The pneumatophores of nearby mangroves were found in the nearby area which indicate that there is no sediment deposition and buried pneumatophores in this area.
- Nearby area also shows the presence of halophytic/ salt marsh plants such as *Sesuvium* and also *Salicornia* nearby creek.
- The *Sesuvium* leaves were green and fresh, also not thicker which represent the good condition of the site.
- The presence of sub-creek system may ensure the availability of tidal water which were be primary need of the plantation.
- A few natural regeneration plants were also observed in the site.
- The presence of the jackal foot marks observed which denotes the overall area have a good ecosystem and where the jackal food (crabs) sources are available.

5.2. Analysis of water and sediment samples

5.2.1. Water analysis

The water samples were collected from the plantation site in pre-cleaned polyethene bottles and rinsed with sample water, and transported to the laboratory in icebox for further analysis such as pH analysis by pH meter, salinity was determined by refractometer. The pH of water sample was found 7.25 and salinity 18 psu. Although there is no domestic freshwater source, and tidal water salinity generally higher, due to the rainy season the salinity shows lower values. However, the lower salinity is also in favour of germination of mangrove seeds.

5.2.2. Sediment/ soil analysis

Sediment samples were collected by using a non-metallic plastic spatula from random locations; three from each transect to cover the whole study area. The collected samples were air-dried at room temperature (Jackson, 1958), homogenized using an agate mortar and pestle, sieved through a standard sieve of 2 mm mesh (Tandon, 2005). The particles with size less than 2mm were retained in pre cleaned plastic bottles for further analysis for various parameters. Total Organic Carbon (TOC), pH, texture, bulk density, etc were analysed.

Texture of sediment: The texture of soil/sediment is one of the key factors when choosing a site for plantation mangroves. Generally, mangrove ecosystems typically have the types of soils which includes muds or clay or sandy mud, etc. The texture of soil significantly impacts the survival and growth of mangroves. The presence of clay texture which makes soil muddy may expected to offer a stable base for mangrove roots to flourish under tidal conditions. Thus, evaluating the soil conditions at the plantation site is crucial before starting mangrove planting activities. Here we collected 3 samples, and all shows good amount of clay percentage in them which may be favourable for the plantation.

