DEENDAYAL PORT AUTHORITY
(Erstwhile: DEENDAYAL PORT TRUST)

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EG/WK/4751/Part (Stage II)/ 116

Dated: 09/12/2025

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: "Development of Integrated facilities (Stage II) within the existing Deendayal Port Trust (Erstwhile Kandla Port Trust) at District Kutch, Gujarat (1. Setting up of Oil Jetty no. 7, 2. Setting up of Barge Jetty at Jafrabadi, 3. Setting up of Barge Port at Veera, 4. Administrative office building at Tuna Tekra, 5. Road connecting from Veera Barge Jetty to Tuna gate by Deendayal Port Authority (Erstwhile Deendayal Port Trust)"– **Pointwise Compliances of the conditions stipulated in CRZ Recommendations req.**

Ref.: 1) GCZMA CRZ recommendation vide letter No. ENV-10-2015-251-E (T cell) dated 29/06/2016
2) DPT letter EG/WK/4751/Part (Remaining 3 facilities)/53 dated 29/07/2021.
3 DPT letter EG/WK/4751/Part (Remaining 3 facilities)/144 dated 08/02/2022
4) DPT letter EG/WK/4751/Part (Stage II)/141 dated 01/07/2022
5) DPT letter EG/WK/4751/Part (Stage II)/292 dated 03/05/2023
6) DPT letter EG/WK/4751/Part (Stage II)/371 dated 03/10/2023
7) DPA letter EG/WK/4751/Part (Stage II)/109 dated 09/08/2024
8) DPA letter EG/WK/4751/Part (Stage II)/35 dated 24/02/2025
9) DPA letter EG/WK/4751/Part (Stage II)/43 dated 17/07/2025

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

In this connection, it is to state that, the Gujarat Coastal Zone Management Authority vide above referred letter dated 29/6/2016 had recommended the aforesaid project of Deendayal Port Authority. Subsequently, the MoEF&CC, GOI had accorded the Environmental & CRZ Clearance vide letter dated 19/02/2020

Subsequently, DPA vide letter dated 22(24)/12/2020 has submitted compliance report of the stipulated conditions mentioned in the CRZ Recommendation letter 29/06/2016

..........Cont..........

Now, as directed under Specific Condition No. 28 mentioned in the CRZ Clearance letter dated 29/6/2016 i.e. ***A six monthly report on compliance of the conditions mentioned in this letter shall have to be furnished by the DPA on a regular basis to this Department and MoEF&CC, GoI***, please find enclosed herewith compliance report (for the period April 2025 to September 2025) of stipulated conditions along with necessary annexures, for kind information & record please **(Annexure I).**

Further, as per the MoEF&CC, Notification S.O.5845 (E) dated 26.11.2018, stated that ***"In the said notification, in paragraph 10, in sub-paragraph (ii), for the words "hard and soft copies" the words "soft copy" shall be substituted"***. Accordingly, we are submitting herewith soft copy of the same via e-mail ID gczma.crz@gmail.com & direnv@gujarat.gov.in.

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

Thanking you.

Yours faithfully,

XEN (EMC)
Deendayal Port Authority

Copy to:

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

Annexure –I

Subject: Point-wise Compliance Status Report for CRZ Clearance for Developing Integrated facilities (Phase-II)- within the existing Kandla Port at Kandla Dist: Kutch by M/s. Kandla Port Trust – Regarding (for the period from April, 2025 to September, 2025)

1. **Setting up of Oil Jetty No.7**
2. **Setting up of Barge jetty at Jafarwadi**
3. **Setting up of Barge port at Veera**
4. **Administrative office building at Tuna Tekra**
5. **Road connecting from Veera barge jetty to Tuna gate**

Ref No: - GCZMA CRZ recommendation vide Letter No- ENV-10-2015-251-E (T Cell) dated 29.06.2016

S No	CRZ Conditions	Compliance Status
	SPECIFIC CONDITIONS	
1.	The provision of the CRZ notification 2011 shall be strictly adhered to by the KPT. No activity in contradiction to the provision of the CRZ notification shall be carried out by the KPT.	The work of project at Sr. No. 1 of EC i.e. ***"Setting up of Oil jetty no. 7"*** is Completed and it is under operation w.e.f January 2023. The Consent to Operate (CCA) from the Gujarat Pollution Control Board has already been obtained dated 20/1/2023 **Copy submitted along with the compliance report submitted on 03/10/2023.** However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet), it is assured that, the provisions of the CRZ Notification, 2011 will be strictly adhered to by DPA
2.	All necessary permissions under various laws/Rules/Notifications issued thereunder from different Government Department/agencies shall be obtained by M/s. KPT before commencing any enabling activities for proposed project.	The Consent to Establish (CTE) from the GPCB had already been obtained vide CTE No. 74134 granted by the GPCB vide letter no. PC/CCA-KUTCH 1319/GPCB ID 48573 dated 27/11/2015. In addition to this as the construction work for the project at Sr 1 is completed and it is under operation w.e.f January 2023 therefore CCA has obtained from the Gujarat Pollution Control Board vide GPCB/CCA- Kutch-1319/ID-48573/701442 dated 20/01/2023. **Copy submitted along with the compliance report submitted on 03/10/2023.**
3.	The KPT shall have to ensure that there shall not be any damage to the existing mangrove area.	The construction work for the project at Sr 1 is completed and it is under operation w.e.f January 2023. However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet), it is assured that, there shall not be any damage to the existing mangrove area
4.	The KPT shall effectively implement the mangrove Development, Protection & Management plan for control of indirect impacts on mangrove habitat	DPA has undertaken Mangrove Plantation in an area of 1650 Hectares since the year 2005. carried out through various agencies. The copy of the details has already been communicated with the earlier compliance reports submitted. In addition to the above, DPA appointed M/s GUIDE, Bhuj, for "Regular Monitoring of Mangrove Plantation carried out by DPA" (period 15/9/2017 to 14/9/2018 vide work order dated 1/9/2017 and 24/5/2021 to 23/5/2022 vide work order dated 3/5/2021). The final report submitted by M/s GUIDE, Bhuj, for the years 2017 to 2018 as well as for the year 2021 to 2022 has been submitted in the earlier compliance report submitted. Further, vide work order dated 10/06/24 DPA appointed M/s GUIDE, Bhuj, for "Regular Monitoring of Mangrove Plantation carried out by DPA" (Period 10/06/2024 to 09/06/2025). The work has completed and the final report submitted by GUIDE, Bhuj is attached herewith as **Annexure A.**

5.	The KPT shall have to make a provision that mangrove areas get proper flushing water and free flow of water shall not be obstructed	The construction work for the project at Sr 1 is Completed and it is under operation w.e.f January 2023. However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet), it is assured that, provision will be made for mangrove areas will get proper flushing of water and free flow of water is not obstructed.
6.	The KPT shall have to dispose of the dredged material only after scientific study to be carried out by the Institute of National repute and at a location suggested by them.	The work of project at Sr. No. 1 of EC i.e. "Setting up of Oil jetty no. 7" is Completed and it is under operation w.e.f January 2023. Capital Dredging at O.J. completed on 14/04/2023. It is submitted that, in compliance of specific condition no. xi of the EC dated 19/02/2020 DPA appointed IIT- Mumbai as an Independent agency for monitoring the dredging activities undertaken, vide work order no. HD/WK/1078/2022/OJ7/dredging/ENV610 dated 21/12/2022. However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet), it is assured that condition mentioned will be complied with.
7.	The KPT shall have to maintain the record for generation and disposal of capital dredging and maintenance dredging.	Point noted for the compliance.
8.	No dredging, reclamation or any other project related activities shall be carried out in the CRZ area categorized as CRZ I (i) and it shall have to be ensured that the mangrove habitats and other ecologically important and significant areas, if any, in the region are not affected due to any of the project activities	It is hereby assured that DPA will undertake only those activities recommended by the GCZMA vide letter dated 29/06/2016 and as permitted under the EC & CRZ Clearance accorded by the MoEF&CC, GoI, vide letter dated 18/02/2020. DPA has already prepared a comprehensive mangrove preservation plan for the entire Kandla area. In addition to the above, DPA appointed M/s GUIDE, Bhuj for "Regular Monitoring of Mangrove Plantation carried out by DPA" for the period 15/09/2017 to 14/09/2018 vide work order dated 01/09/2017, and again for the period 24/05/2021 to 23/05/2022 vide work order dated 03/05/2021. The final report for 2017–2018 was submitted along with the earlier compliance report, and the final report for 2021–2022 was submitted with the compliance report dated 03/05/2023. In continuation of the same, DPA has appointed M/s GUIDE, Bhuj for "Monitoring of Mangrove Plantation (1600 ha) carried out by DPA" for the period 10/06/2024 to 09/06/2025 vide work order dated 10/06/2024. A copy of the final report is attached herewith as **Annexure A**. Further, DPA had assigned to M/s GUIDE, Bhuj the work of "Regular Monitoring of Marine Ecology in and around Deendayal Port Authority and Continuous Monitoring Programme covering all seasons on various aspects of the coastal environs, including physico-chemical parameters of marine water and marine sediment samples, coupled with biological indices, as per EC & CRZ clearance requirements," for the period 2021–2024. The final reports for this work have already been submitted along with the earlier compliance reports. In continuation of this activity, DPA has again assigned M/s GUIDE, Bhuj the work of "Regular Monitoring of Marine Ecology in and around Deendayal Port Authority and Continuous Monitoring Programme covering all seasons on various aspects of the coastal environs, including physico-chemical parameters of marine water and marine sediment

		samples coupled with biological indices," for the period 2024–2027 vide work order dated 10/06/2024. A copy of the final report is attached herewith as **Annexure B**. It is relevant to mention that DPA has already undertaken mangrove plantation over an area of 1650 hectares since 2005. The detailed statement of mangrove plantation activities was submitted along with the compliance report dated 09/08/2024.
9.	The KPT shall participate financially for installing and operating the vessel traffic management system in the Gulf of Kutch and shall also take lead in preparing and operational sing the Regional Oil Spill Contingency plan in the Gulf of Kutch	DPA had already contributed an amount of Rs. 98.955 crore i.e 25% of the total project cost of 395.82 crore for installing and operating VTMS in Gulf of Kachchh
10.	The KPT shall strictly ensure that no creeks or rivers are blocked due to any activity at Kandla	The work of project at Sr. No. 1 of EC i.e. "Setting up of Oil jetty no. 7" is Completed and it is under operation w.e.f January 2023. However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet), it is assured that condition mentioned will be complied with
11.	Mangrove plantation in an area of 50 ha shall be carried out by the KPT within 2 years in a time bound manner on Gujarat coastline either within or outside the Kandla port Trust area and six-monthly compliance report along with the satellite images shall be submitted to the ministry of Environment and Forest as well as to this Department without fail.	DPA has signed MoU with Gujarat Ecology Commission, Gandhinagar to carry out mangrove plantation through PPP mode for the year 2020-2021. DPA (Erstwhile KPT) had already undertaken Mangrove Plantation in an area of 1650 Ha. till date since the year 2005. A statement showing details of the mangrove plantation and the cost incurred has already been submitted along with compliance report submitted on 09/08/2024 In addition to the above, DPA appointed M/s GUIDE, Bhuj, for "Regular Monitoring of Mangrove Plantation carried out by DPA" (period 15/9/2017 to 14/9/2018 vide work order dated 1/9/2017 and 24/5/2021 to 23/5/2022 vide work order dated 3/5/2021). The final report submitted by M/s GUIDE, Bhuj, for the years 2017 to 2018 has been submitted in the earlier compliance report, and the final report for the year 2021 to 2022 is Submitted along with the compliance report submitted on 03/05/2023. In continuation of same, DPA appointed M/s GUIDE, Bhuj, for "Monitoring of Mangrove Plantation 1600 ha carried out by DPA" (period 10/06/2024 to 09/06/2025 vide work order dated 10/6/2024. A copy final report is attached herewith as **Annexure A**
12.	No activity other than those permitted by the competent authority under the CRZ Notification Shall be carried out in the CRZ area.	The construction work for the project at Sr 1 is completed and it is under operation. The work of project at Sr. No. 1 of EC i.e. "Setting up of Oil jetty no. 7" is Completed and it is under operation w.e.f January 2023. The Consent to Operate (CCA) from the Gujarat Pollution Control Board has already been obtained dated 20/1/2023 .Copy of same is already submitted in the earlier compliance report submitted on 03/10/2023. However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet), it is assured that, no activity other than those permitted by the competent authority under the CRZ Notification Shall be carried out in the CRZ area
13.	No ground water shall be tapped for any purpose during the proposed expansion/modernization activities.	The work of project at Sr. No. 1 of EC i.e. "Setting up of Oil jetty no. 7" is Completed and it is under operation w.e.f January 2023 required water supply is purchased from GWSSB. However, for other projects mentioned at Sr. no. 2 to 5 (no

		construction activities started yet), it is assured that condition mentioned will be complied with.
14.	All necessary permissions from different Government Departments/agencies shall be obtained by the KPT before commencing the expansion activities.	DPA had already obtained the necessary EC & CRZ clearance for the project on dated 19/02/2020. Further, Consent to establish from GPCB had already been obtained from GPCB for the same. Subsequently, DPA obtained EC to CTE (PCB ID 48573) vide GPCB Order dated 13/10/2020 after obtaining Environmental and CRZ Clearance from MoEF&CC, GoI vide F. No. 11- 13/2015-IA-III dated 19/02/2020 In addition to this as the construction work for the project at Sr 1 is completed and it is under operation w.e.f January 2023 therefore CCA has obtained from the Gujarat Pollution Control Board vide GPCB/CCA- Kutch-1319/ID-48573/701442 dated 20/01/2023. Copy of same is already submitted in the earlier Compliance report submitted on 03/10/2023.
15.	No effluent or sewage shall be discharged into the sea/creek or in the CRZ area and it shall be treated to confirm to the norms prescribed by the Gujarat Pollution Control Board and would be reused/recycled with in the plant premises.	In this regard, it is to state that, DPA is in process to install bio toilets at the oil jetty area. DPA has been conducting regular monitoring of Environmental parameters through NABL Accredited laboratory since the year 2016 in continuation of this DPA appointed M/s Gujarat Environment Management Institute (GEMI), Gandhinagar (NABL Accredited laboratory) for regular Monitoring of environmental parameters vide work order dated 15/02/2023. The work is in progress & DPA is submitting the monitoring data regularly to all the concerned authorities along with compliance reports submitted. The latest Environmental Monitoring Reports is enclosed herewith as **Annexure C.** Further, necessary provisions will be made for the projects at Sr. No. 2 – 5 to not discharge effluent or sewage into the sea/creek or in CRZ area
16.	All the recommendations and suggestions given by the Mantec Consultant Pvt. Ltd. New Delhi in their Comprehensive Environment Impact Assessment report for conservation/protection and betterment of environment shall be implemented strictly by the KPT.	DPA has installed Mist Canon at the Port area to minimize the dust Further, DPA has already installed continuous sprinkling system to prevent dust pollution. Further, to control dust pollution in other area, regular sprinkling through tankers on roads and other staking yards is being done. Regular sweeping of spilled cargo from roads is done by parties on regular basis. DPA has been conducting regular monitoring of Environmental parameters through NABL Accredited laboratory since the year 2016 in continuation of this DPA appointed M/s Gujarat Environment Management Institute (GEMI), Gandhinagar (NABL Accredited laboratory) for regular Monitoring of environmental parameters vide work order dated 15/02/2023. The work is in progress & DPA is submitting the monitoring data regularly to all the concerned authorities along with compliance reports submitted. The latest Environmental Monitoring Reports is enclosed herewith as **Annexure C.** For ship waste management, DPA issued Grant of License/Permission to carry out the work of collection and disposal of "Hazardous Waste/Sludge/ Waste Oil" and "Dry Solid Waste (Non- Hazardous)" from Vessels calling at Deendayal Port" through DPA contractors Further, it is to state that, all ships are required to follow DG

		Shipping circulars regarding the reception facilities at Swachch Sagar portal DPA assigned work to M/s GUIDE, Bhuj, for regular monitoring of Marine Ecology since the year 2017 (From 2017 – 2021), and reports of the same are being submitted regularly to the Regional Office, MoEF&CC, GoI, Gandhinagar as well as to the MoEF&CC, GoI, New Delhi along with compliance reports submitted. The final report for the Holistic Marine Ecological Monitoring for the period up to May 2021 was submitted on 22.05.2021. Copy of the report was communicated vide earlier compliance report submitted vide letter dated 29/6/2021 Further, it is to submit that DPA issued a work order to M/s GUIDE vide its letter no. EG/WK/ 4751 /Part (Marine Ecology Monitoring) /11 dated 03/05/2021 for Regular monitoring of Marine Ecology in and around Deendayal Port Authority (Erstwhile Deendayal Port Trust) and continuous Monitoring Program covering all seasons on various aspects of the Coastal Environs for the period 2021-24. The copy of the final reports has already been submitted along with compliance report submitted earlier. In continuation of the same, DPA had assigned the work to M/s GUIDE, Bhuj for "Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme covering all seasons on various aspects of the Coastal Environs covering Physico-chemical parameters of marine water and marine sediment samples coupled with biological indices as per the requirements of EC & CRZ Clearances reg. (for three years (2024-2027) vide its work order dated 10/06/2024. Copy of final report is attached herewith as **Annexure B** As already informed, DPA entrusted work of green belt development in and around the Port area to the Forest Department, Gujarat at Rs. 352 lakhs (Area 32 hectares). The work is completed DPA has appointed Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-l)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May, 2022. The work completed. A copy of Final report is submitted along with the compliance report submitted on 03/10/2023. Further DPA has accorded the work of "Green belt development in DPA and its surrounding area (Phase II) to Gujarat Institute of Desert Ecology (GUIDE), Bhuj for the plantation of 10000 saplings of suitable species vide work order dated 23/06/2023. The work is completed and final report is communicated along with compliance report submitted on 24/02/2025 Further DPA has accorded the work of "Green belt development in DPA and its surrounding area (Phase III) to Gujarat Institute of Desert Ecology (GUIDE), Bhuj for the plantation of 5000 saplings at DPA and 200 saplings at Gopalpuri colony. The inception report is attached herewith as **Annexure D**. For dredged material management, DPA assigned work to

		M/s GUIDE, Bhuj for analysis of dredged material since the year 2017 and the reports are being submitted from time to time along with compliance reports submitted DPA assigned work to M/s GUIDE, Bhuj for analysis of dredged material since the year 2017 and the reports are being submitted from time to time along with compliance reports submitted. The work is completed and final report for the year 2023-2024 has attached and submitted along with compliance report submitted on 02/06/2025 In continuation of same, DPA had issued work order to GUIDE, Bhuj for Study on dredged material for presence of Contaminants for year 2024-2027 vide work order dated 07/10/2024. The Copy of 2nd season report is attached herewith as **Annexure E** Further, Dredged Material will be disposed of at designated location as identified by the CWPRS, Pune For energy conservation measures, DPA is already generating 20.7 MW installed capacity of Wind energy. In addition to it, DPA has commissioned a 45 kWP Solar Plant at Gandhidham. Further, it is relevant to mention that, two out of four Nos. of Harbour Mobile Crane (HMC) made electric operated. Balance 02 Nos. shall be made electric operated by 2025 end. Four Nos. of Deisel operated RTGs converted to e-RTGs. Retrofitting of hydrogen fuel cell in Tug Kalinga and Pilot Boat Niharika to be done as a pilot project under the guidance of MoPSW. Also, 14 Nos. of EV cars to be hired in this year and Hydrogen Buses to be procured in the year 2025-26. Further, for Oil Spill Management, DPA is already having Oil Spill Contingency Plan in place and Oil Response System as per the NOS-DCP guidelines. Copy already submitted along with compliance report submitted on 24/02/2025.
17.	The construction and operational activities shall be carried out in such a way that there is no negative impact on mangrove and other coastal/marine habitats. The construction activities and dredging shall be carried out only under the constant supervision and guidelines of the Institute of National repute like NIOT	The construction work for the project at Sr 1 is completed and it is under operation w.e.f January 2023 and due care is being taken for so that, there is no negative impact on mangrove and other coastal/marine habitats. Further, for project at Sr. No. 2 to 5 (Construction not yet started); however, the specified condition will be complied with
18.	The KPT shall contribute financially for any common study or project that may be proposed by this Department for environmental management/conservation /improvement for the Gulf of Kutch	Point noted for the compliance.
19.	The construction debris and/or any other type of waste shall not be disposed of into the sea, creek or in the CRZ areas. The debris shall be removed from the construction site immediately after the construction is over.	The work of project at Sr. No. 1 of EC i.e. ***"Setting up of Oil jetty no. 7"*** is Completed and it is under operation w.e.f January 2023. The Consent to Operate (CCA) from the Gujarat Pollution Control Board has already been obtained dated 20/1/2023. Copy of same submitted along with compliance report submitted on 03/10/2023. However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet) DPA had already issued general circular vide dated 3/9/2019 regarding Construction and Demolition Waste Management for strict implementation in DPA. Copy is already submitted during the compliance report submitted on 03/05/2023

20.	The construction camps shall be located outside the CRZ area and the construction labour shall be provided with the necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by the construction labours.	The work of project at Sr. No. 1 of EC i.e. ***"Setting up of Oil jetty no. 7"*** is Completed and it is under operation w.e.f January 2023. The Consent to Operate (CCA) from the Gujarat Pollution Control Board has already been obtained dated 20/1/2023 Copy of same is already submitted in the earlier compliance report submitted on 03/10/2023. However, for other projects mentioned at Sr. no. 2 to 5 (no construction activities started yet) the condition will be complied with
21.	The KPT shall regularly update their Local oil spill contingency and disaster management plan in consonance with the National oil Spill and Disaster Contingency plan and shall submit the same to this Department after having it vetted through the Indian Coast Guard.	DPA already has updated Disaster management plan and Local oil spill contingency plan. Copy already submitted along with compliance report submitted on 24/02/2025. DPA has also executed MOU with Oil companies, i.e., IOCL, HPCL, BPCL etc, for setting up of Tier I facility for combating the Oil Spill at Kandla.
22.	The KPT shall bear the cost of the external agency that may be appointed by this Department for supervision/monitoring of proposed activities and the environmental impacts of the proposed activities.	Point noted for the compliance.
23.	The KPT shall take up massive green belt development activities in and around Kandla and also within the KPT limits.	DPA assigned work for green belt development in an area of about 32 hectares to the Forest Department, Govt. of Gujarat, in August 2019 at the cost of Rs. 352.32 lakhs. The work is completed. Further, DPA also undertook massive green belt development in and around the Port area and at the Gandhidham area. DPA has appointed Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-I)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May, 2022. The work completed. A copy of Final report is submitted along with the compliance report submitted on 03/10/2023. Further DPA has accorded the work of "Green belt development in DPA and its surrounding area (Phase II) to Gujarat Institute of Desert Ecology (GUIDE), Bhuj for the plantation of 10000 saplings of suitable species vide work order dated 23/06/2023. The work is completed and copy of final report submitted along with compliance report submitted on 24/02/2025. Further DPA has accorded the work of "Green belt development in DPA and its surrounding area (Phase III) to Gujarat Institute of Desert Ecology (GUIDE), Bhuj for the plantation of 5000 saplings at DPA and 200 saplings at Gopalpuri colony. The inception report is attached herewith as **Annexure D**.
24.	The KPT shall have to contribute financially for taking up the socio-economic upliftment activities in this region in consultation with the Forests and Environment Department and the District Collector/District development officer.	DPA has already been undertaking CSR activities. The details of CSR Activities implemented as well as proposed are enclosed herewith as **Annexure F.**
25.	A separate budget shall be earmarked for environmental management and socio-economic activities and details there of shall be furnished to this Department as well as the MoEF,GOI. The details with respect to the expenditure from this budget head shall also be furnished.	DPA has already kept Rs. 585 lakhs in RBE. 2024-25 under the scheme "Environmental Services & Clearance thereof".