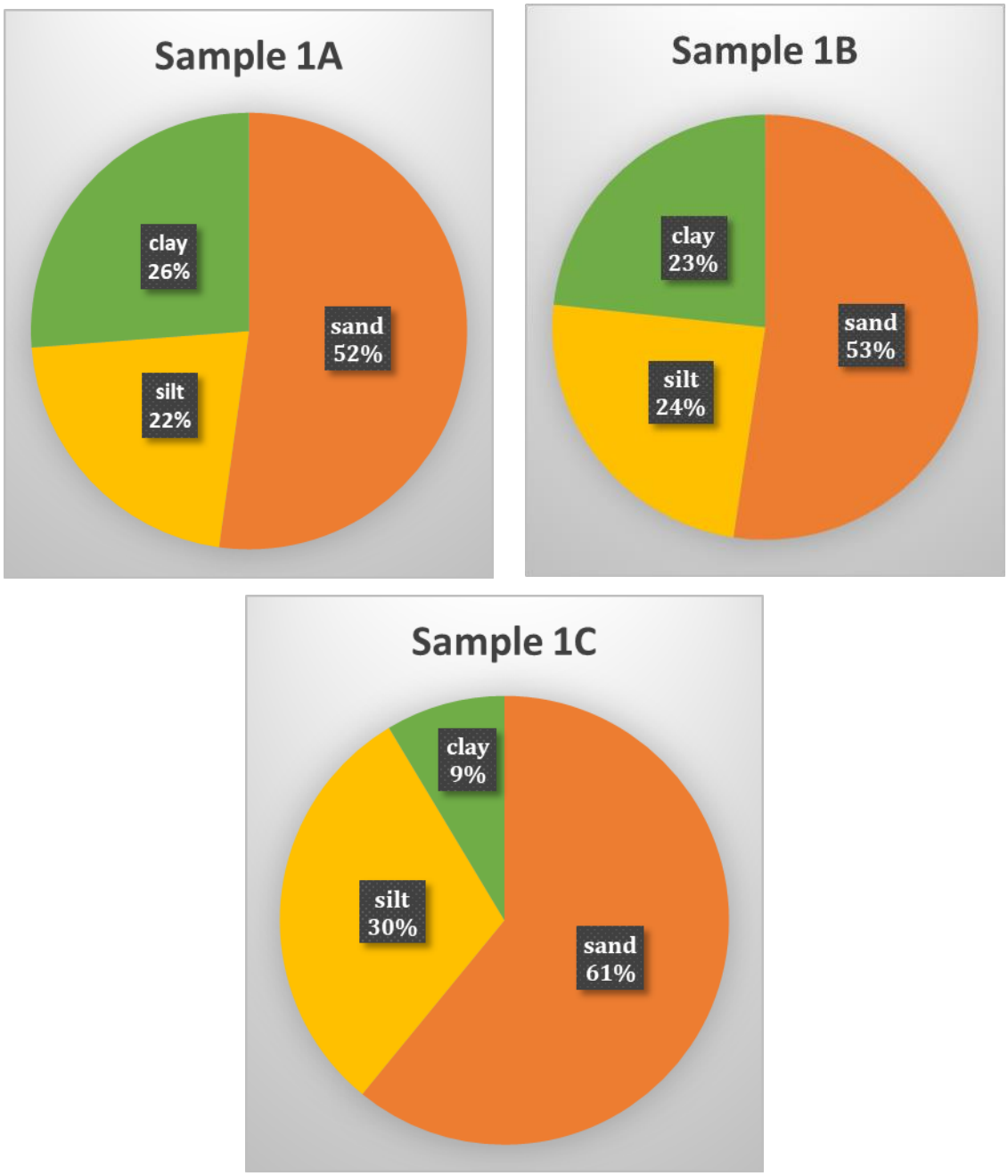

Figure 2: Sediment textural composition in the sampling sites

Bulk density of soil: It refers to the amount of soil organic matter within a given volume of soil. This property can vary significantly and is influenced by the soil's texture, structure, and organic matter content. Soils with high organic matter tend to have lower bulk density, while compacted soils exhibit higher bulk density.

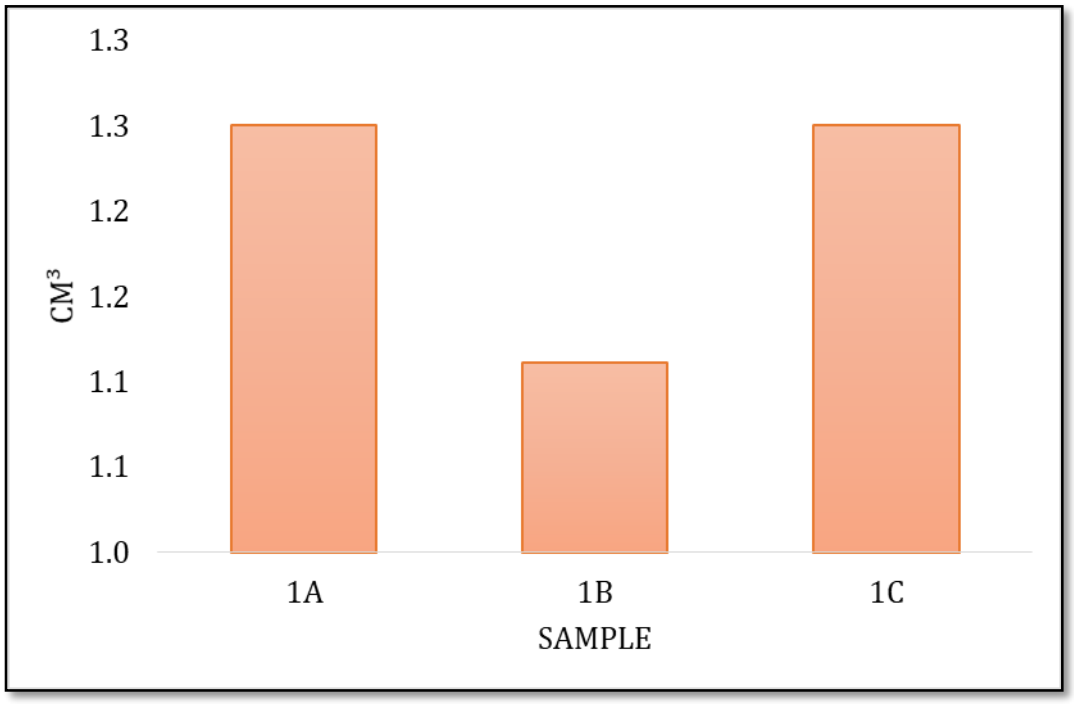

Figure 3: Bulk density of sediment samples

Total Organic Carbon: Organic carbon levels are influenced by living organisms, and the diversity of life forms in mudflats affects the total organic carbon (TOC) estimates. In all samples, the TOC percentage was ranged from 2.7 % to 2.85%

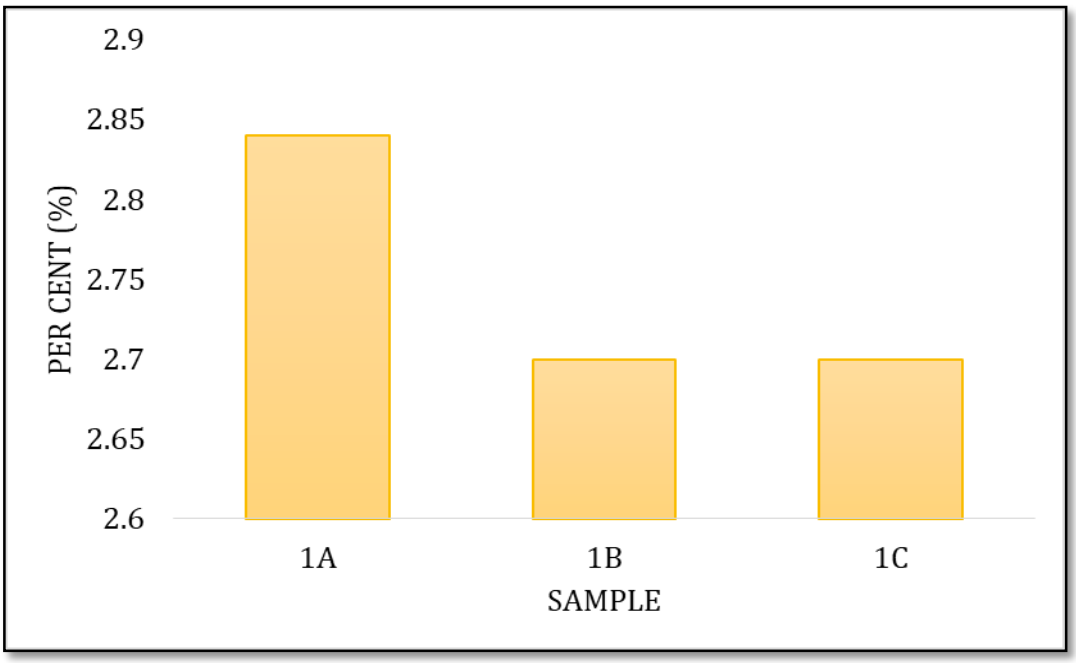

Figure 4: Total Organic Carbon content of sediment samples

Plate 1: Selection of suitable sites for mangrove plantation in DPA area based on sediment characteristics, tidal pattern, cattle grazing etc

Plate 2: Site identification, planning and field observation at mangrove plantation site on July 17th to 31st, 2024

Plate 3: Mangrove Seed Collection at Kandla on 1st to 07th August, 2024

Plate 4: Team involved in collection and separation of healthy mangrove seeds on 8th to 17th August, 2024

Plate 5: Women involved in processing of mangrove seeds on 17th to 25th August, 2024

Plate 6: Preparation and filling of bags for submerged Nursery Development Activity on 25th to 30th August, 2024

Plate 7: Labour Involvement in filling of bags for nursery preparation at Kandla on 25thAugust to 5th September, 2024

Plate 8: Seed sowing of *Avicennia marina* in polybags at nursery at Kandla on 6th to15th September, 2024

Plate 9: Site submerged during high tide on 15th September, 2024

Plate 10: Germination of *A. marina* seeds in polybags and germination during visit of GUIDE team at Kandla on 15th to 25th September, 2024

Plate 11: Nursery of *A. marina* saplings in natural tidal inundation at Kandla on 5th to 25th October, 2024