26.	A separate environmental management cell with qualified personnel shall be created for environmental monitoring and management during construction and operational phases of the project.	-DPA is already having Environment Management cell. Further, DPA has also appointed expert agency for providing Environmental Experts from time to time. DPA appointed M/s Precitech Laboratories, Vapi for providing Environmental Experts vide work order dated 4/10/2024 (Copy of work order is attached herewith as **Annexure G**. In addition, it is relevant to submit here that, DPA has appointed a Chief Manager (Environment and Safety) and two Managers (Environment and Safety) on contractual basis for the period of 3 years and further extendable to 2 years (Copy of duty report is attached herewith as **Annexure H**. Further, DPA had assigned the work of monthly environmental monitoring to M/s A 2 Z Envirotech vide Work Order dated 15/09/2022. The copy of the monitoring report has already been communicated with the earlier compliance report submitted. Recently, DPA has assigned the work of monthly environmental monitoring to GEMI, Gandhinagar for a period of 3 years vide letter dated 18/04/2023. The work is in progress and the latest monitoring report submitted by GEMI is attached herewith as **Annexure C**.
27.	An Environmental report indicating the changes if any, with respect to the baseline environmental quality in the coastal and marine environment shall be submitted every year by the KPT to this Department as well as to the MoEF&CC,GOI	DPA has been conducting regular monitoring of Environmental parameters through NABL Accredited laboratory since the year 2016 in continuation of this DPA appointed M/s Gujarat Environment Management Institute (GEMI), Gandhinagar (NABL Accredited laboratory) for regular Monitoring of environmental parameters vide work order dated 15/02/2023. The work is in progress & DPA is submitting the monitoring data regularly to all the concerned authorities along with compliance reports submitted. The latest Environmental Monitoring Reports is enclosed herewith as **Annexure C.** DPA has been submitting the environmental monitoring report along with the compliance report to IRO, MoEF&CC, GoI
28.	The KPT shall have to contribute financially to support the National Green Corps Scheme being implemented in Gujarat by the GEER foundation. Gandhinagar in consultation with Forests and Environment Department.	Point noted for the compliance.
29.	A six monthly report on compliance of the conditions mentioned in this letter shall have to be furnished by the KPT on regular basis to this Department/MoEF&CC,GOI	DPA has been regularly submitting a six-monthly report in compliance with the conditions mentioned to GCZMA and MoEF&CC, GOI. Last compliance submitted on 17/07/2025.
30.	Any other condition that may be stipulated by this Department and MoEF&CC,Gol from time to time for environmental protection / management purpose shall also have to be complied with by DPT.	Point noted.

Annexure–A

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 25/8/2022 - 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

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Project Team

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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.

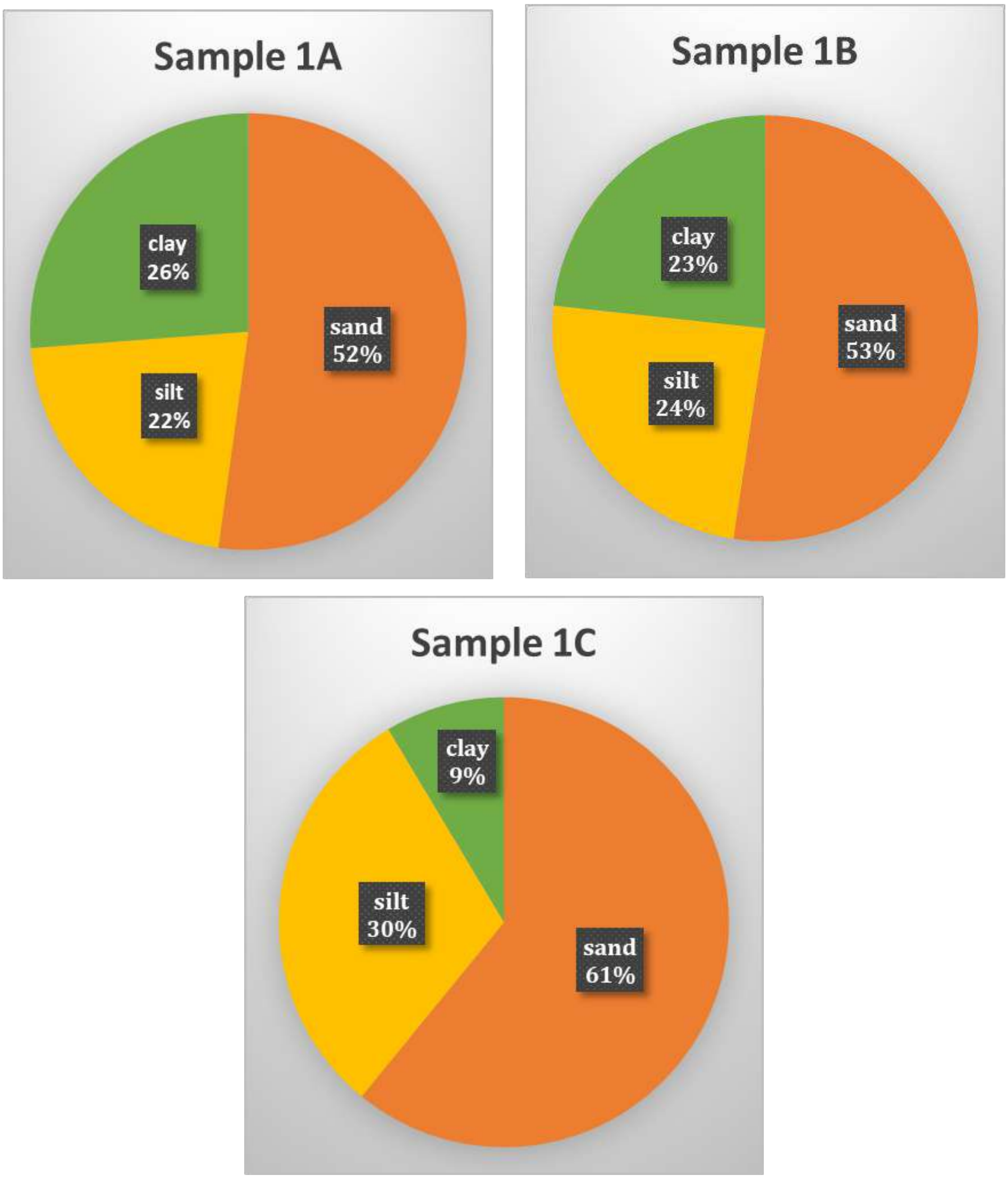

Figure 2: Sediment textural composition in the sampling sites

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.

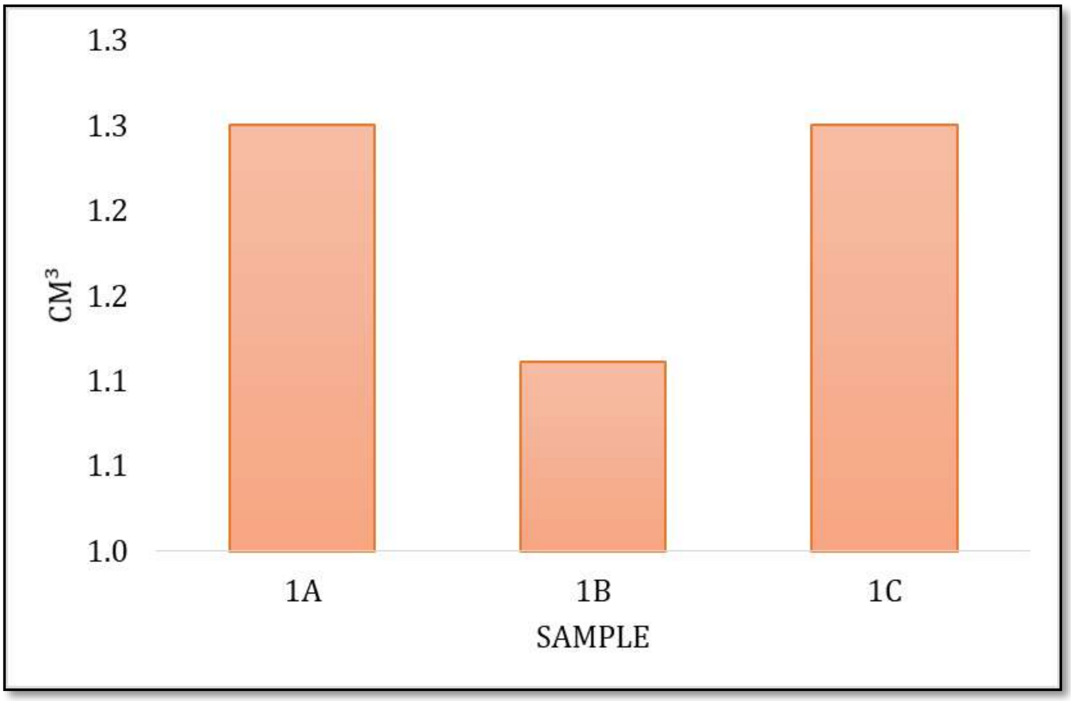

Figure 3: Bulk density of sediment samples

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%

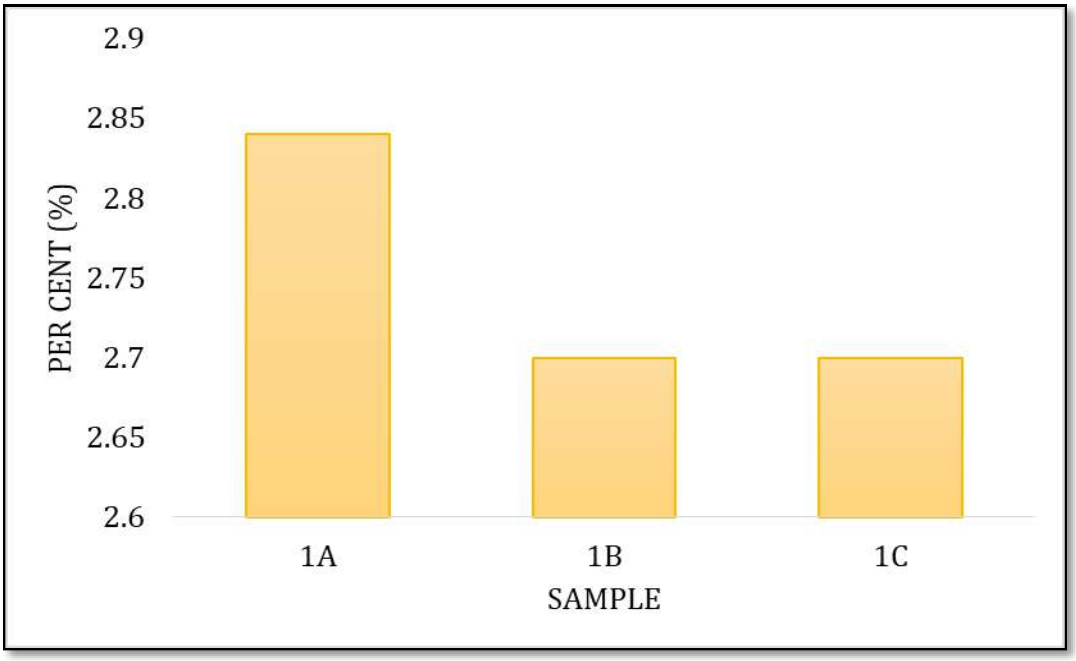

Figure 4: Total Organic Carbon content of sediment samples

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 8^{th} to 17^{th} August, 2024

Plate 5: Women involved in processing of mangrove seeds on 17^{th} to 25^{th} 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.

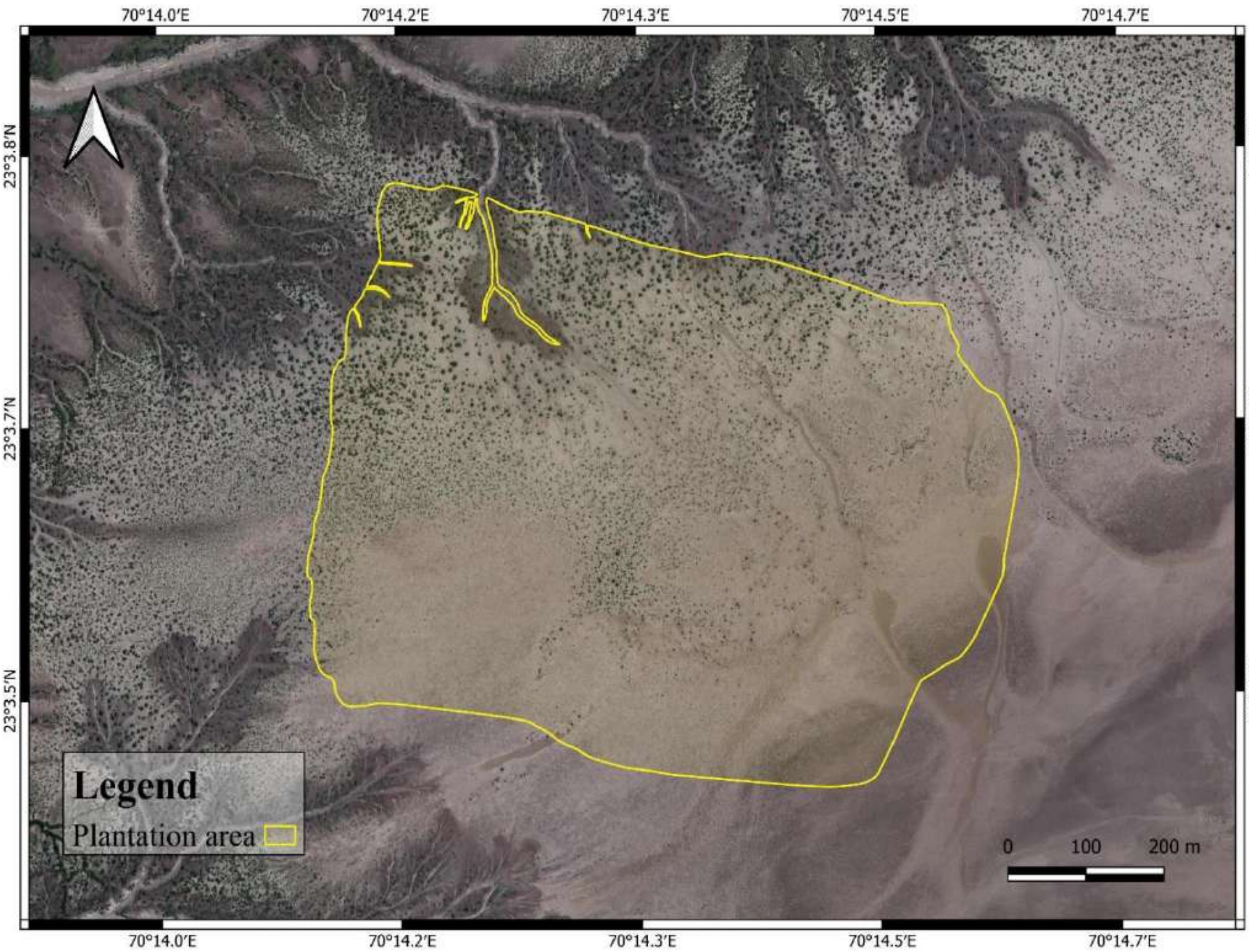

Figure 5: Mangrove plantation site area at Kandla, Gujarat, India

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

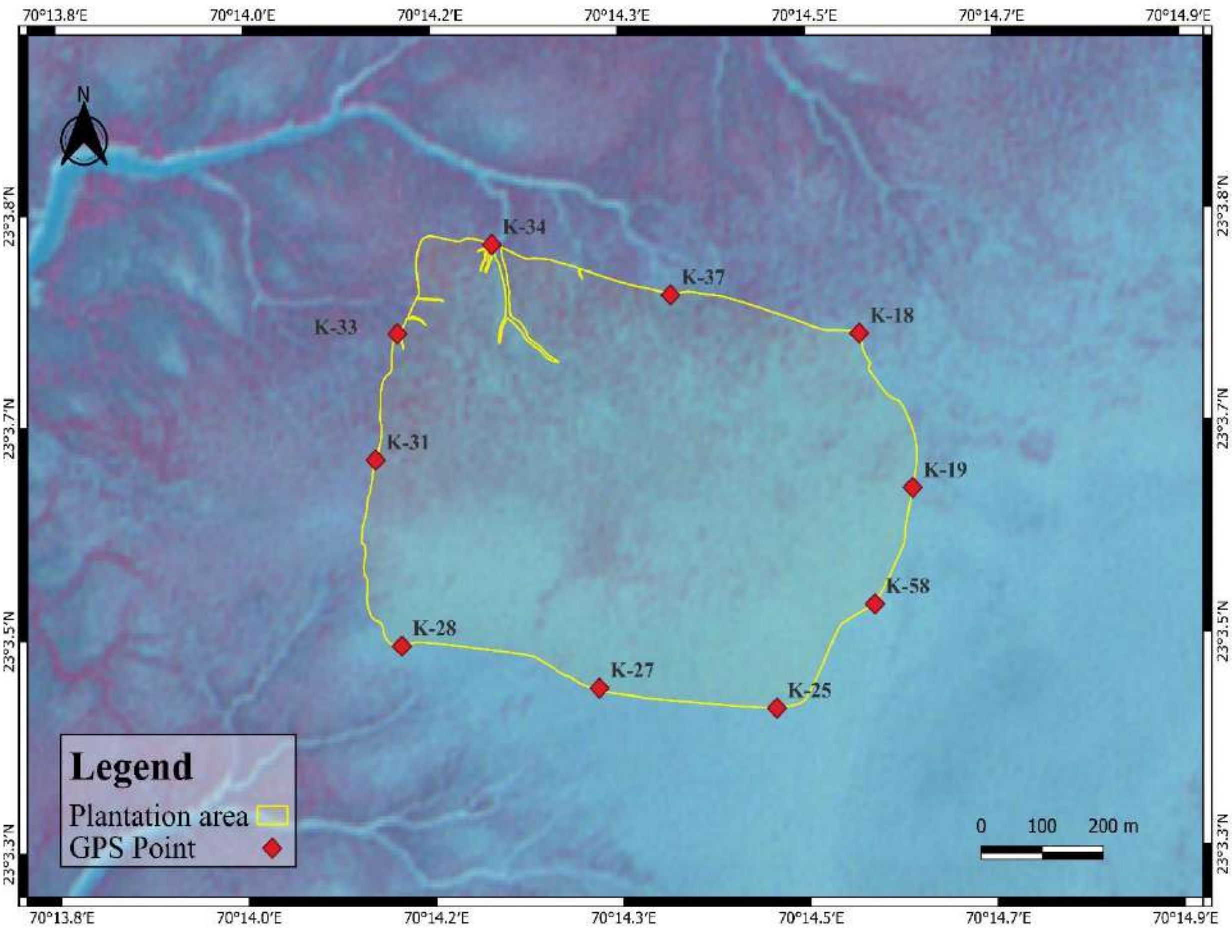

Figure 6: Mangrove plantation site area with GPS location points at kandla, Gujarat, India

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.