Plate 12: Insect pests and diseases in *A. marina* leaf and stem in saplings during visit of GUIDE team at Kandla on 25th October to 5th November, 2024

Plate 13: Labour Involvement in Otla bed raised method at Kandla 1st to 07th September, 2024

Plate 14: Seed sowing of *A. marina* in Otla beds at nursery at Kandla on 10th to 25th September, 2024

Plate 15: Germination of *A. marina* in Otla beds observed during visit of GUIDE team at Kandla on 5th to 25th October,

Plate 16: Mangrove Growth of *A. marina* prior to Transplanting from Nursery to Plantation Site by the GUIDE Team at Kandla on 30th November

Plate 17: Labour Participation in Loading Nursery Bags onto Boats for Transportation to Plantation Sites at Kandla on 1st December to 15th December, 2024

Plate 18: Labour Involvement plantation the *A. marina* at Kandla on 1st December, 2024 to 31st January, 2025

Plate 19: Labour Involvement plantation the *A. marina* at Kandla on 1st December, 2024 to 31st January, 2025

Plate 20: Labour Involvement in *A. marina* Plantation during GUIDE Team Visit to Kandla on 15th January, 2025

Plate 21: *A. marina* Plantation during GUIDE Team and DPA Team Visit to Kandla on 15th January, 2025

Plate 22: Mangrove outplanting, including row establishment and saplings placing inside hole, levelling soil surface at Kandla on 10th February, 2025

6. Summary of the Report

The aim of the report is to assess the situation of growing mangrove saplings at DPA Gulf of Kutch. In order to comply with the stipulated condition of the EC & CRZ Clearance dated 1/1/2024 accorded by the MoEF&CC, GoI read with CRZ Recommendation dated 25/8/2022 for "Augmentation of Liquid Cargo Handling capacity from 8 to 23.8 MMTPA through modernization of existing Pipeline network at Oil Jetty area of DPA, Kandla"), DPA assigned work of "Mangrove Plantation in an area of 50 Hectares for Deendayal Port Authority reg.", to GUIDE, Bhuj vide work order dated 10/6/2024.

The DPA has initiated a program for plantation of mangroves to improve these ecosystems within the limits of its port. The general focus of this project is to evaluate mangrove plantation in an area of 50 Hectares for Deendayal Port Authority, site conditions for planting, study the soil and water characteristics, and formulate and execute a site-specific planting plan utilizing nursery grown transplant, otla method and other forms. The objective is to increase the mangrove species, improve the resilience of the ecosystem and provide the local population with valuable resources and services, all while ensuring the sustainability of mangrove cover over the long term. The increased ecological stability and productivity of the region, and provide necessary resources and services to the local and marginalized communities throughout the work in a selected, defined and timetabled manner to observe the speed of the work done. The Mangrove Plantation in an area of 50 Hectares of *Avicennia marina* and *Rhizophora mucronata* at scientifically identified location (Satsaida bet) is completed.

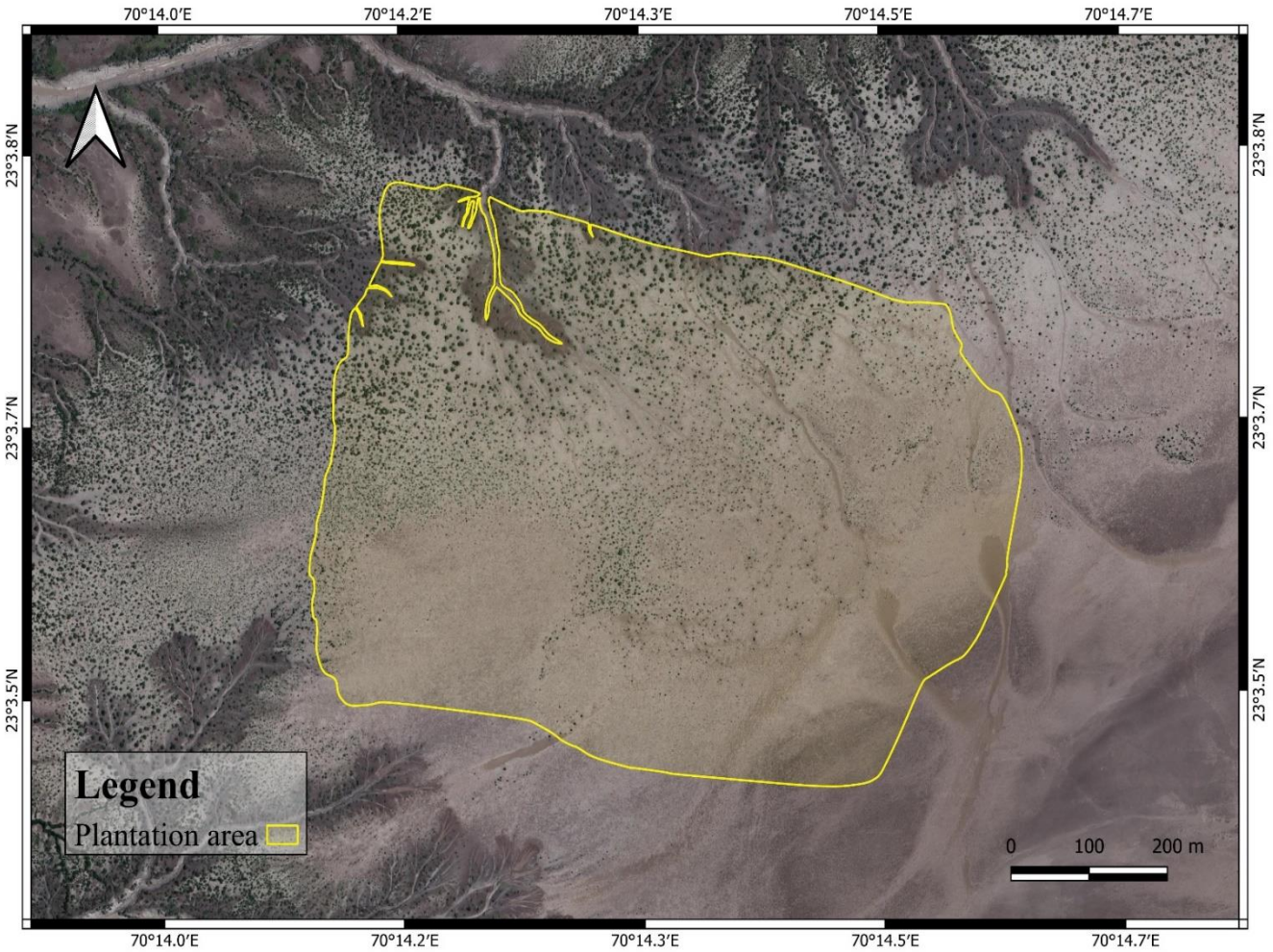

Figure 5: Mangrove plantation site area at Kandla, Gujarat, India

Plate 24: Growing saplings during GUIDE Team Visit to Kandla on 10th February, 2025

Plate 25: Labour Involvement plantation the *Rhizophora mucronata* at Kandla on 31st January to 28th March, 2025

Table: 2 GPS Points of Mangrove Project Site at Kandla, Gujarat, India

No	Point No.	Longitude	Latitude
1	**K-18**	70.243	23.062
2	**K-19**	70.244	23.06
3	**K-23**	70.243	23.058
4	**K-25**	70.241	23.057
5	**K-27**	70.239	23.057
6	**K-28**	70.235	23.058
7	**K-31**	70.235	23.061
8	**K-33**	70.235	23.062
9	**K-35**	70.237	23.064
10	**K-37**	70.24	23.063