8. References

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Annexure–B

First Year - Annual Report
(2024-2025)

Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme

Submitted to

DEENDAYAL PORT AUTHORITY

DEENDAYAL PORT AUTHORITY
Administrative Office Building
Post Box No. 60, Gandhidham (Kuchchh)
Gujarat-370201

Submitted by

Gujarat Institute of Desert Ecology
P.O Box No. #83, Opp. Changleshwar Temple,
Mundra Road Bhuj - 370001
Gujarat - India

May 2025

First Year - Annual Report
(2024-2025)

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Mundra Road Bhuj - 370001
Gujarat - India

May 2025

Gujarat Institute of Desert Ecology

Dr. V. Vijay Kumar
Director

CERTIFICATE

This is to state that this final report of work entitled "**Regular monitoring of Marine ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme**" has been prepared as per the work order issued by DPA vide no EG/WK/4751/Part (Marine Ecology Monitoring)/72 dt.10.06.2024 for the period 2024-2025 as per EC and CRZ clearance accorded by the MOEF& CC, GOI dated 19.12.2016,18.2 2020,19.2.2022 and 20.11.2020 with specific conditions xviii, xxiii, xv iv and xxv respectively.

Authorized signatory

Gujarat Institute of Desert Ecology Bhuj

Institute seal

Project Coordinator

Dr. V. Vijay Kumar, Director

Principal Investigator		
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Co-Principal Investigator		
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Dr. Dhara Dixit	Project Scientist	Physico-chemical
Team Member		
Dr. L. Prabha Devi	Advisor	Management Plan
Dr.S.K Sajan	Scientist	Avifauna
Mr. Viral. D. Vadodariya	Project Fellow	Avifauna
Mr. Dayesh Parmar	Project officer	GIS & Remote sensing
Mr. Rupak Kumar Dey	Project Scientist	GIS & Remote sensing
Mr. Samir Mashru	Project assistant	Physico-chemical& Macrobenthos
Ms, Shivani Singh	Project assistant	Physico-chemical& Biological

Abstract May-2024 to May 2025

S. No	Components of the Study	Remarks
1	**MoEF & CC Sanction Letter and Details**	• EC & CRZ clearance granted by the MoEF &CC, GoI dated 19/12/16 Dev. Of 7 integrated facilities – specific condition no. xviii. • EC & CRZ clearance granted by the MoEF &CC, GoI dated 18/2/2020 Dev. Remaining 3 integrated facilities – specific condition no. xxiii. • EC & CRZ clearance granted by the MoEF &CC, GoI dated 19/2/2020 Dev. integrated facilities (Stage II-5 -specific condition no. xv. • EC & CRZ clearance granted by the MoEF &CC, GoI dated 20/11/20 – Creation of waterfront facilities (OJ 8 to 11- Para VIII Marine Ecology, specific condition iv. • EC& CRZ clearance granted by MoEF CC , GOI dated 1/1/2024 augmentation of iquid cargo handling facility specific condition no XXV.
2	Deendayal Port letter Sanctioning the Project	DPA work Order: WK/4751/Part/ (Marine Ecology Monitoring)/72
3	Duration of theProject	Three years-from 24.05.2021 to 23.05.2024
4	Period Of Survey Carried out	Three years-from 2024-2027
5	Survey Area Within the Port limit	All major and minor creek systems from Tuna to Surajbari and Vira coastal area.
6	Number of sampling locations	Fifteen sampling locations in and around DPA port jurisdiction
7	**Components of the report**	
7a	**Mangroves**	During the monsoon 2024, the overall average tree density recorded was 2,189 trees/ha, with Tuna Creek exhibiting the highest mean density (2,535 trees/ha) and S-6 having the highest individual density (3,673 trees/ha). During post-monsoon 2024-2025, the overall tree density recorded as 1,986 trees/ha, with Kharo Creek leading at 2,788 trees/ha and S-6 remaining the densest (3,156 trees/ha). During pre-monsoon 2025, the overall tree density recorded was 1,907 trees/ha and S-6 continued to show the highest density (3,113 trees/ha), with an impressive 6,774 trees per hectare

7b	**Mudflats**	The sediment organic carbon of DPA varied from may 2024 to May 2025 was 0.5% to 3.2 % with average variation of 1.8% to 2.5%. Through out season the highest percentage of organic carbon was observed in post-monsoon followed by monsoon and pre-monsoon. The sediment bulk density varied from 1.10 gm/cm3 to 1.89 gm/cm3 with overall average variation of 1.21 gm/cm3 to 1.68 gm/cm3 . Highest bulk density was observed in Pre-monsoon followed by post-monsoon and post-monsoon

	Phytoplankton	The density of different phytoplankton group varied from 4000 No/L to 24320 No/L with average variation of 7,627 No/L to 24, 320. Highest phytoplankton density was observed in post-monsoon followed by Pre-monsoon and Monsoon. During monsoon 15 genera such as *Cheatoceros, Coscinodiscus, Dictylum, Eucampia, GyrosigmaMelosira, Navicula, Nitzschia, Odontella, Pleurosigma, Pseudonitzschia, Rhizosolenia, Synedra, Thalassionema, Thalassiothrix* represent 100% of occurrence. But in Post-monsoon and pre monsoon represent less number i.e 8 and 5 number of genera represent 100% of occurrence.
7c	**Zooplankton**	The density of zooplankton from May 2024 to May 2025was 8,000 No/L to 20,000 No/L with average variation of 7,653 No/L to 17,660 No/ L. Highest Zooplankton density was observed in Post-mon soon followed by pre-monsoon and Monsoon. 12 genera such as *Acartia, Acrocalanus, Bivalve larvae, Brachyuran larvae, Calanus, Cirripede nauplius, Codonellopsis, Eucalanus, Gastropod larvae,Globigerina, Microsetella, Tintinnopsis* occurred 100% of occurrence.
7d	**Intertidal Fauna**	The survey of the intertidal Fauna of DPA Kandla area recorded the presence of 4 phyla (Arthropoda, Chordata, Mollusca). The faunal diversity was the highest for phylum Mollusca followed by Arthropoda and Chordata respectively. The organism such as Austruca iranica, Austruca sindensis, and Austruca variegata contribute highest percentage of composition. The density of Intertidal organism among different station was varied from 17No/m2 to 133 No/m2 with overall variation in 3 season was 18 No/m2 to 97No/m2. Monsoon contribute highest density of organism followed by Pre- and Post-Monsoon.
7e	**Sub-tidal Macrobenths**	The number of macro benthic fauna of the various groups from the DPA port environment includes Annelida, Arthropoda, Mollusca and Nematoda. The average density and population of subtidal macrobenthos from May 2024 to May 2025 varied from 307 N0/m2 to 507 No./m 2 and 12 to 20 in number. In station wise density of subtidal macrobenthos varied from 25 no/m2 to 1150 no /m2 with average variation of 100 no/m2 to 754 no/m2 . Highest dinsith was observed in Pre-monsoon and lowest was observed during post-monsoon. The species such as *Mysis larvae, Nereis sp, Glauconome angulata* and *Pirenella cingulata* was dominated

7f	Seaweeds and Seagrasses	No species of sea weeds and sea grass was recorded from the the stations sampled.
7g	Halophytes	During the period of May 2024 to May 2025 four major halophytes were recorded along the selected study stations of Deendayal Port Authority sites during the 3 seasons, were Salicornia brachiata, Aeluropus lagopoides, Salvadora persica and Sesuvium portulacastrum. Maximum percentage coverage of halophytes belongs to species Salicornia brachiate shared highest percentage of coverage in all season (100%) followed Sesuviumportulacastrum (30-45%)
7h	**Mammals**	No species of mammals was recorded from the stations sampled
7i	**Reptiles**	During the Monsoon AND Post- period of 2024-2025 field surveys it was encounter at S-10 located in the Southern part of Sat Saida bet
7j	**Fisheries**	The major fish catch activity is carried out in extensive creek systems of Khari creek, Tuna creek, Navalakhi creek and Jhangi creek. For the period of period 2024-2025, cast net was operated in different creek system of Kandla and major fish catch was include during monsoon Mugil cephalus, is major catch within 10 minutes around 1 km of distance.
7k	**Avifauna**	A total of 64 species (34 species terrestrial and 30 aquatic bird) representing 11 order, 26 families and 46 genera were recorded during the study period. Among 64 species, only five species viz. Painted Stork Mycteria leucocephala (Pennant, 1769), Black-headed Ibis Threskiornis melanocephalus (Latham, 1790), Glossy Ibis Plegadis falcinellus (Linnaeus, 1766), Black-tailed Godwit Limosa limosa (Linnaeus, 1758) and Eurasian curlew Numenius arquata (Linnaeus, 1758) are under the Near Threatened

Comparison Study of Marine Biodiversity of Deendayal Port Authority (DPA) Since 2019-2025

Habitat/ Groups	Major Taxa/Genera/Species	Year 2019-2020		Year 2020-2021		Year May 2021- May 2022			Year May 2022- May 2023		
		Pre Monsoon	Post monsoon	Pre monsoon	Post monsoon	Monsoon	Post monsoon	Pre monsoon	Monsoon	Post monsoon	Pre monsoon
Mangroves	*Avicennia marina*, *Ceriops tagal*, *Rhizophora mucronata*, *Aegiceras corniculatum*	4	4	4	4	4	4	4	4	4	4
Intertidal Habitat	Gastropods, Bivalves, Crustaceans Polychaetes, fishes, amphipods and Isopods	19	10	10	12	21	16	16	14	14	13
Subtidal Habitat	Polychaetes, molluscs, crustaceans,echinoderms	26	28	30	48	22	22	11	14	21	32
Phytoplankton	*Bacillaria, Navicula, Nitzschia, Chaetoceros, Coscinodiscus, Triceratium, Bidulphia, Melosira, Thassiosira*	32	26	23	19	35	23	23	24-33	22-26	21-26
Zooplankton	Copepods, Harpacticoids, Cyclopoids. brachyurans, cirripedes, Bivalve veligers	33	36	29	27	42	35	42	41	45	40
Seaweeds	Nil (Drifted tufts only)	Nil	Nil	drifted	drifted	drifted	drifted	drifted	NIL	NIL	NIL

Habitat/ Groups	Major Taxa/Genera/Species	Year		Year		Year			Year		
		2019-2020		2020-2021		May 2021- May 2022			May 2022- May 2023		
		Pre-M	**Post-M**	**Pre-M**	**Post-M**	**Monsoon**	**Post-M**	**Pre-M**	**Monsoon**	**Post-M**	**Pre-M**
Sea grasses	Nil (Drifted tufts only)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Halophytes	*Sesuvium portulacastrum, Salvadora persica, Aeluropus*	3	4	4	4	4	4	4	4 Salicrnia dominance	4 Salicrnia dominance	5 Salicrnia dominance
Avifauna	Charadriiformes, Phoenicopteriformes, Pelecaniformes, Passeriformes	49	89	49	69	62	84	52	49	79	53
Fishes	*Mugil cephalus, Harpodon nehereus, Pampus argenteus, Hilsa, Engraulis, Coilia* sp. *Peneaus,Portunus,lobester*	10	8	5	4	7	5	7		160 kg	50 kg
Marine Mammals	Dolphin, *Sousa plumbea*	1	1	Nil	Nil	1	Nil	Nil	1	1	Nil
Reptiles in the	The saw-scaled viper, *Echis*	1	1	Nil	1	Nil	Nil	1	1	1	Nil

For the period May 2023 to May 2024

Habitat/ Groups	Major Taxa/Genera/Species	Year		
		May 2023- May 2024		
		Monsoon	Post monsoon	Pre monsoon
Mangroves	*Avicennia marina*, *Ceriops tagal*, *Rhizophora mucronata, Aegiceras corniculatum*	4	4	4
Intertidal Habitat	Annelida, Arthropoda, Chordata Mollusca	15	15	14
Subtidal Habitat	Annelida,Arthropoda,Mollusca Chordata	26	21	15
Phytoplankton	*Coscinodiscus* dominance in all season	20-25	8-27	11-20
Zooplankton	The phylum Arthropoda was the predominant represented 16 groups in monsoon and post-monsoon (9) and pre-monsoon it contain 6 group which mainly include Copepoda, Harpacticoida, Cyclopoida, Decapoda, Crab larvae and Malacostrac	29-36	15-36	15-31
Seaweeds	No observation of seaweed during the study period	NIL	NIL	NIL

Habitat/ Groups	Major Taxa/Genera/Species	Year		
		May 2023- May 2024		
		Monsoon	Post monsoon	Pre monsoon
Sea grasses		NIL	NIL	NIL
Halophytes	*Sesuvium portulacastrum*, , Aeluropus lagopoides, *Salicornia brachiata*, *Suaeda nudiflora*	Present	Present	Present
Avifauna	55 species, 71 species , 68 species	55 species 8 order,24 families 23 genera	71 species 9 orders 29 families 55 genera	68 species 8 orders 28 families 53 genera
Marine Mammals	*Sousa plumbea*	No observation	S-6 and S-11	No observation
Fishes	*Mugil cephalus, Planiliza klunzingeri, Planiliza planiceps, Planiliza macrolepis*	*Mugil cephalus* More catch	*Mugil cephalus* More catch	Mugil cephalus
Reptiles	*Echis carinatus sochureki*	No observation	S-10	No observation

For the period May 2024 to May 2025

Habitat/ Groups	Major Taxa/Genera/Species	Year			
		May 2024- May 2025			
		Monsoon	Post monsoon	Pre monsoon	
Mangroves	*Avicennia marina*, *Ceriops tagal*, *Rhizophora mucronata*, *Aegiceras corniculatum*	4	4	4	
Intertidal Habitat	Arthropoda ,Chordata, Mollusca	Total density 53	Total density 42	Total density 45	
Subtidal Habitat	Annelida,Arthropoda, Mollusca, Nematoda 307, 412,508	Total density 307	Total density 42 Total density 412	Total density 42 Total density 508 45	Total density 42 Total density 45
Phytoplankton	*Pennales, Centrales* dominated	65.1% 54.55	59.4% 33.9%	42.4% 33.1%	
Zooplankton	The phylum Arthropoda was the predominant represented include Copepoda, Harpacticoida, Cyclopoida, Decapoda, Crab larvae and Malacostrac	14420	20000	18560	
Seaweeds	No observation of seaweed during the study period	Nil	Nil	Nil	

e

Habitat/ Groups	Major Taxa/Genera/Species	Year		
		May 2024- May 2025		
		Monsoon	**Post monsoon**	**Pre monsoon**
Sea grasses		NIL	NIL	NIL
Halophytes	*Sesuvium portulacastrum*, , Aeluropus lagopoides, *Salicornia brachiata*, *Suaeda nudiflora*	Present	Present	Present
Avifauna	A total of 64 species (34 species terrestrial and 30 aquatic bird) representing 11 order, 26 families and 46 genera were recorded during the study period.	53	64	60
Marine Mammals	*Sousa plumbea*	no	no	no
Fishes	*Mugil cephalus, Planiliza klunzingeri, Planiliza planiceps, Planiliza macrolepis*	*Mugil cephalus*	*Mugil cephalus*	Mugil cephalus
Reptiles	*Echis carinatus sochureki*	S-10	S-10	NO

List of Plates

1. Introduction

Deendayal Port is located at Kandla in the Kachchh district of Gujarat state, operated by Deendayal Port Authority (DPA) (constituted under the major port Authority Act and the administrative control of the Ministry of ports shipping & water way (GOI) is India's busiest major port in recent years and is gearing to add substantial cargo handling capacity with private participation. DPA being one of the 12 major ports in India is situated at latitude 22°59'4.93N and longitude 70°13'22.59 E on the Kandla creek at the inner end of Gulf of Kachchh (GoK). Since its formation in the 1950s, the Deendayal Port provides the maritime trade requirements of states such as Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana and Gujarat. Because of its proximity to the Gulf countries, large quantities of crude petroleum are imported through this port. About 35% of the country's total export takes place through the ports of Gujarat in which the Deendayal port has a considerable contribution. Assortments of liquid and dry cargo are being handled at DPA Port. The dry cargo includes fertilizers, iron and steel, food grains, metal products, ores, cement, coal, machinery, sugar, wooden logs, etc. The liquid cargo viz. chemicals, edible oil, crude oil and other petroleum products etc. DPA has handled 132.3 MMTPA during the year 2023-2024. Presently, the Port has total 1-16 dry cargo berths, 7 oil jetties, and one barge jetty at Bunder basin, dry bulk terminal at Tuna Tekra, barge jetty at Tuna and two SPMs (2 local & 1 Nayara energy Limited and two product berths-Nayara energy Limited) at Vadinar for handling crude oil and petroleum products. Regular expansion or developmental activities such as the addition of jetties, allied SIPC and ship bunkering facilities oil jetty No 8 and container terminal at Tuna Tekra are underway in order to cope with the increasing demand for cargo handling during the recent times. A developmental initiative of this magnitude is going on since the past 7 decades, which will have its own environmental repercussions. Being located at the inner end of Gulf of Kachchh, Deendayal Port Authority encompasses a number of fragile marine ecosystems that includes a vast expanse of mangroves, mudflats, creek systems and associated biota. Deendayal Port is a natural harbour located on the eastern bank of North-South trending Kandla creek at an aerial distance of 90 km from the mouth of Gulf of Kachchh. The Port's location is marked by a network of major and minor mangrove lined creek systems with a vast extent of mudflats. The coastal belt in and around the port has an irregular and dissected configuration. Due to its location at the inner end of the Gulf, the tidal amplitude is elevated, experiencing 6.66 m during mean high-water spring (MHWS) and 0.78 m during mean low water spring (MLWS) with MSL of 3.88 m. Commensurate with the increasing tidal amplitude, vast intertidal expanse is present in and around the port environment. Thus, the occurrence of mudflats on the intertidal zone enables mangrove formation to an extensive area. Contrary to the southern coast of Gulf of Kachchh, the coral formations, seaweed and seagrass beds are absent in the northern coast due to high turbulence induced suspended sediment load in the water column, a factor again induced due to the conical Gulf geomorphology and surging tides towards its inner end.

1.1. Rationale of the present study

The ongoing developmental activities at Deendayal Port Authority has been intended for the following.

(i) The development of the 3 remaining integrated facilities (Stage 1) within the existing Port at Kandla which includes development of a container terminal at Tuna off Tekra on BOT base T shape jetty, construction of port craft jetty and shifting of SNA section of Deendayal port and railway line from NH-8A to Tuna port.

(ii) EC & CRZ clearance granted by the MoEF &CC, GoI dated 18/2/2020 Dev. Remaining 3 integrated facilities (Stage I) within the existing Kandla port – specific condition no. xxiii.

(iii) EC & CRZ clearance granted by the MoEF &CC, GoI dated 19/2/2020 Dev. integrated facilities (Stage II-5 (1) Setting of oil jetty No7 (2) Setting up barrage jetty at Jafar wadi (3) Setting up barrage port at Veera (4) Administrative office building at Tuna Tekra (5) Road connecting from Veera barrage jetty to Tuna gate by M/s DPA -specific condition no. xv.

(iv) EC & CRZ clearance granted by the MoEF &CC, GoI dated 20/11/20 – expansion of port by creation of water front facilities (Oil jetty 8,9,10 and 11) and development of land area 554 acres for associated facilities for storage at old Kandla, Gandhidham, Kachchh by Ms. PA Para VIII Marine Ecology, specific condition iv.

(v)Development of 7 integrated facilities (Stage I) within the existing Kandala port CRZ clearance MoEFcc , GOI dated 19/12/2016-Specific condition (ii),(iii) and (iv) the project proponent ensure that, no damage to the mangrove patch without disturbing creek water circulation ,there is no blocking of creek or rivers of project area and shoreline also not damaged and it periodically monitored .

(vi) EC& CRZ clearance granted by MoEF &CC , GOI dated 1/1/2024 augmentation of liquid cargo handling facility specific condition no XXV.

As per the environmental clearance requirements to these developmental initiatives, by MoEF & CC, among other conditions, has specified to conduct the continuous monitoring of the coastal environment on various aspects covering all the seasons. The regular monitoring shall include physico-chemical parameters coupled with biological indices such as mangroves, seagrasses, macrophytes and plankton on a periodic basis during the construction and operation phase of the project. Besides, the monitoring study also includes an assessment of Mudflats, Fisheries, and Intertidal fauna including the macrobenthos as components of the management plan. The regular marine ecology monitoring includes Micro, Macro and Mega floral and faunal components of marine biodiversity of the major intertidal ecosystems, the water and sediment characteristics. In accord with MoEF&CC directive, DPA has consigned the project on 'Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme" to Gujarat Institute of Desert Ecology (GUIDE), Bhuj during May, 2021. Further, Deendayal Port authorities has entrusted Gujarat Institute of Desert Ecology (GUIDE) to continue the study for another three years, i.e., 2021 – 2024 and further extended to another 3 years i.e from May 2024 to May 2027 with specific condition XXV for augmentation of liquid cargo handling facility . The study covers all the seasons as specified by specific condition of the Ministry of Environment, Forest and Climate Change (MoEF&CC). The present study is designed considering the scope of work given in the EC conditions

1.2 Scope of work

The scope of the present investigation includes physico-chemical and marine biological components as mentioned in the specific conditions of MoEF&CC, EC & CRZ clearance dated 19.12.2016,18.2.2020,19.2.2022 and 20.11.2020 & 1.1.2024 with specific conditions xviii, xxiii, xv, iv and xxv respectively. A detailed holistic approach to different components of marine physico-chemical parameters of water and sediment and marine biodiversity within the Deendayal Port area will be carried out. Based on the results obtained during the project period, a detailed management plan will be drawn at the end of the project period. The biological and physico-chemical variables will be investigated during the present study on a seasonal basis i.e., monsoon, post-monsoon and pre-monsoon as the period May 2024 to May 2025 as follows:

- Physico-chemical characteristics of water and sediment will be analysed.
- Detailed assessment of mangrove vegetation structure including density, diversity, height, canopy and other vegetation characteristics.
- GIS and RS studies to assess different ecologically sensitive land use and land cover categories within the Port area such as the extent of dense and sparse mangroves, mudflats, creek systems and other land cover categories within the port limits.
- To study the intertidal faunal composition, distribution, diversity, density and other characteristics, other mega faunal components such as mammals, reptiles and amphibians.
- To investigate the species composition, distribution, diversity, density of sub-tidal benthic fauna.
- To estimate the primary productivity of the selected sampling sites located in around DPA area.
- ToInvestigate the species composition, distribution, density and diversity of phytoplankton and zooplankton.
- To study the distribution of halophytes, sea grasses, seaweeds and other coastal flora, their occurrence, distribution, abundance and diversity.
- To study the Avifaunal density, diversity, composition, habitat, threatened and endangered species and characters.
- Fishery Resources - Common fishes available, composition, diversity, Catch Per Unit Effort (CPUE) and other socio-economic information.

This study in short attempts the following, to i) developing a strong long-term monitoring of the port marine environment from the biological perspective which could be used to monitor changes in the future, and ii) formulating a management plan based on the baseline data in order to ensure long-term ecological health of the port environment. A better understanding of the marine ecology of the port and its processes has been attempted in this study which will assist in better management and conservation decisions to promote marine environmental health within the port limits.

1.2.1. Study Area

The coastal belt in and around Deendayal Port Authority jurisdiction is characterized by a network of creek systems and mudflats which are covered by sparse halophytic vegetation like scrubby to dense mangroves, creeks and salt-encrusted landmass which form the major land components (Table1) .The surrounding environment in 10 km radius from the port includes built-up areas, salt pans, human habitations and port related structures on the west and north creek system, mangrove formations and mudflats in the east and south (Fig1). The nearest major habitation is Gandhidham town located about 12 km away on the western part with population of 2,48,705 (as per 2011 census).

Table 1 . Sampling locations of study area (2024-2025)

Locations	GPS coordination	
	Latitude	Longitude
S-1	22.9410	70.1358
S-2	22.9616	70.1244
S-3	22.9876	70.2345
S-4	23.0285	70.2331
S-5	23.0804	70.2245
S-6	23 9'19.99	7024'1.47
S-7	22.9771	70.2125
S-8	23.0378	70.4070
S-9	22.9960	70.3932
S-10	23.1007	70.2961
S-11	23.1608	70.4948
S-12	22.9446	70.1062
S-13	23° 6'58.69"	70°21'8.77"
S-14	22.89590	70.07450
S-15	23.0654	70.2172

2.Sampling of water and sediment samples

Sampling was carried out for the coastal water (surface) and sediment to determine physical and chemical characteristics from the prefixed sampling sites. The biological parameters (benthic and pelagic fauna, flora and productivity) were also estimated (Table.2). The water samples were collected from each pre-designated site in pre-clean polyethylene bottles. Prior to sampling, the bottles were rinsed with sample water to be collected and stored in an ice box for transportation to the laboratory and refrigerated at 4°C till further analysis. The analysis of the water quality parameters was carried out by following standard methods (APHA, 2017). All extracting reagents were prepared using metal-free, AnalaR grade chemicals (Qualigens Fine Chemicals Division of Glaxo SmithKline Pharmaceuticals Limited, Mumbai) and double distilled water prepared from quartz double distillation unit.

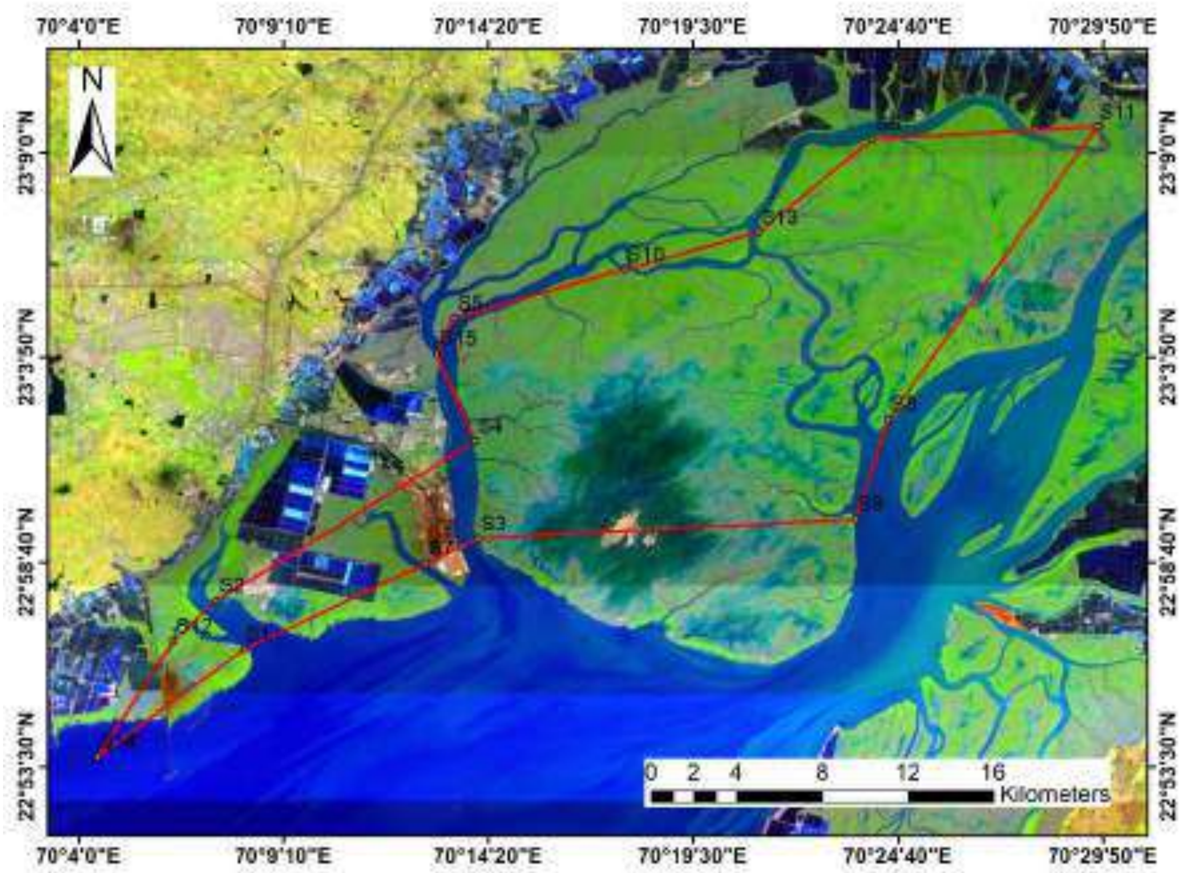


Figure 1. Sampling locations of Study area

2, Land use Land Cover Changes

In order to understand the spatial and temporal changes in the vicinity of the Deendayal port jurisdiction area, Remote Sensing and GIS technique has been employed. Land cover classification was carried out using digital satellite imageries. Images for the Deendayal Port area were acquired for the period of April 2017, December 2019 and March 2020, November 2020, April 2021, March 2022 and March 2023 were used for the study. These were brought to UTM projection with spheroid and datum named WGS 84 in UTM zone 42 north.

Table 2 Satellite Imagery Used for Land Use Land Cover Map

Image use	Satellite name	Sensor	Spatial Resolution	Date acquired
2017	IRS-R2A	LISS IV	5.8m	26 April- 2017
2019	IRS-R2A	LISS IV	5.8m	24-DEC-2019
2020	IRS-R2A	LISS IV	5.8m	29-March-2020
2020	IRS-R2	LISS IV	5.8m	17-Nov-2020
2021	IRS-R2	LISS IV	5.8m	10-APR-2021
2022	IRS-R2	LISS IV	5.8m	12-March-2022
2023	IRS-R2	LISS IV	5.8m	31-March-2023

2.1 Methodology

Training samples were collected from these imageries. Selecting training samples from these cloud-free mosaics was straightforward due to the very distinctive signature of mangrove area. High contrast with open water, saltpan and mudflat helped in selecting the training data successfully. Same training samples with slight modifications in each imageries mosaic (addition and removal of few training samples) were used for the classification of all different date images. Six major classes viz., mangrove, water, mudflat, other vegetation, salt pan and port were delineated. For the tonal variation and pixel values in the imageries, NDVI (Normalised Differential Vegetative Index) and a supervised Maximum Likelihood Classification (MLC) methods were used for the classification. ERDAS Imagine 9.3 was used for satellite image processing, classification and data transformation whereas ARC GIS 10.3 was used for the map formation. Forgraphs and databases processing, MS WORD and MS EXCEL were used.Ground truth study comprises data collection of ground features along with the respectivegeographical positions in terms of latitudes and longitudes with Garmin e-Trex Vista GPS. Thus, the data were interpreted using all the collected information.

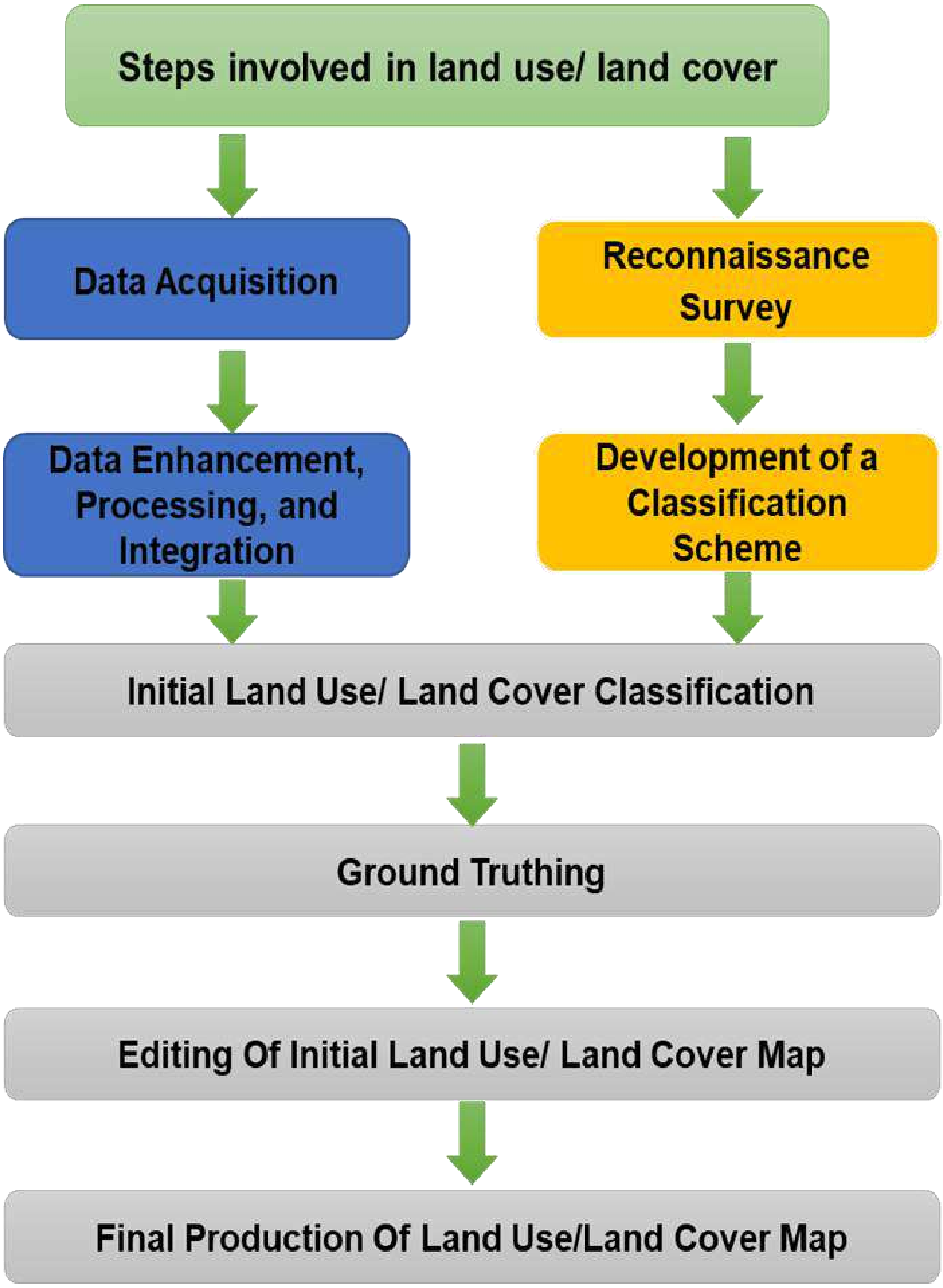


Figure 2. Methodology for land use Land cover

2.2.1Land use Land Cover

Classified imageries are presented in Fig 3 to Fig 4 and detailed presented in table 2 and 3.

Figure 3. Land use/ Land cover classification in DPA area- April-2017

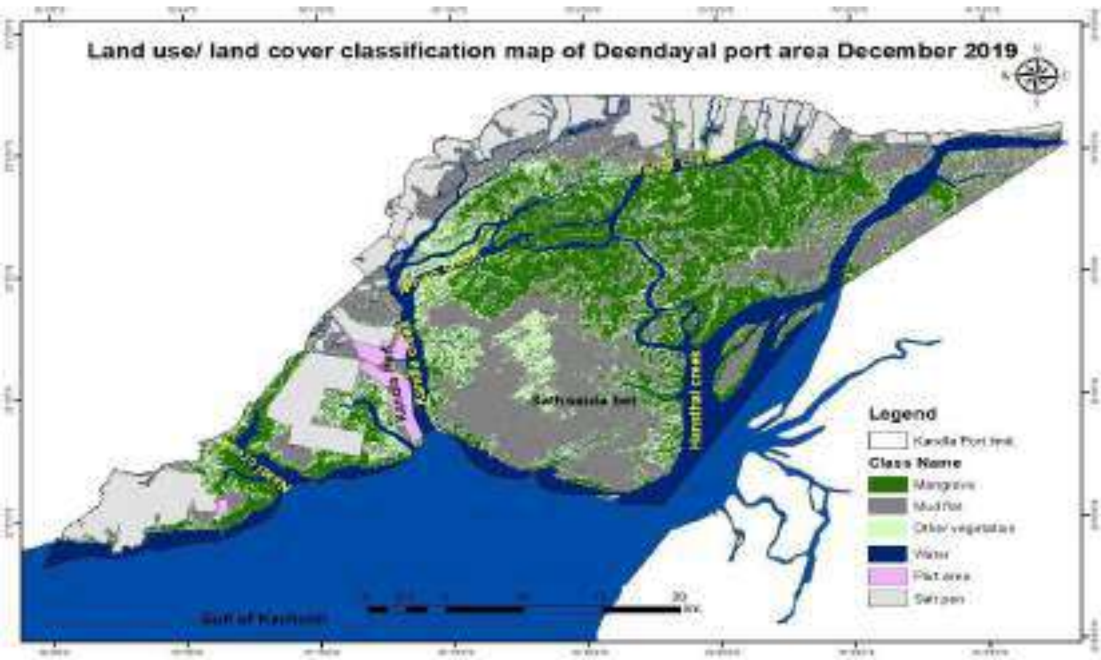


Figure 4. Land use/ land cover classification in DPA area December-2019

Table 3. Land use /Land cover statistics in the DPA area - April-2017

Class Name	Area (ha)	Percentage
Mangrove (Dense + Sparse)	19319.71	19.32
Mudflat	31293.43	31.3
Other veg	12438.8	12.44
Port Area	1243.67	1.24
Salt pan	15016.1	15.02
Water	20674.3	20.68
Total	**99986.01**	**100**

Table 4. Land use /Land cover statistics in the DPA area - December-2019

Class Name	Area (ha)	Percentage
Mangrove	23060.04	23.06
Mudflat	31179.87	31.18
Other vegetation	12333.21	12.33
Water	16953.68	16.96
Port area	1346.21	1.35
Salt pan	15113	15.12
Total	**99986.01**	**100**

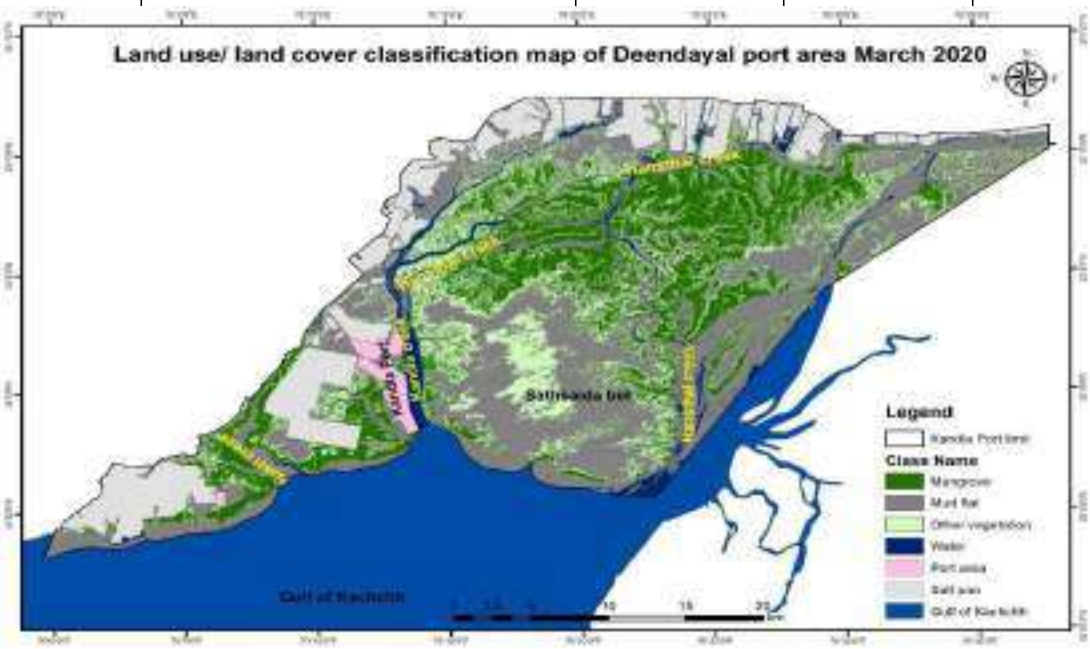


Figure 5. Land use/ land cover classification in DPA area March-2020

Table 5. Land use /land cover statistics in the DPA area- March-2020

Class name	Area (ha)	Percentage
Mangrove	23168.4	23.17
Mudflat	40714.6	40.72
Other vegetation	15991.69	15.99
Port area	1346.21	1.35
Salt pan	15054.5	15.06
Water	3710.61	3.71
Total	**99986.01**	**100**

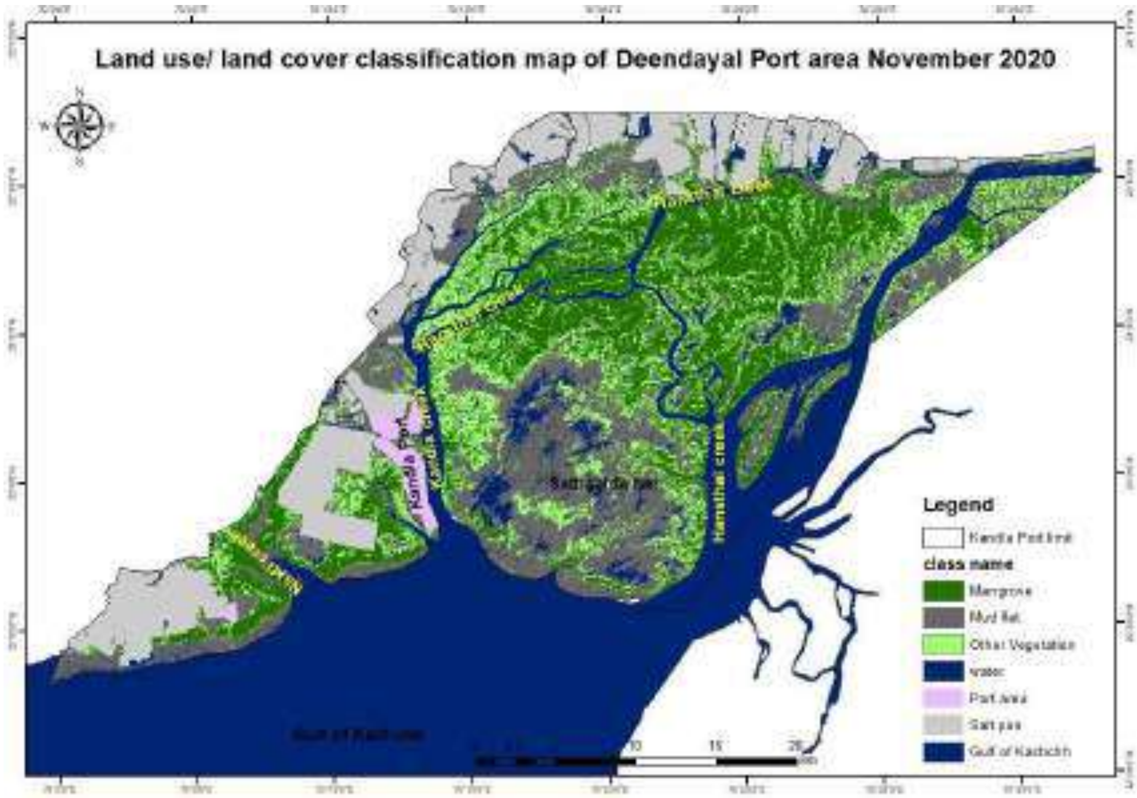


Figure 6. Land use/ land cover classification in Deendayal port area November 2020