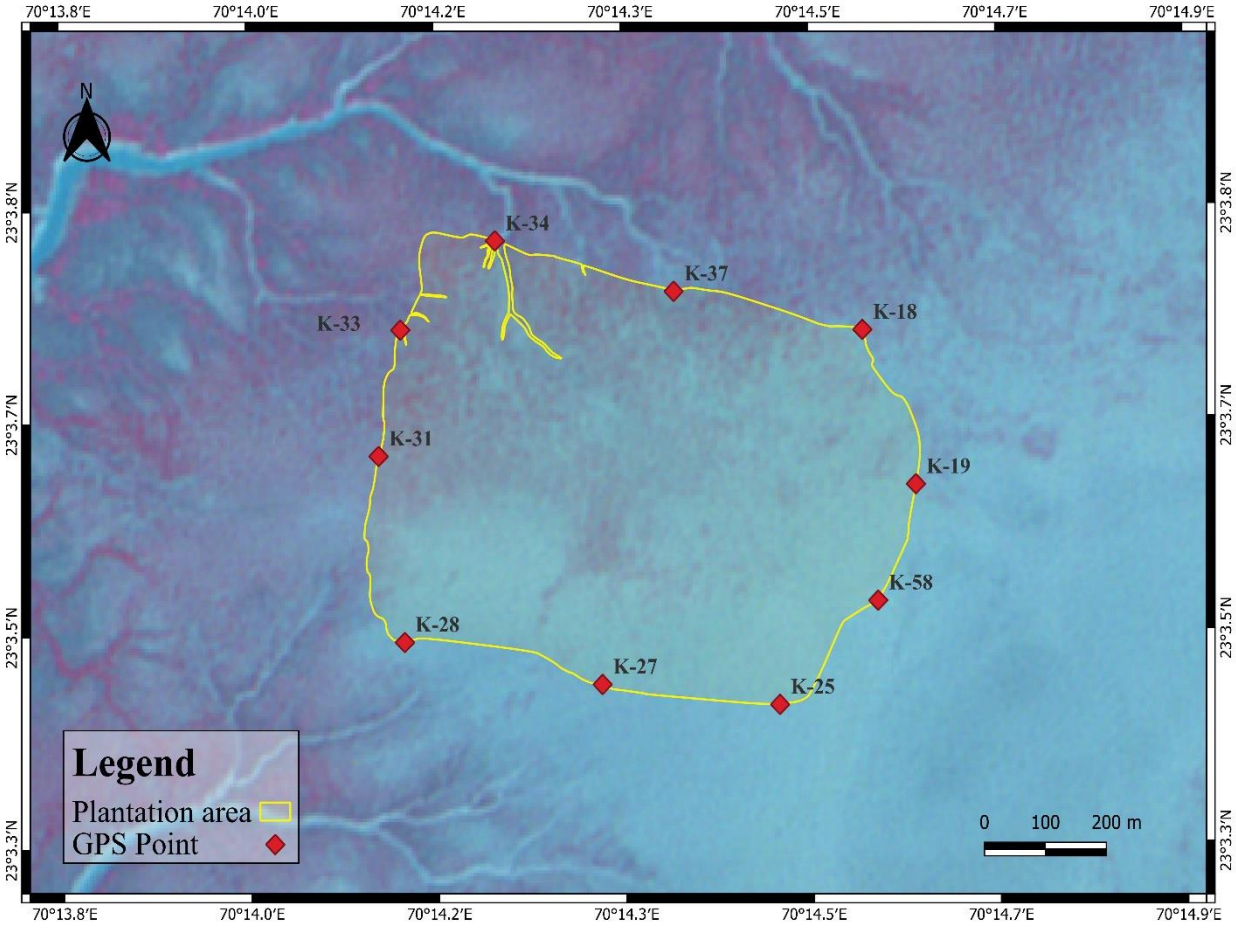

Figure 6: Mangrove plantation site area with GPS location points at kandla, Gujarat, India

7. Future Considerations for Mangrove Plantation

DPA needs to focus on the mangrove plantation project in Kandla. In ensuring that, this report puts forward the steps that need monitoring for the future.

7.1. Carry out regular monitoring of mangrove plantation

The regular monitoring of mangrove plantations is must in the plantation site to ensure growth status of the planted mangroves. It will also help in detection of any signs of disease or damage early. Regular monitoring also helps to understand any threats to mangrove such as potential erosion or grazing etc, also help to protect the local ecosystem and biodiversity. It will useful in the measurement of effectiveness of conservation efforts.

7.2. Regular gap filling to be done

Maintenance of the plantation is crucial for its continued success. Regular upkeep is needed, including filling in gaps where plants may have failed to establish. In addition to *Avicennia marina*, it's important to plant a variety of mangrove species to boost biodiversity. This increased diversity enhances the ecosystem's resilience to environmental changes, such as fluctuations in salinity, temperature, and sea level rise. Regular monitoring and management practices ensure the plantation's long-term health and ecological stability, contributing to the protection of coastal areas and marine life habitats.

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