Table 6. Land use /land cover statistics in the DPA area- November2020

Class	Area (ha)	Percentage
Mangrove	23856.8	23.86
Mudflat	28764.6	28.77
Other Vegetation	16346.1	16.35
Port area	1346.21	1.35
Salt pan	15193.5	15.2
water	14478.8	14.48
Total	99986.01	100

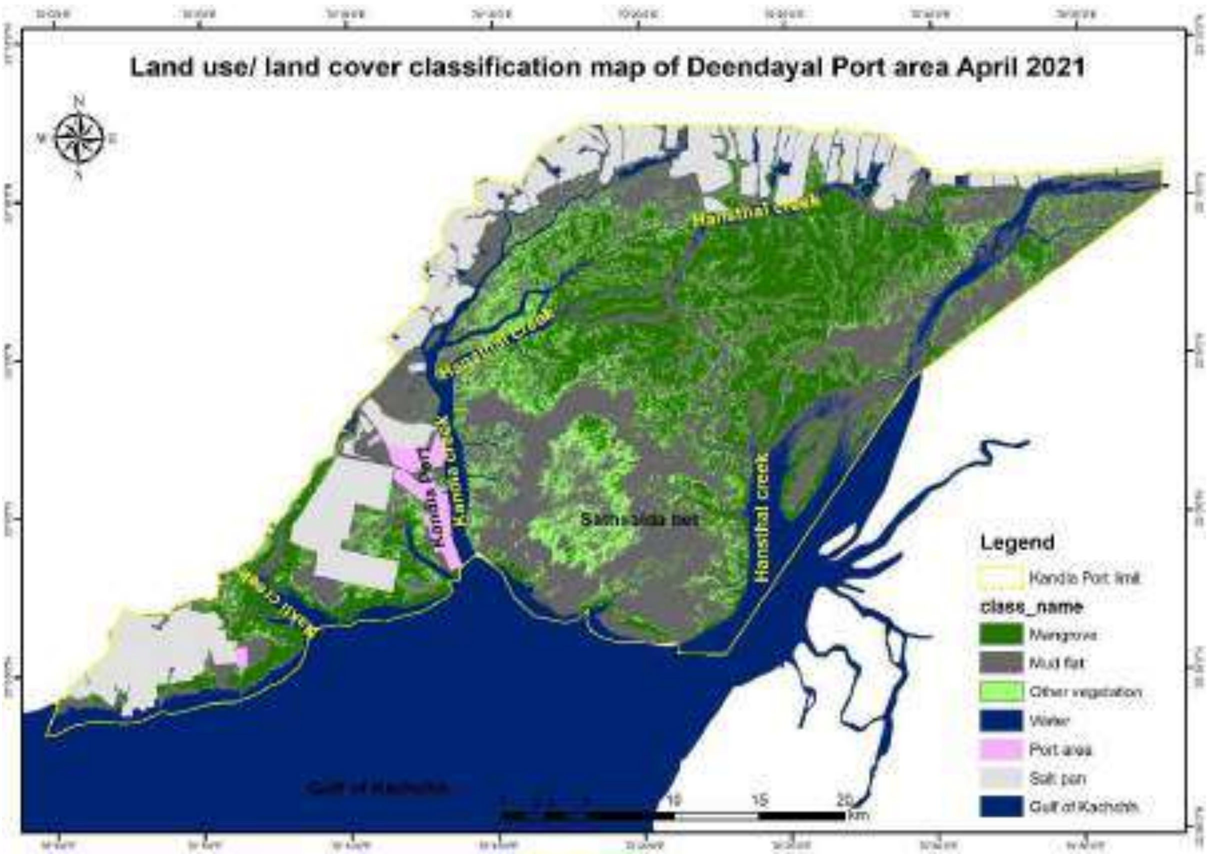


Figure 7. Land use/ land cover classification in Deendayal port area April-2021

Table 7. Land use /land cover statistics in the DPA area April-2021

class name	Area (ha)	Percentage
Mangrove	23967.4	23.97
Mudflat	36909.3	36.91
Other vegetation	11230.4	11.23
Port area	1346.21	1.35
Salt pan	15236.6	15.24
Water	11296.1	11.3
total	**99986.01**	**100**

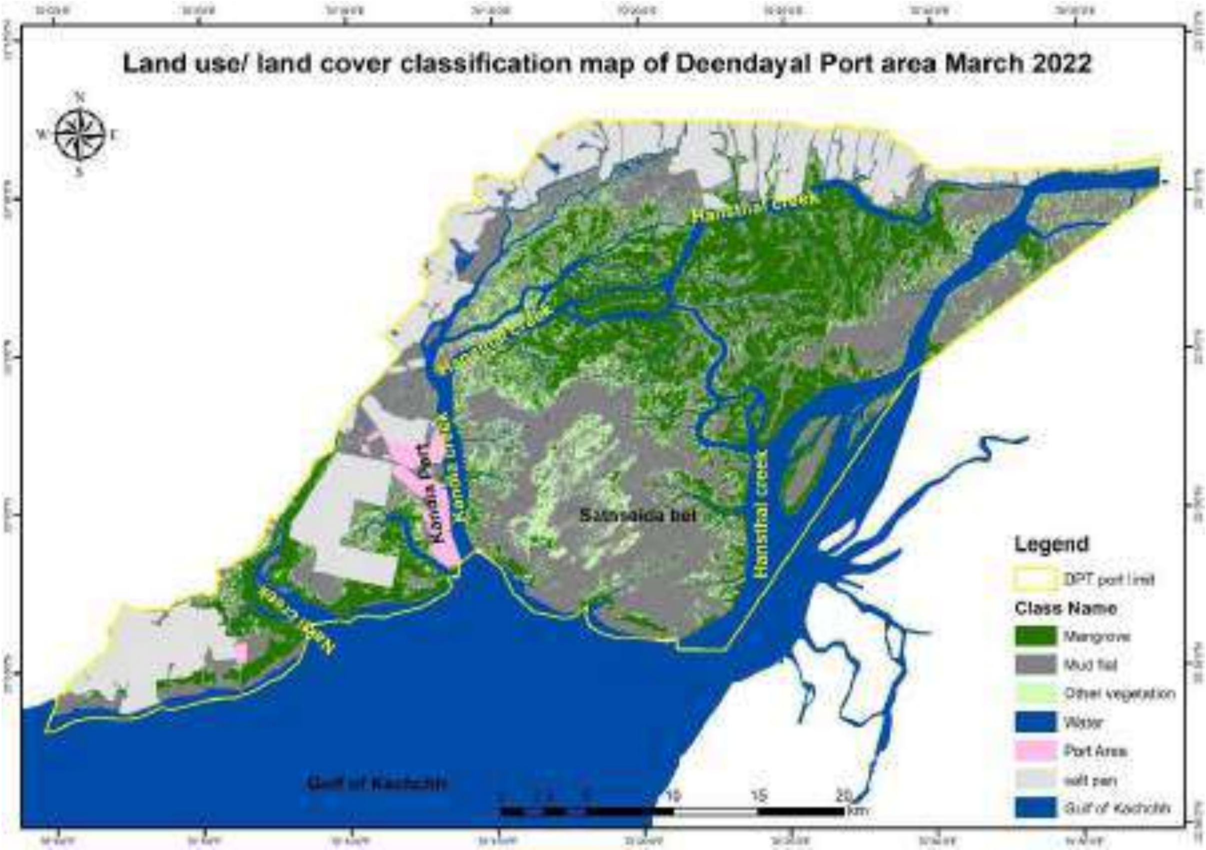


Figure 8.Land use/ land cover classification in Deendayal port area March-2022

Table 8. Land use /land cover statistics in the DPA area March-2022

class name	Area (ha)	Percentage
Mangrove	24328.7	24.33
Mudflat	31089.06	31.09
Other vegetation	11561.2	11.56
Port Area	1436.75	1.44
salt pan	15545.7	15.55
Water	16024.6	16.03
Total	**99986.01**	**100**

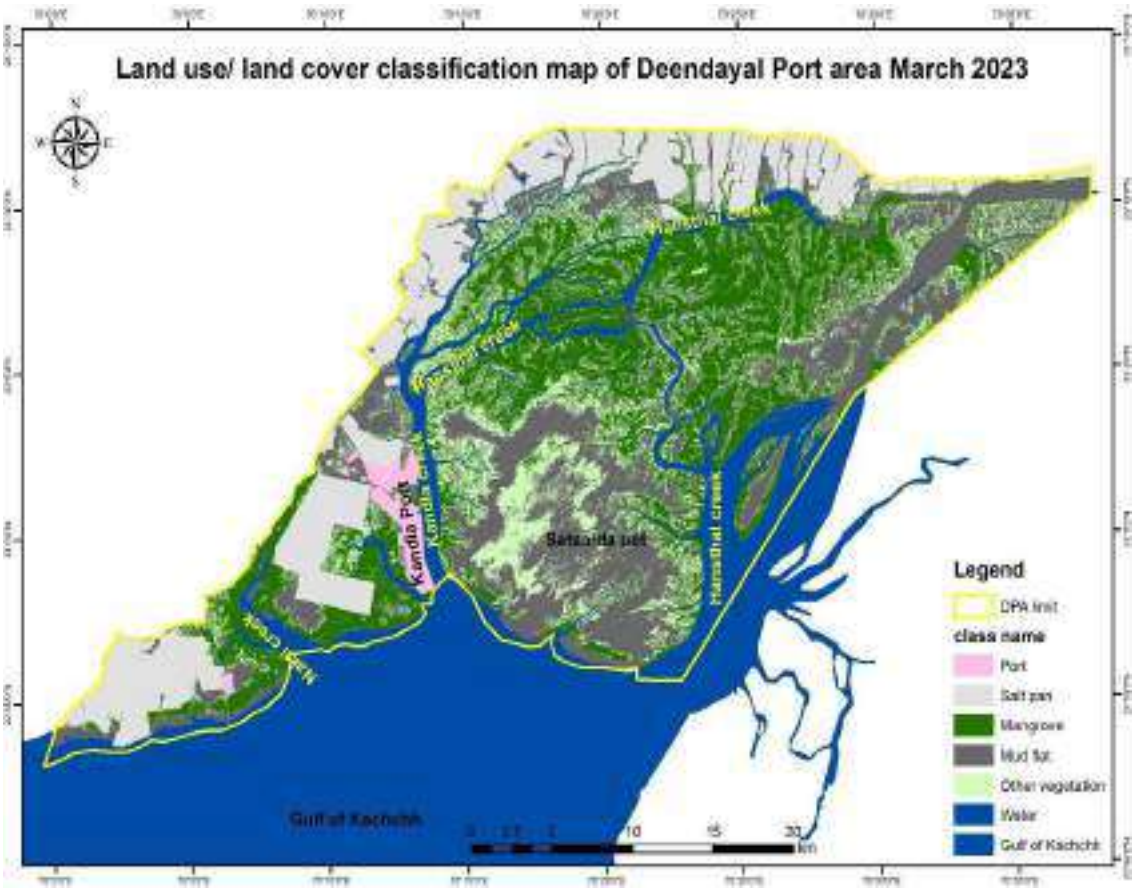


Figure 9. Land use/ land cover classification in Deendayal port area March-2023

Table 9. Land use /land cover statistics in the DPT area for March-2023

class name	Area (ha)	Percentage
Mangrove	26520.56	26.52
Mud flat	27547.90	27.55
Other vegetation	15969.90	15.97
Port	1436.75	1.44
Salt pan	16094.80	16.10
Water	12416.10	12.42
Total	**99986.01**	**100.00**

2.2.2. Comparative Analysis of Land use Land Cover Study

From April 2017 to March 2023 the overall mangrove area increased from 19319 ha to 26520.5 ha, i.e. 7 % of the total area of DPA. Mangrove area is replacing on the mostly on mudflat, hence there is a decreasing trend of the mudflat is clearly seen. Since this area comes under the influence of the tidal time mudflat area comes high value in that case water area decrease. But overall trends show mudflat is replaced by mangroves. (Fig 3.9). Good monsoon and favorable environment have positively impacted the mangroves to flourish. The below graph shows clearly, year on year mangrove area in DPA vicinity is increasing, currently, around 26.5% of the total area of DPT is covered by mangroves.

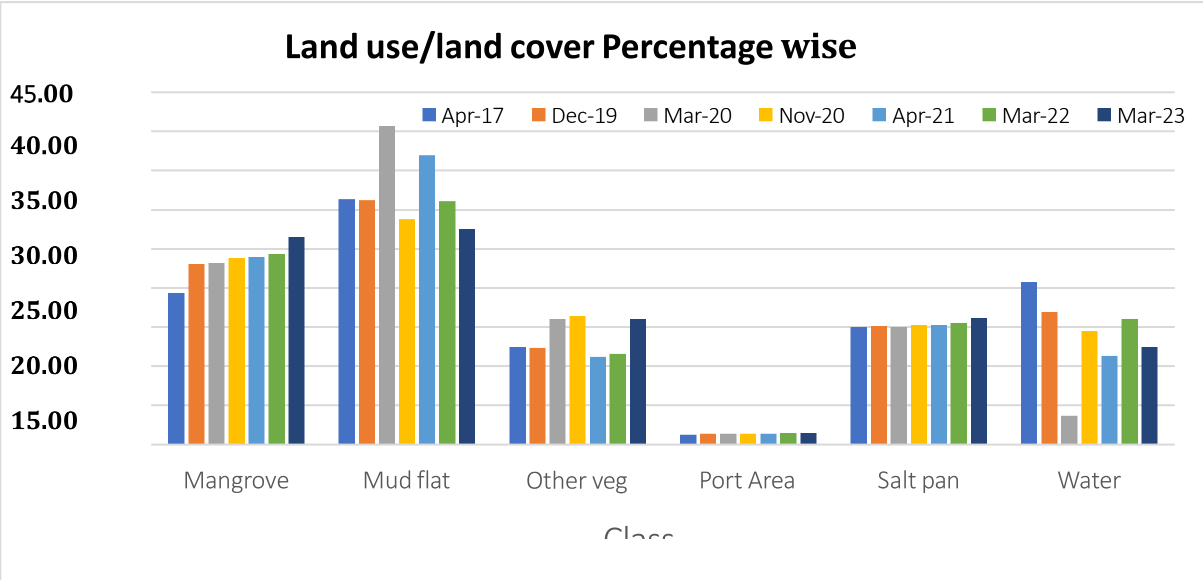
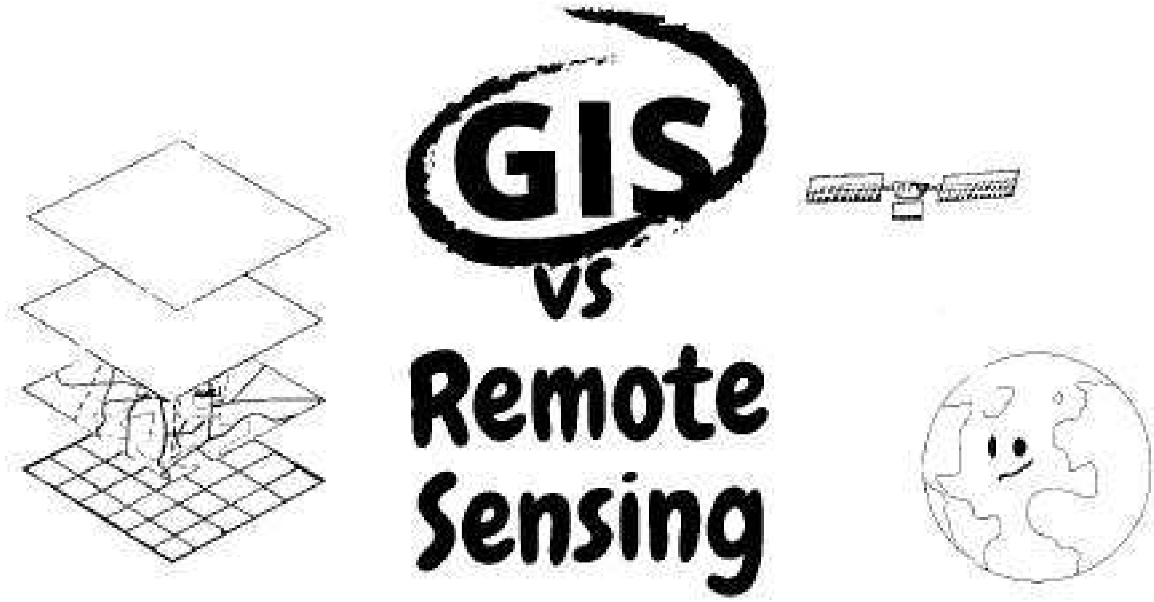


Figure 10. LU/LC Percentage area for the period 2017 to 2023 in Deendayal Port Authority

Table 10. Land use /land cover Percentage wise in the vicinity of DPA area for the study period 2017-2023

Month-Year	**Apr-17**	**Dec-19**	**Mar-20**	**Nov-20**	**Apr-21**	**Mar-22**	**Mar-23**
Class Name	Area (ha)						
Mangrove	19.32	23.06	23.17	23.86	23.97	24.33	26.52
Mudflat	31.30	31.18	40.72	28.77	36.91	31.09	27.55
Other veg	12.44	12.33	15.99	16.35	11.23	11.56	15.97
Port Area	1.24	1.35	1.35	1.35	1.35	1.44	1.44
Salt pan	15.02	15.12	15.06	15.20	15.24	15.55	16.10
Water	20.68	16.96	3.71	14.48	11.30	16.03	12.42
Total	100	100	100	100	100	100	100



3. Methodology

3.1.Physico-chemical Parameters, Water and Sediment

A port is a location on a coast or shore containing one or more harbors where ships can dock and transfer people or cargo to or from land. Port locations are selected to optimize access to land and navigable water, for commercial demand, and for shelter from wind and waves. Harbors can be natural or artificial. An artificial harbor has deliberately constructed breakwaters, sea walls, or jetties, or otherwise, they could have been constructed by dredging, and these require maintenance by further periodic dredging.Ports are economic instruments for trade and a vital component in the nation's economy. Nevertheless, port activities such as land reclamation, dredging and large-scale construction and its continuous expansion negatively affect the marine ecosystems in its vicinity.

In a port environment, activities like dredging, continuous movement of vessels and humans create major impacts at the marine/coastal environment and the living resources. This will have several impacts on the coastal environmental health which can be reflected by the nature of the physico-chemical characteristics of water which in turn indicates in its productivity. The change in productivity pattern of the marine environment is highly influenced by the flow of nutrients which generally originates from natural and anthropogenic sources. This change in quality of marine water, impacts the composition and availability of aquatic organisms directly and also affects the natural process in the marine ecosystem biological component, coral reefs and seagrass habitats etc. Similar to water, marine sediments also receive pollutants / such as heavy metals, petroleum hydrocarbons, polyaromatic hydrocarbons, polychlorinated biphenyls etc as contaminants from various activities, both off shore and on shore near ports and harbours. Hence assessing the water and sediment characteristics is imperative to understand the environmental changes and to suggest scientific interventions to restore the ecosystem integrity

3.1.1. Sampling Parameters & Water sample collection

Sampling was carried out for the coastal water (surface) and sediment for the determination of physical and chemical characteristics from the prefixed sampling sites. The biological parameters (benthic and pelagic fauna, flora and productivity) were also estimated (Table 11).

Table 11: Physico-chemical and biological parameters analysed

Parameters	
Water	**Mangrove & Other Flora**
pH	**Mangrove**
Temperature	Vegetation structure, density
Salinity (ppt)	Diversity
Dissolved oxygen	Height
Total Suspended Solids (TSS)	Canopy and other vegetation characteristics
Total Dissolved solids (TDS	**Halophytes:**
Turbidity	Percentage of distribution and cover
Nutrients	Diversity
Nitrate (NO_3)	**Seagrass and Seaweed**
Nitrite (NO_2)	Occurrence, distribution, and diversity
Phosphate	**Intertidal fauna**
Silicate	Composition, distribution, diversity, density and other characteristics
Petroleum Hydrocarbon (PHs)	**Mammals**
Sediment	**Avifauna**
Texture	Density, diversity, composition, habitat,
Bulk density	Threatened and endangered species and characters
Total organic carbon (TOC)	
Biological Parameters	
Phytoplankton- Genera, abundance, diversity and biomass	
Productivity-Chlorophyll a	
Zooplankton – Species, abundance, diversity	
Macrobenthos - genera, abundance, diversity	
Fishery Resources	
Common fishes available	
composition, diversity	
Catch Per Unit Effort (CPUE)	

The water samples were collected from each pre-designated sites in pre-cleaned polyethylene bottles. Prior to sampling, the bottles were rinsed with sample water to be collected and stored in an ice box for transportation to laboratory and refrigerated at 4°C till further analysis. The analysis of the water quality parameters was carried out by following standard methods (APHA, 2017). All extracting reagents were prepared using metal-free, AnalaR grade chemicals (Qualigens Fine Chemicals Division of Glaxo SmithKline Pharmaceuticals Limited, Mumbai) and double distilled water prepared from quartz double distillation assembly. There is one water sample will be collect from each designated sampling locations and period of survey will be carried out June to September as Monsoon, October to January will be designated as Post-monsoon and February to May will be designated as Pre-monsoon.

3.1.2.pH and Temperature

A Thermo fisher pH / EC / Temperature meter was used for pH and temperature measurements. The instrument was calibrated with standard buffers just before use.

3.1.3.Salinity

A suitable volume of the sample was titrated against silver nitrate (20 g/l) with Potassium chromate as an indicator. The chlorinity was estimated, and from that, salinity values were derived using a formula (Strickland and Parsons,1972).

3.1.4.Total Suspended Solids (TSS)

About 100 ml of the water sample was filtered through pre-weighed filter paper and placed in the Hot Air Oven at a specified temperature as per the protocol for 1 hour. The filter paper was allowed to cool in a desiccator to obtain a constant weight by repeating the drying and desiccation steps.

3.1.5. Total Dissolved Solids (TDS)

The water samples were subjected for gravimetric procedure for confirmation of the readings obtained from the hand -held meter. About 100 ml of the water sample was taken in a beaker and filtered, which was then dried totally in a Hot Air Oven (105°C). The TDS values were calculated using the difference in the initial and final weight of the container.

3.1.6.Turbidity

The sample tube (Nephelometric cuvette) was filled with distilled water and placed in the sample holder. The lid of the sample compartment was closed. By adjusting the‘ SET ZERO’ knob, the meter reading was adjusted to read zero. The distilled water was removed, the 40 NTU standard solutions were filled in the tube, and the meter reading was set to read 100. Other standards were also run. The turbidity of the marine water sample was then found by filling the sample tube with the sample, and the reading was noted.

3.1.7. Dissolved Oxygen (DO)

The amount of dissolved oxygen (DO) was determined by Winkler’s method (Strickland and Parsons,1972).

3.1.8.Phosphate

Acidified Molybdate reagent was added to the sample to yield a phosphomolybdate complex that is reduced with Ascorbic acid to a highly coloured blue compound, which is measured at the wavelength of 690 nm in a Spectrophotometer (Shimadzu UV 5040). The Phosphorus compounds in the sample were oxidized to phosphate with alkaline Potassium per sulphate at high temperature and pressure. The resulting phosphate was analyzed and described as total phosphorous (APHA,2017).

3.1.9. Silicate

The determination of dissolved silicon compounds in natural waters is based on the formation of a yellow silicomolybdic acid when an acid sample is treated with a molybdate solution. It is Spectrophotometrically measured by absorbance (810 nm for maximum absorbance and 660 for about 40% by adopting method of Grasshoff et.al. (1999).

3.1.10.Nitrite

Nitrite in the water sample was allowed to react with Sulphanilamide in acid solution. The resulting diazo compound was reacted with N-1-Naphthyl ethylenediamine dihydrochloride to form a highly coloured azo-dye. The light absorbance was measured at the wavelength of 543 nm in Spectrophotometer (Shimadzu UV 5040).

3.1.11.Nitrate

The Nitrate content was determined as nitrite (as mentioned above) after its reduction by passing the sample through a column packed with amalgamated Cadmium.

3.1.12.Petroleum Hydrocarbon (PHs)

The water sample (1liter) was extracted with Hexane and the organic layer was separated, dried over anhydrous sulphate and reduced to 10 ml at 30°C under low pressure. Fluorescence of the extract was measured at 360 nm (excitation at 310 nm) with Saudi Arabian crude residue as a standard. The residue was obtained by evaporating lighter fractions of the crude oil at 120°C.

3.2 Sediment Characteristic (Sediment sampling)

Sediment samples were collected from the prefixed stations by using a Van Veen grab having a mouth area of 0.04m^2 or by a non-metallic plastic spatula. Sediment analysis was carried out by using standard methodologies. In each location (grid), sediment samples were collected from three different spots and pooled together to make a composite sample, representative of a particular site. The collected samples were air dried and used for further analysis.

3.2.1.Sediment Texture

For texture analysis, specified unit of sediment sample was passed through sieves of different mesh size as per Unified Soil Classification System (USCS). Cumulative weight of the fraction retained in each sieve was calculated starting from the largest sieve size and adding subsequent sediment weights from the smaller size sieves (USDA,1951). The percentage of the various fractions was calculated from the weight retained and the total weight of the sample. The cumulative percentage was calculated by sequentially subtracting percent retained from the 100%.

3.2.2.Total Organic carbon

Percentage of organic carbon in the dry sediment was determined by oxidizing the organic matter in the sample by Chromic acid and estimating the excess Chromic acid by titrating against Ferrous ammonium sulphate with Ferroin as an indicator (Walkley and Black, 1934).

3.3. Biological Characteristics of water and Sediment

3.1.1.Primary productivity

Phytoplankton possess the plant pigment chlorophyll 'a' which is responsible for synthesizing the energy for metabolic activities through the process of photosynthesis in which CO_2 is used and O_2 is released. It is an essential component to understand the consequences of pollutants on the photosynthetic efficiency of phytoplankton in the system. To estimate this, a known volume of water (500 ml) was filtered through a 0.45 µm Millipore Glass filter paper and the pigments retained on the filter paper were extracted in 90% Acetone. For the estimation of chlorophyll 'a' and pheophytin pigments the fluorescence of the Acetone extract was measured using Fluorometer before and after treatment with dilute acid (0.1N HCL) (Strickland and Parsons,1972).

3.1.2.Phytoplankton

Phytoplankton samples were collected from the prefixed 15 sampling sites from the coastal water in and around DPA location using standard plankton net with a mesh size of 25µm and a mouth area of 0.1256 m^2 (20 cm radius). The net fitted with a flow meter (Hydrobios) was towed from a motorized boat moving at a speed of 2 nautical miles/hr. The Plankton adhering to the net was concentrated in the net bucket by splashing seawater transferred to a pre-cleaned and rinsed container and preserved with 5% neutralized formaldehyde and appropriately labelled indicating the details of the collection, and stored for further analysis. The Quantitative analysis of phytoplankton (cell count) was carried out using a Sedgewick-Rafter counting chamber. The density (No/l) was calculated using the formula: $N=n \times v/V$ (Where, N is the total No/liter, n is the average number of cells in 1 ml, v is the volume of concentrate; V is the total volume of water filtered. The identification was done by following the standard literature of Desikachary, (1987), Santhanam *et.al*. (2019) and Kamboj *et.al*. (2018).

3.1.3.Zooplankton

Zooplankton samples were collected using a standard zooplankton net made of bolting silk having 50µm with mouth area of 0.25 m^2 fitted with a flow meter. The net was towed from a boat for 5 minutes with a constant boat speed of 2 nautical miles/hr. The initial and final reading in the flow meter was noted down and the plankton concentrate collected in the bucket was transferred to appropriately labelled container and preserved with 5% neutralized formaldehyde. One ml of the zooplankton concentrate was added to a Sedgwick counting chamber and observed under a compound microscope and identified by following standard literature. The group/taxa were identified using standard identification keys and their number was recorded. Random cells in the counting chamber were taken for consideration and the number of zooplankton was noted down along with their binomial name. This process was repeated for five times with 1 ml sample and the average value was considered for the final calculation. For greater accuracy, the final density values were counter-checked and compared with the data collected by the settlement method.

3.1.4.Intertidal Fauna

The Intertidal faunal assemblages were studied for their density, abundance and frequency of occurrence during Pre-monsoon 2025 at the pre-fixed 15 sampling locations within the DPA jurisdiction. Sample collection and assessment of intertidal communities were done in the intertidal zone during the low tide period. At each site, 1 x1m^{2}quadrates were placed randomly and all visible macrofaunal organisms encountered inside the quadrate were identified, counted and recorded. At each site, along the transects which run perpendicular to the waterfront, three to six replicate quadrate samples were assessed for the variability in macro-faunal population structure and the density was averaged for the entire intertidal belt. Organisms, which could not be identified in the field, were preserved in 5% formaldehyde, brought to the laboratory and identified using standard identification keys (Abott, 1954; Vine, 1986; Rao, 2003; 2017; Psomadakis *et al.,* 2015; Naderloo 2017; Ravinesh *et al.* 2021; Edward *et al.,* 2022). Average data at each site were used to calculate the mean density (No/m^2).

3.1.5.Sub tidal macro benthic Fauna

The sampling methods and procedures were designed in such a way to obtain specimens in the best possible condition as to maximize the usefulness of the data obtained. For studying the benthic organisms, triplicate samples were collected at each station using Van Veen grab, which covered an area of 0.04m^2. The wet sediment was passed through a sieve of mesh size 0.5 mm for segregating the organisms. The organisms retained in the sieve were fixed in 5-7% formalin and stained further with Rose Bengal dye for ease of spotting at the time of sorting. The number of organisms in each grab sample was expressed as No. /10cm^2. All the species were sorted, enumerated and identified by following the available literature. The works of Day (1967), Hartman (1968), Rouse and Pleijel (2001), Robin *et al*., (2003), Amr (2021), were referred for polychaetes; Crane (1975), Holthuis (1993), Naderloo (2017). Xavier *et al*., (2020) for crustaceans; Subba

Rao (2017), Ravinesh *et al*. (2021) and Edward *et al*, (2022) for molluscs. Statistical analyses such as diversity indices and Univariate measures such as Shannon-Wiener diversity index (H'), Margalef's species richness (d), Simpson's dominance (D) were determined using Paleontological Statistics Software Package for Education and Data (PAST) version 3.2.1 (Hammer et al., 2001).

Plate 1: Estimation of intertidal fauna by the quadrate method

Plate 2a: Collection of Plankton

2 b. Collection macrobenthos in subtidal habitat

3.4. Mudflats

Mudflats are ecologically and socio-economically vital ecosystems that bring benefits to human populations around the globe. These soft-sediment intertidal habitats, with >10% silt and clay (Dyer, 1979), sustain global fisheries through the establishment of food and habitat (including important nursery habitats), support resident and migratory populations of birds, provide coastal defences, and have aesthetic value. Mudflats are intimately linked by physical processes and dependent on coastal habitats, and they commonly appear in the natural sequence of habitats between subtidal channels and vegetated salt marshes. In some coastal areas, which may be several kilometres wide and commonly form the largest part of the intertidal area. Mudflats are characterized by high biological productivity and abundance of organisms but low in species diversity with few rare species. The mudflat biota reflects the prevailing physical conditions of the region. Intertidal mudflats can be separated into three distinct zones such as the lower tidal, middle and upper mudflats. The lower mudflats lie between mean low water neap and mean low water spring tide levels, and are often subjected to strong tidal currents. The middle mudflats are located between mean low water neaps and mean high water springs. The upper mudflats lie between the mean high-water neap and mean high water springs. The upper mudflats are the least inundated part and are only submerged at high water by spring tides (Klein, 1985). Salt marsh vegetation may colonize as far seaward as mean high water neaps. Mudflats will often continue below the level of low water spring tides and form sub-tidal mudflats (McCann, 1980). The upper parts of mudflats are generally characterized by coarse clays, the middle parts by silts, and the lower region by sandy mud (Dyer *et al*., 2000). The intertidal mudflats are prominent sub-environments that occurred on the margin of the estuaries and low relief sheltered coastal environments. The fine-grained sediments of intertidal mudflats (70%-90%) are derived from terrestrial and marine regions (Lesuerd *et.al.*,2003). Estuarine mudflats are potential sites for deposition of organic matter derived from terrigenous, marine, atmospheric and anthropogenic sources and are mainly associated with fine grained particles (Wang *et.al*., 2006).

Plate 3. Sediment sample collection at mangrove and mudflat areas

Sampling locations

The Sediment samples were collected from 15 sampling locations by using sediment corer. From each site triplicate samples were collected from up to 100 cm depth with four intervals (0-25cm, 25-50cm, 50-75cm & 75-100cm) and made into composite sample for analysis. The samples were packed in zip lock bags, stored in icebox and shifted to the laboratory for subsequent analysis.

Total Organic Carbon

The organic carbon content of the mudflat sediment was estimated to assess the biological productivity of the sediment. Soil Organic Carbon (SOC) was estimated following the method of Walkley and Black (1934). In this method, organic matter (humus) in the soil gets oxidized by Chromic acid (Potassium dichromate plus concentrated H2SO4) by utilizing the heat evolved with the addition of H_2SO4. The unreacted dichromate is determined by back titration with Ferrous ammonium sulphate (redox titration). Organic carbon was determined by following the below given formula:

$$\text{Oxidizable organic carbon (\%)} = \frac{10\ (B - T)}{B} \times 0.003 \times \frac{100}{\text{wt. of soil}}$$

Where B = volume (mL) of Ferrous ammonium sulfate required for blank titration.T = volume of Ferrous ammonium sulfate needed for soil sample. Wt. =weight of soil (g).

Estimation of Bulk Density (BD)

The soil under field condition exists as a three-phase system viz. solid (soil particles), liquid (water) and gas (mostly air). The soil organic matter contained in a unit volume of the soil sample is called its bulk density. The amount of bulk density depends on the texture, structure and organic matter status of the soil. High organic matter content lowers the bulk density, whereas compaction increases the bulk density. To determine the bulk density of the sediment samples collected during the present study, the oven-dry weight of a known sediment volume was considered, and mass per unit volume was calculated (Maiti, 2012).

3.5. Mangrove assessment

Mangroves are widely distributed on the Deendayal Port Authority jurisdiction area along the Kandla coast. The 15 sites were selected at the different creeks belong to Deendayal Port Authority jurisdiction to represent the mangroves status in Kandla. The mangrove stations in this study were named Tuna, Jangi, Kandla, Phan and Navlakhi based on the closeness of the location to the respective creek system. The Point Centered Quadrate Method (PCQM) was used for the collection of data of the mangrove vegetation structure. The data included, measurements of density of plants, height variations, canopy and basal girth of mangrove trees as per the method of Cintron and Novelli (1984). For this method, a transect of a maximum of 200 m was applied mostly perpendicular or occasionally parallel to the creek. The sampling points were considered at an interval of every 10 m and the vegetation structure of the that area were recorded. As the orientation of the transect line was already fixed, it was easy for movements within the station area for data recording. The distance between trees from the centre of the sampling point to the nearest 4 trees of four different directions, height of trees from the ground level, canopy length and canopy width were measured to determine the canopy cover in this study. The equipments utilized in the field were handy, and easy to use such as ranging rods, pipes and for measurement of girth at root collar above the ground (GRC), a measuring tape was used. The plants with a height <50 cm was considered as regeneration class and >50 cm but <100 cm was considered as recruitment class. Along the transects, sub-plots of 1×1 m^2 for regeneration and 2×2 m^2 were laid randomly for recruitment class of the mangrove sites.

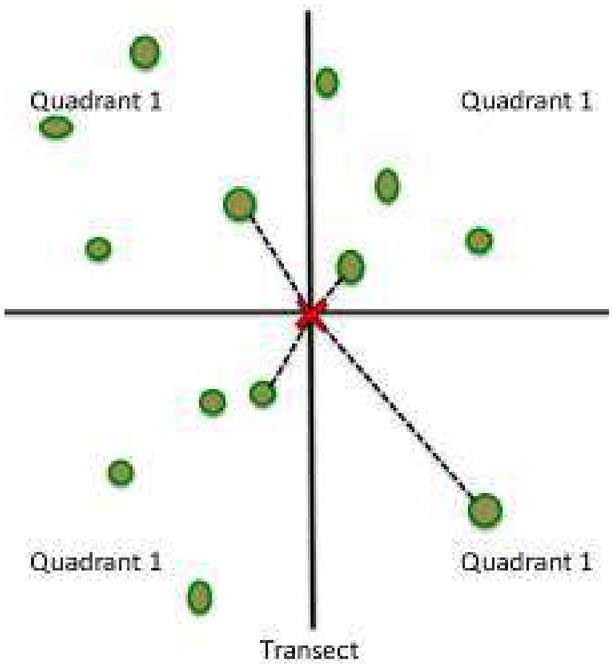


Figure 11 . Point Centred Quadrate Method

Plate 4: Assessment of mangrove density, height, canopy cover and girth

3.6. Halophytes

To quantify and document the halophytes at Deendayal Port Authority region, quadrate method was followed. At each sampling location quadrates of various sizes have been laid during every seasonal sampling. For recording the plant density at each transect, a quadrate 1 x 1m^2 has been laid within the site each tree quadrates were used randomly (Mishra,1968; Bonham, 1989). Four quadrates each for shrubs and herbs were laid in each tree quadrate to assess the halophytes and the percentage cover in the study area. To enrich the species inventory, areas falling outside the quadrates were also explored and the observed species were recorded and photographed and identified using standard keys. Specimens of the various species were collected to know more information on habitat and for the preparation of herbarium.

Plate 5: Assessment and percentage cover of halophyte

3.7. Marine Fishery

Fishery resources and the diversity were assessed from the selected sampling sites. Finfish and shellfish samples were collected using a gill net with a 10 mm mesh size. The net was operated onto the water from a canoe or by a person standing in waist deep water during the high tide using a cast net (Plate 6). For effective sampling, points were fixed at distances within the offshore sites for deploying fishing nets to calculate the Catch per Unit effort estimated per hour. The collected specimens were segregated into groups, weighed and preserved in 10% neutralized formalin solution. Finfishes were identified following Fischer and Bianchi (1984), Masuda *et al*. (1984), de Bruin et al. (1995) and Mohsin and Ambiak (1996). Relevant secondary information pertaining to fishery resources of Deendayal Port creek systems were gathered through technical reports, the District Fisheries department, Government gazette and other research publications.

Plate 6: Fisheries Information from DPA environment

3.8. Avifauna

The Avifauna population was determined along DPA mangrove stands for which the area was demarcated into fifteen major stations. In each station, creeks of varying lengths from 2 to 5 km are available. These creeks were surveyed by using boat and adopting "line transect" method. A total of fifteen boat transect (one in each site) survey was conducted in the Monsoon, Post -Monsoon and Pre-monsoon season (May 2024- May 2025. Survey was done in terrestrial habitats like mangrove plantations adjoining the mudflats, waste land, and aquatic habitats, like creek area, rivers and wetland.

Boat Surveys

Mangrove bird diversity was calculated by using Boat Survey method. Birds were observed from an observation post on board the boat which has given the greatest angle of clear view. Birds within a 100 meter transect on one side of the boat were counted in 10-minute blocks of time (Briggs *et al.* 1985; van Franeker, 1994). Detection of birds was done with a binocular (10 x 40) and counts were made: (1) continuously of all stationary birds (swimming, sitting on mangrove, or actively feeding) within the transect limits and (2) in a snap-shot fashion for all flying birds within the transect limits. The speed of the boat determines the forward limit of the snapshot area within a range of 100 meters. Longer or shorter forward distances were avoided by adapting the frequency of the snapshot counts. Birds that following and circling the boat were omitted from both snapshot and continuous counts. If birds arrive and then follow the boat, they were included in the count only if their first sighting falls within a normal snapshot or continuous count of the transect area. For each bird observation species, number of individuals and activity at the time of sighting, were recorded. Species richness and diversity index were calculated for different mangrove patches (i.e. fifteen station) of the study station in the Deendayal port Authority.Data collected in- situ and through laboratory analysis of samples were subjected to descriptive statistical analysis (PAST and Primer 7.0) for the mean, range and distribution of different variables from the selected 15 study stations.

Figure .12 Line transect method for Avifauna survey

3.9 Data analysis

Data collected in situ and through laboratory analysis of samples were subjected to descriptive statistical analysis (PAST) for the mean, range and distribution of different variables from the selected 15 study stations.

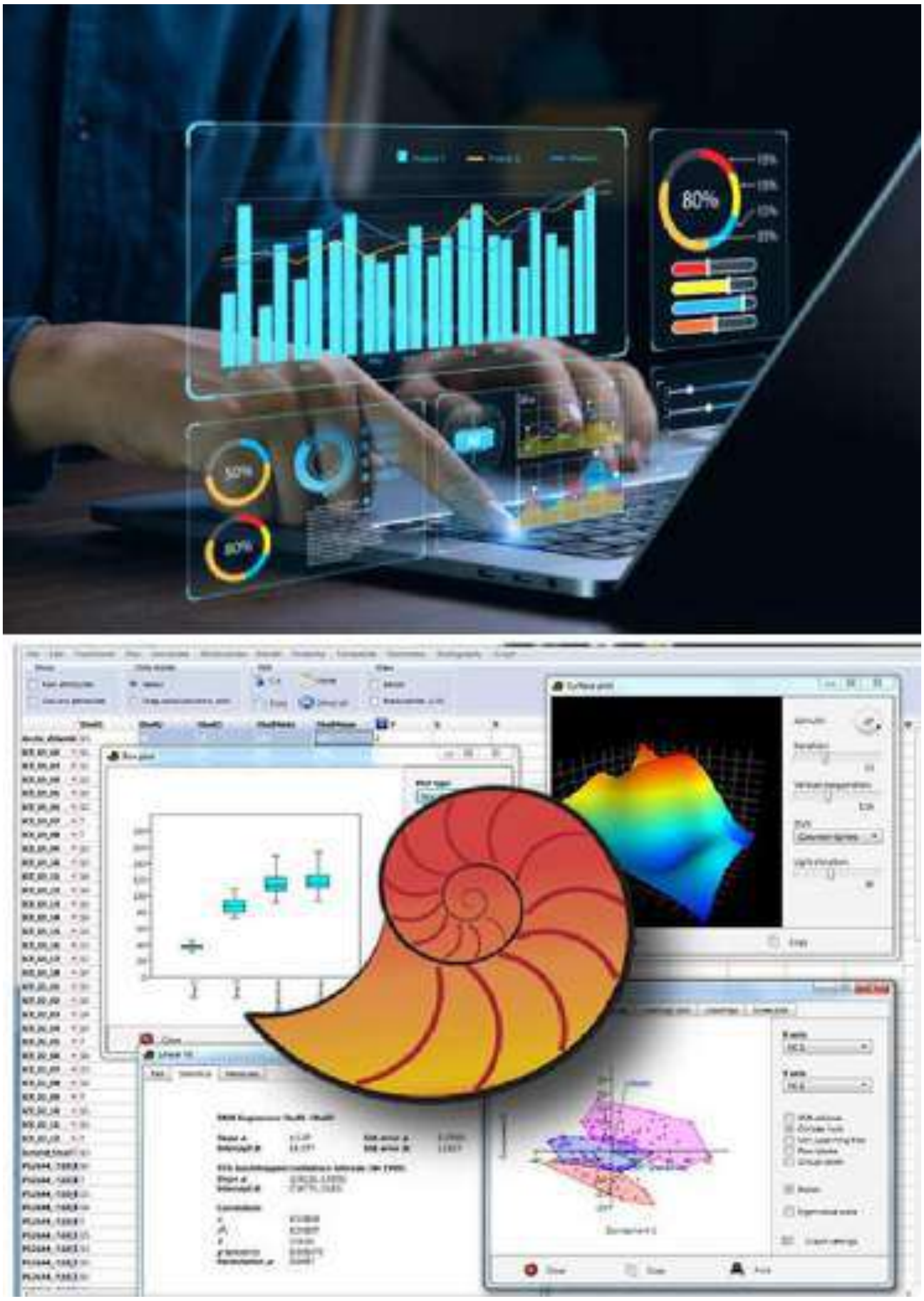


Plate 7 Statistical Data analysis methods

4.Results

4.1. Physico-Chemical Characteristics of water and Sediment

4.1.1.Water quality assessment

The data on the mean water quality parameters measured at the time of sampling of the biological components from the 15 study sites are presented in Table12.

Table-12 Physico-chemical characteristics of the DPA Jurisdiction From May 2024- May 2025

Parameter		Monsoon 2024	Post Monsoon 2024-25	Pre Monsoon 2025
Temperature (°C)	max	30	27	29
	min	23	12	25
pH	max	8.1	8.5	8.3
	min	7.7	7.3	7.8
Salinity	max	42	42	41
	min	34	32	32
Dissolved oxygen (mg/L)	max	8.2	7.7	5.3
	min	2.9	3.9	3.2
Total Suspended Solids (TSS) (mg/L	max	729	579	722
	min	205	222	253
Total Dissolved solids (TDS) (mg/L)	max	139862	95571	41300
	min	26876	9829	3035
Turbidity (NTU)	max	160	133	489
	min	20	38	61.4
Nitrate (NO3) (mg/L)	max	0.003	0.140	0.019
	min	0.001	0.020	0.009
Nitrite (NO2) (mg/L)	max	0.173	0.003	0.128
	min	0.001	0.001	0.003
Total Phosphorus (mg/L)	max	73.24	65.90	27.12
	min	36.18	30.60	3.16
Total silicate	max	0.058	0.07	4.48
	min	0.012	0.01	1.02
PHs (µg/L)	max	10.10	70.80	8.32
	min	1.20	2.50	0.19
Chlorophyll a (mg/L)	max	0.89	0.65	2.98
	min	0.04	0.04	0.12

Temperature (°C)

The values for the Temperature obtained from 15 different sampling station for all the three seasons (Monsoon, post monsoon and pre monsoon) have been represented in Figure 13. During monsoon, the value ranged from 23°C to 30°C while in post monsoon observation, the value ranged from 12°C to 27°C. However, in pre monsoon the values were noted in the range of 25°C to 29°C. During monsoon, the highest temperature was noted at station S-7 while the lowest temperature was noted at S-6 and S-15. In post-monsoon maximum temperature was recorded at S-2 and S-4 and lowest at S-15 while in pre-monsoon highest temperature exhibited at S-2 & S-8 and lowest temperature observed at S-10.

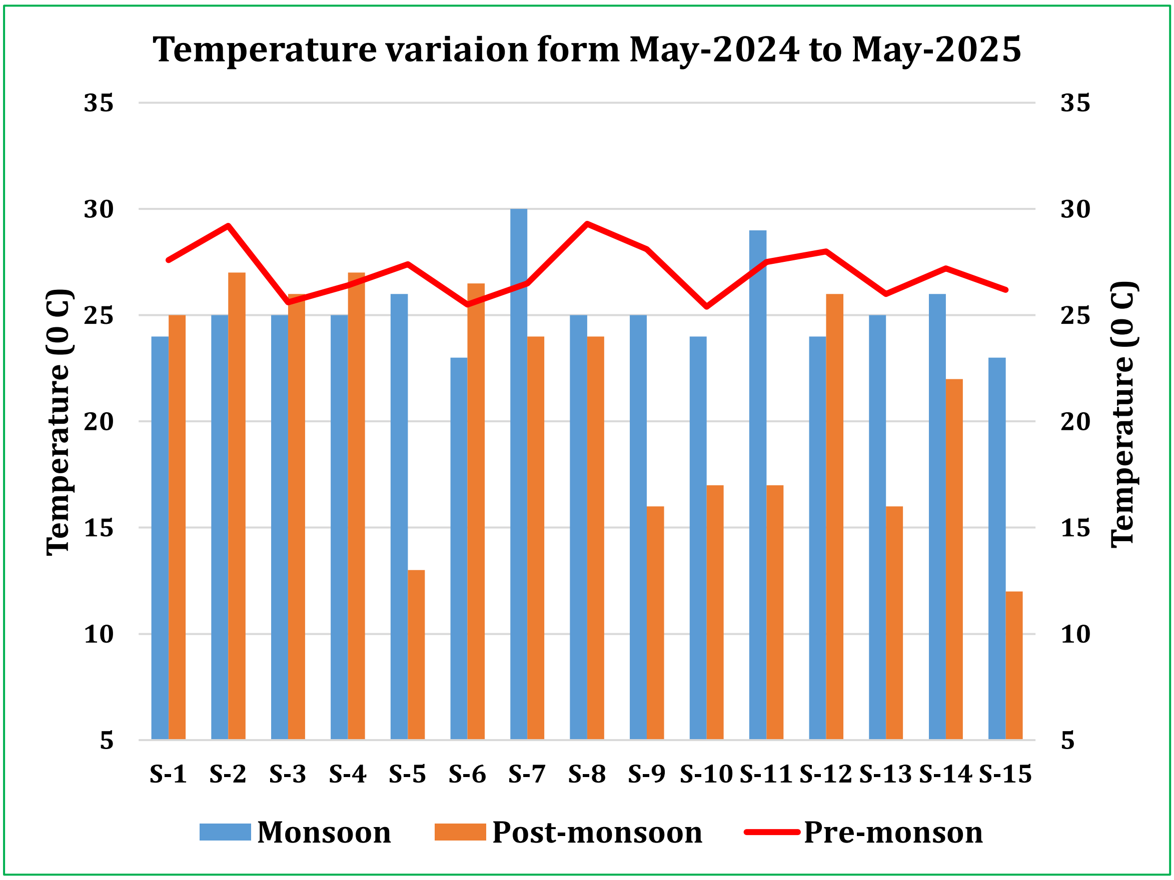


Figure 13. Temperature variation in DPA study sites during 2024-2025

The average temperature in Deendayal port authority jurisdiction varied from 21° C to 27°C in 3 seasons throughout the year.

pH

The pH obtained from 15 different sampling station for all the three seasons (Monsoon, post monsoon and pre monsoon) have been represented in Figure 12. During monsoon, the value ranged from 7.7 to 8.1 while in post monsoon observation, the value ranged from 7.3 to 8.5. However, in pre monsoon the values were noted in the range of 7.8 to 8.3. During monsoon, the highest pH was noted at station S-1, S-3, S-6, S-7, S-13, & S-14 while the lowest pH was noted at S-8 & S-11. On an average, the pH ranged between 7.3 to 8.5 throughout the year inclusive of all the three seasons.

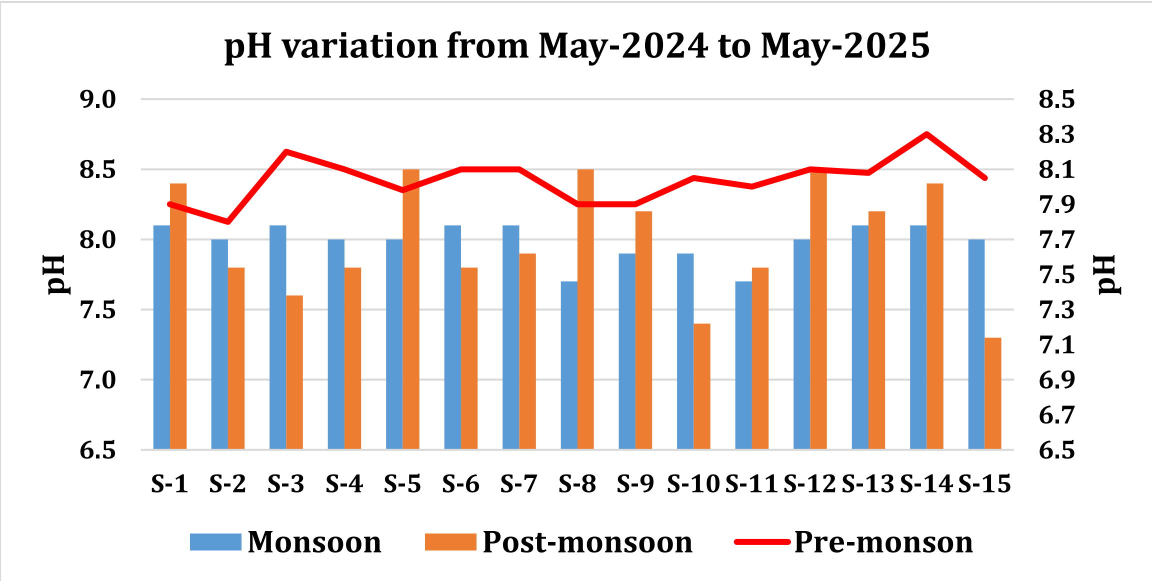


Figure 14. pH variation May 2024 to May 2025 in Deendayal Port Authority

Salinity (ppt)

The salinity obtained from 15 different sampling station for all the three seasons (Monsoon, post monsoon and pre monsoon) have been represented in Figure 15. During monsoon, the salinity ranged from 34 ppt to 42 ppt while in post monsoon observation, the value ranged from 32 ppt to 42 ppt. However, in pre monsoon the values were noted in the range of 32 ppt to 41 ppt. During pre-monsoon, the highest salinity was noted at stations S-10 & S-11 while the lowest salinity was recorded at S-5. It was observed that maximum salinity was recorded in pre-monsoon and post-monsoon seasons while the lowest was recorded during monsoon. The average salinity throughout the year in Deendayal port authority jurisdiction varied from 32 ppt to 42 ppt during 3 seasons.

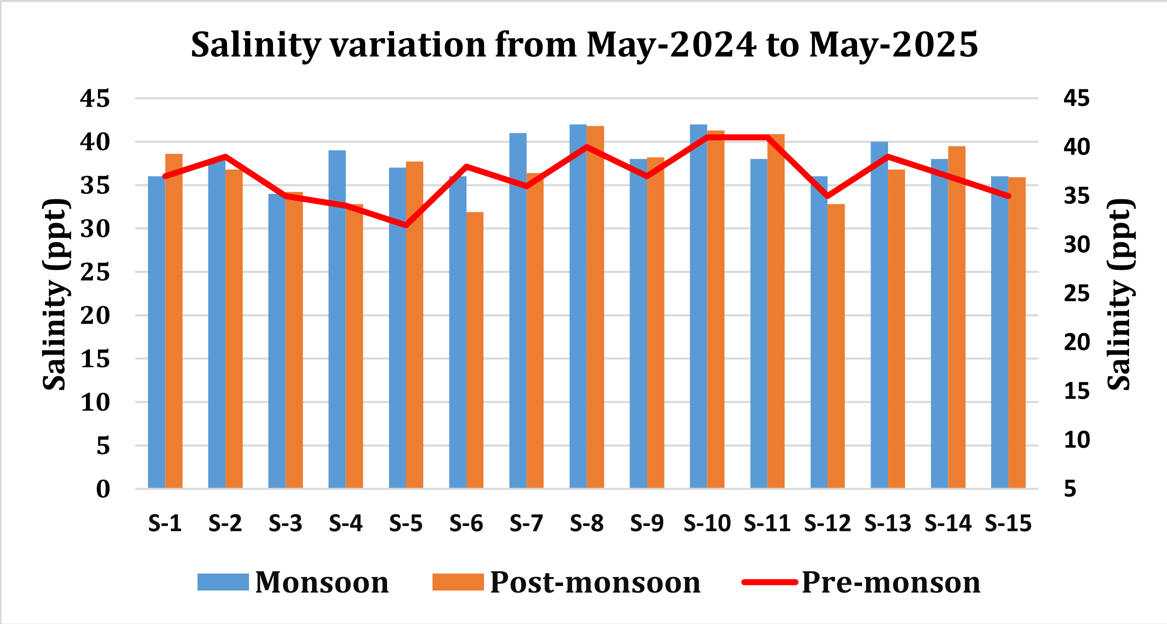


Figure 15. Seasonal variation of salinity during 2024-2025 at DPA

Dissolved oxygen (DO)

The maximum Dissolved Oxygen concentration of the sampling stations for three seasons varied from 5.3 mg/L to 8.2 mg/L with average of 4.1 mg/L to 5.8 mg/L from May 2024 to May 2025. The minimum DO values varied from 2.9 mg/L to 3.9 mg/L. The seasonal variation of water DO among stations is presented in Figure 16.

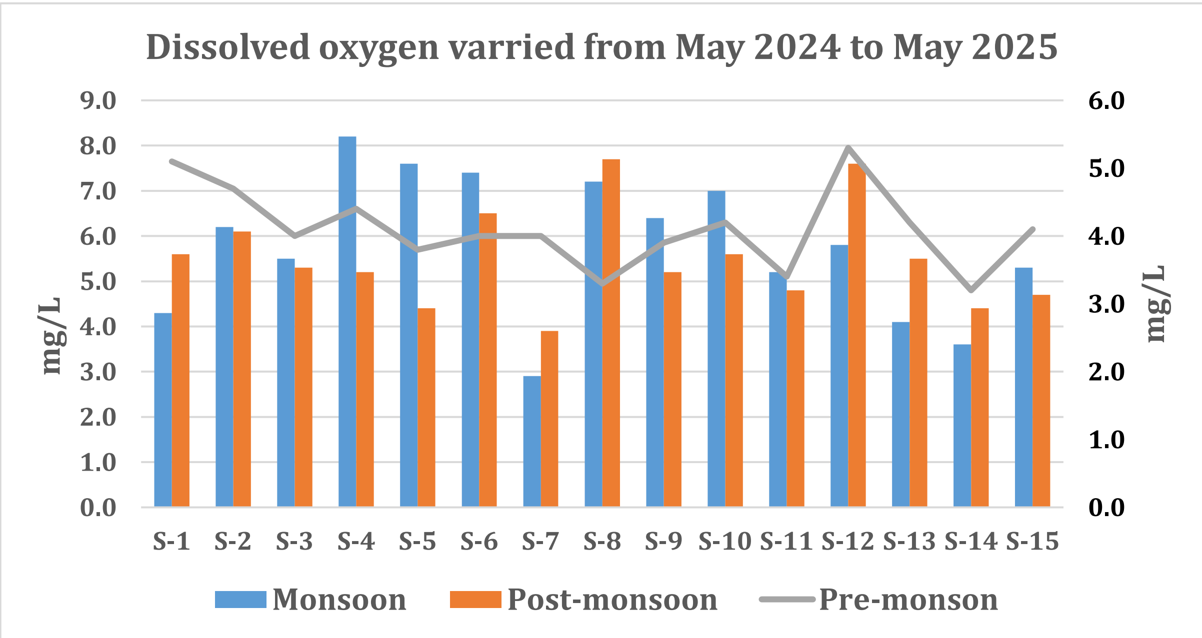


Figure 16. Seasonal variation Dissolved Oxygen from May 2024 to May 2025

During monsoon, the highest DO concentration was observed at station S-4 (8.2 mg/L), and the Lowest dissolved oxygen concentration was observed at S-7 (2.9 mg/L). In post-monsoon, the highest dissolved oxygen was observed at S-8 (7.7 mg/L) and the lowest value at S-7 (3.9 mg/L). During Pre-monsoon, the highest and lowest DO values were observed at stations S-12 (5.3 mg/L) and S-14 (3.2 mg/L) respectively.

Total Suspended Solids (TSS)

The values for the Total Suspended Solids (TSS) obtained from 15 different sampling sites for all the three seasons (Monsoon, post monsoon and pre monsoon) have been represented in Figure 15. During monsoon, the value ranged from 205 mg/L to 729 mg/L, while in post monsoon observation, the value ranged from 222 mg/L to 579 mg/L. However, in pre monsoon the values were noted in the range of 253 mg/L to 722 mg/L. During monsoon, the highest TSS was noted at site S-6 while the lowest TSS value was noted at S-13. The maximum TSS was obtained at S-15 and lowest at S-4 during post monsoon while site S-5 exhibited the highest TSS value and S-12 exhibited the lowest value during the pre-monsoon season (Figure 17).

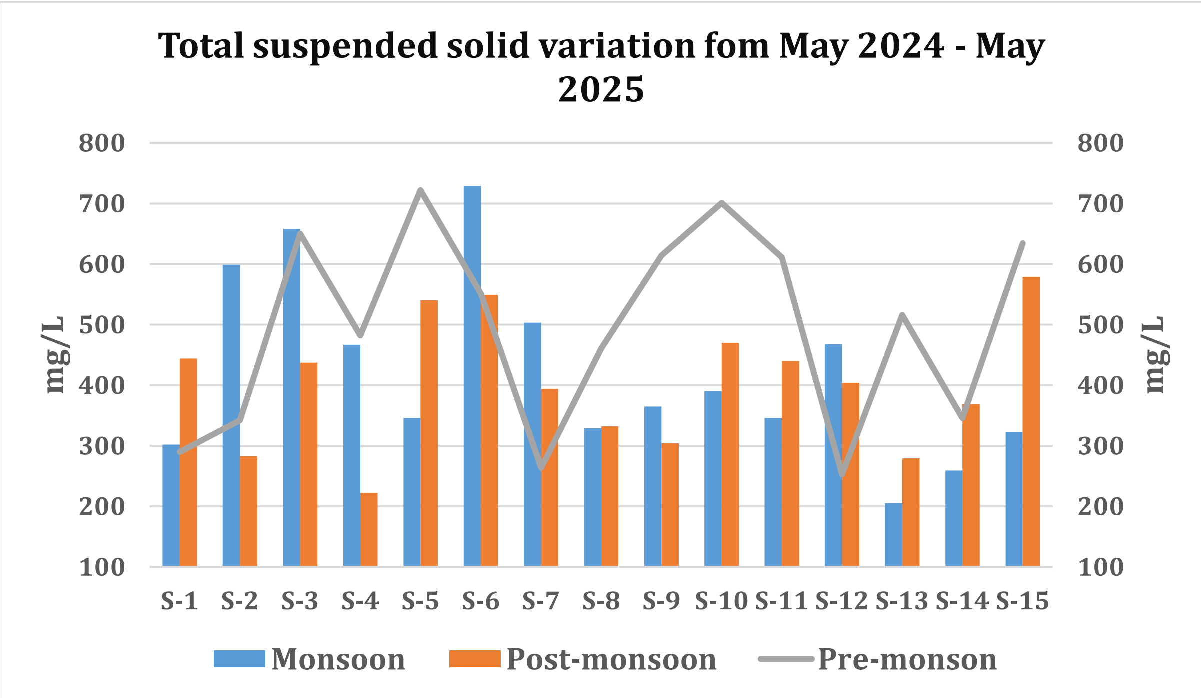


Figure 17 Seasonal variation of TSS during May 2024-May 2025

Total Dissolved solids (TDS)

The values for the Total Dissolved Solids (TDS) obtained from 15 different sampling sites for all the three seasons (Monsoon, post monsoon and pre monsoon) have been represented in Figure 18. During monsoon, the value ranged from 26876 mg/L to 139862 mg/L, while in the post monsoon observation, the value ranged from 9829 mg/L to 95571 mg/L. However, in pre monsoon the values were noted in the range of 3035 mg/L to 41300 mg/L. During monsoon, the highest TDS was noted at site S-10 while the lowest TDS value was noted at S-12. The maximum TDS was obtained at S-14 and the lowest was recorded at S-2 during post monsoon while site S-6 exhibited the maximum TDS value and S-12 showed the lowest value during the pre-monsoon season.

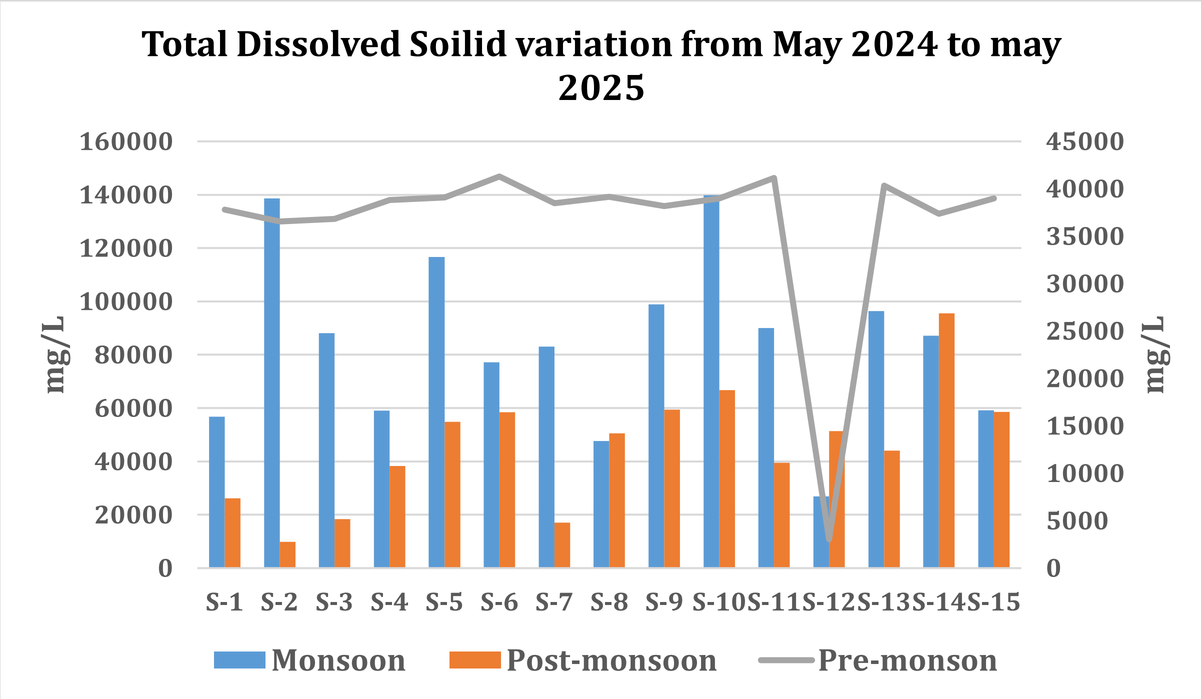


Figure 18 Total Dissolved Solids (TSS) from May 2024 to May 2025

Turbidity

The Turbidity of the sampling stations varied season wise from 20 NTU to 489 NTU for the period May 2024 to May 2025. The seasonal variation of water turbidity among the stations is presented in Figure 19.

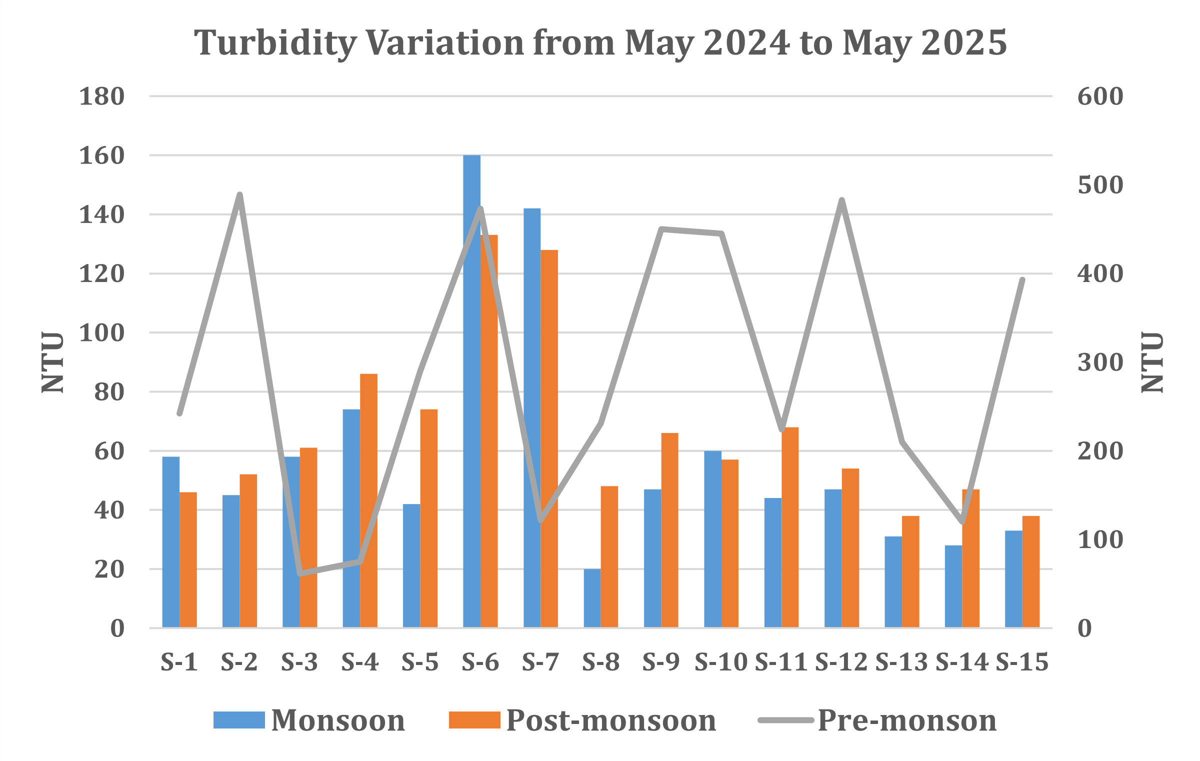


Figure 19 Seasonal variation during Turbidity from May 2024 to May 2025

During monsoon, the highest Turbidity was observed at S-6 (160 NTU) and the lowest was at S-8 (20 NTU). In post-monsoon, the highest Turbidity was observed at station S-6 (133 NTU) and the lowest was at stations S-13 & S-15 (38 NTU). Similarly in Pre-monsoon, the highest and lowest turbidity was observed at S-2 (489 NTU) and S-3 (61.4 NTU) respectively

Nitrate

The amount of Nitrate in the water sample is relatively low throughout the study period. The maximum Nitrate value for the three seasons was 0.140 mg/L from May 2024 to May 2025. This was noted at S-3 during post-monsoon study. The minimum Nitrate values noted during post monsoon were 0.020 mg/L and 0.009 mg/L (during pre-monsoon), both at site S-6. The seasonal variation of Nitrate content in water samples for all the stations is presented in figure 20. During monsoon, the highest Nitrate value observed was 0.003 mg/L at stations S-1, S-6, S-9, S-10 and S-15 whereas the lowest Nitrate value was 0.001 mg/L at station S-7. During post-monsoon study, the values increased and highest Nitrate was observed at S-3 (0.140 mg/L) and lowest at S-6 (0.020 mg/L).

Similarly in Pre-monsoon the highest (0.019 mg/L) and the lowest (0.009 mg/L) were reported S-11 & S-6 respectively.

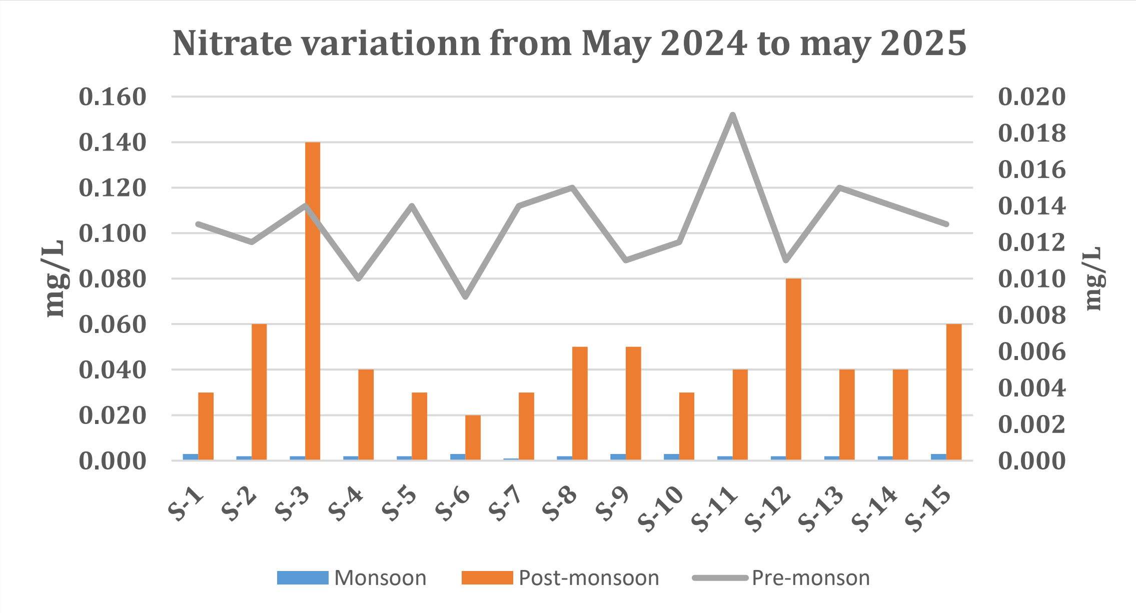


Figure 20. Seasonal variation of Nitrate concentration during May 2024 to May 2025

Nitrite

The amount of Nitrite in the water sample is relatively high compared to the nitrate content throughout the study period. The maximum Nitrite value for the three seasons was 0.173 mg/L from May 2024 to May 2025. This was noted at S-9 during monsoon study. The minimum Nitrite value noted during the study was 0.001 mg/L. The seasonal variation of Nitrite concentration is presented in Figure 21. During monsoon, the highest nitrite concentration was noted at S-9 (0.173 mg/L) and the lowest was recorded at S-14 (0.001 mg/L). In post-monsoon, the maximum value was found at S-1, S-6, S-8, S-12 and S-14 (0.003 mg/L) and lowest nitrite was observed at S-3, S-5, S-10 and S-15 (0.001mg/L). Similarly in Pre-monsoon, the highest nitrite content was (0.128 mg/L) and the lowest content (0.003 mg/L) was observed at S-1 and S-15 respectively.

Total Phosphorous

The total phosphate content at S-4 was highest during the pre-monsoon season during the study period. Seasonal observation revealed that the phosphate values were in the range of 3.16 mg/L to 73.24 mg/L. The seasonal variation for the total phosphorous among stations is presented in Figure 22.

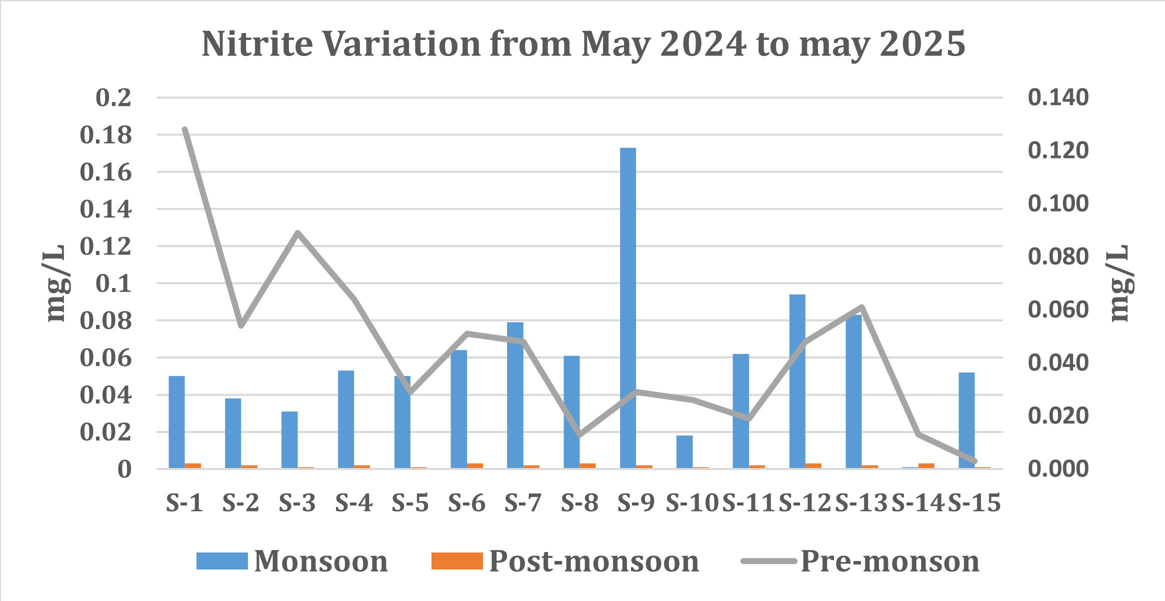


Figure 21. Nitrite concentration during May 2024 to May 2025

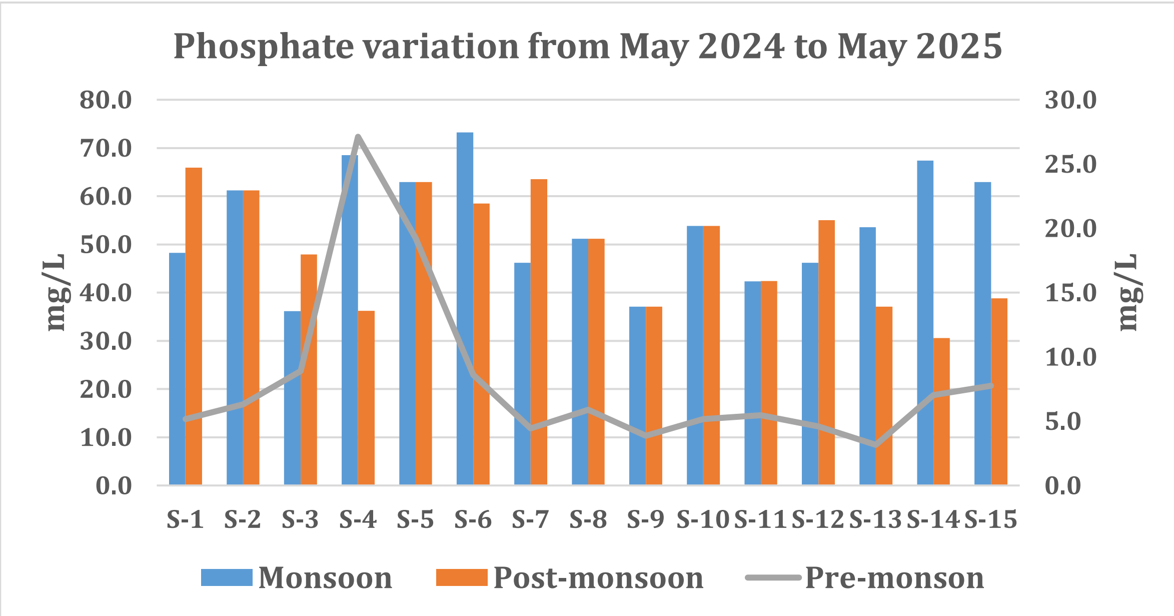


Figure 22 Seasonal variation Total Phosphorou sMay 2024 to May 2025

During Monsoon, the maximum value noted was 73.24 mg/L at (S-6) and the lowest was 36.18 mg/L at (S-3). In post-monsoon, the highest value was 65.90 mg/L at S-1 and 30.60 mg/L at S-14. In Pre-monsoon, the highest and the lowest values observed were 27.12 mg/L and 3.16 mg/L at S-4 and S-13 respectively.

Silicate

The total Silicate content at S-12 was highest during the Pre- monsoon during the study period. Seasonal observation revealed that the silicate values were in the range of 0.012 mg/L to 4.48 mg/L. The seasonal variation for the total silicates among stations is presented in Figure 23. During Monsoon, the maximum value noted was 0.058 mg/L at (S-15) and the lowest was 0.012 mg/L at (S-14). In post-monsoon, the highest and lowest value was 0.07 mg/L at S-15 and 30.01 mg/L at S-10. In Pre-monsoon, the highest and the lowest values observed were 4.48 mg/L and 1.02 mg/L at S-12 and S-13 respectively.

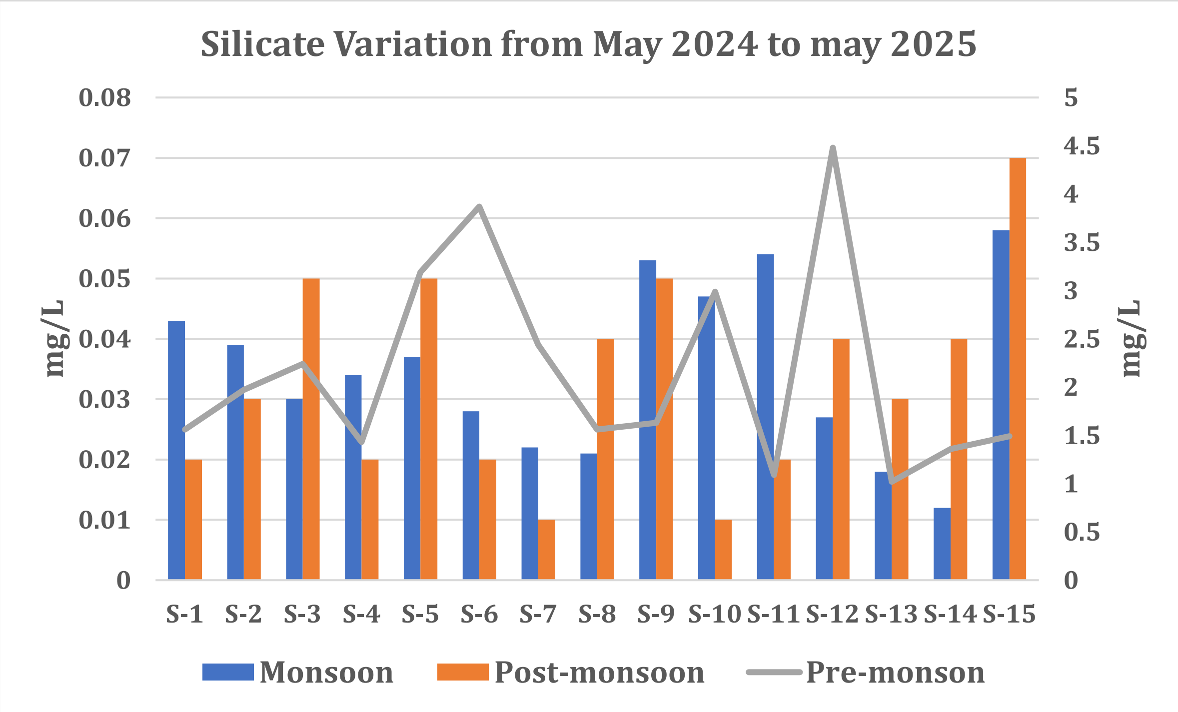


Figure 23. Seasonal variation of Silicate May 2024 to May 2025

4.1.2. Petroleum Hydrocarbon (PHs)

Petroleum Hydrocarbons (PHs) are widely recognized as the most extensively utilized fossil fuels in commercial applications (Kuppusamy et al., 2020). PHs serve as crucial raw materials across various industries and function as primary sources of energy (Varjani, 2017). However, their pervasive use has led to their identification as a major concern in terms of environmental contamination, posing significant threats to ecosystems due to their inherent stability and resilience. The category of PHs encompasses diverse components, including Polycyclic aromatic hydrocarbons (PAHs), alkanes, paraffin, cycloalkanes, organic pollutants, and non-hydrocarbon elements such as phenol, sulfur compounds, thiol, metalloporphyrin, heterocyclic nitrogen, naphthenic acid and asphaltene. The presence of PHs significantly impacts marine organisms, with bioaccumulation of harmful PHs in the aquatic food chain persisting for extended periods. This, in consequence, affects primary producers, primary consumers, and secondary consumers. Notably, approximately 90% of PH discharges are attributed to anthropogenic activities, particularly oil spills, occurring in both terrestrial and marine environments. Reports indicate an alarming annual discharge of around 8.8 million metric tonnes of oil into aquatic environments (Periathamby and Dadrasnia, 2013).

The PHs values were comparatively high at S-7 and S-8 during post-monsoon than the other seasons. The values for Petroleum Hydrocarbons (PHs) for the three-season varied from 0.19 µg/L to 70.80 µg/L (Figure 24). The PHs concentration in general, is at low level during monsoon and pre-monsoon. During monsoon, the highest PHs were observed at S-4 (10.10 µg/L) and lowest PHs were observed along S-5 (1.20 µg/L). Similarly in Pre-monsoon, the maximum PH content was recorded (8.3 µg/L) at S-4 and the minimum was (0.19 µg/L) at S-13. In post-monsoon, the highest PH value was observed at S-7 (70.80 µg/L) and the lowest PH was observed S-6 (2.50 µg/L).

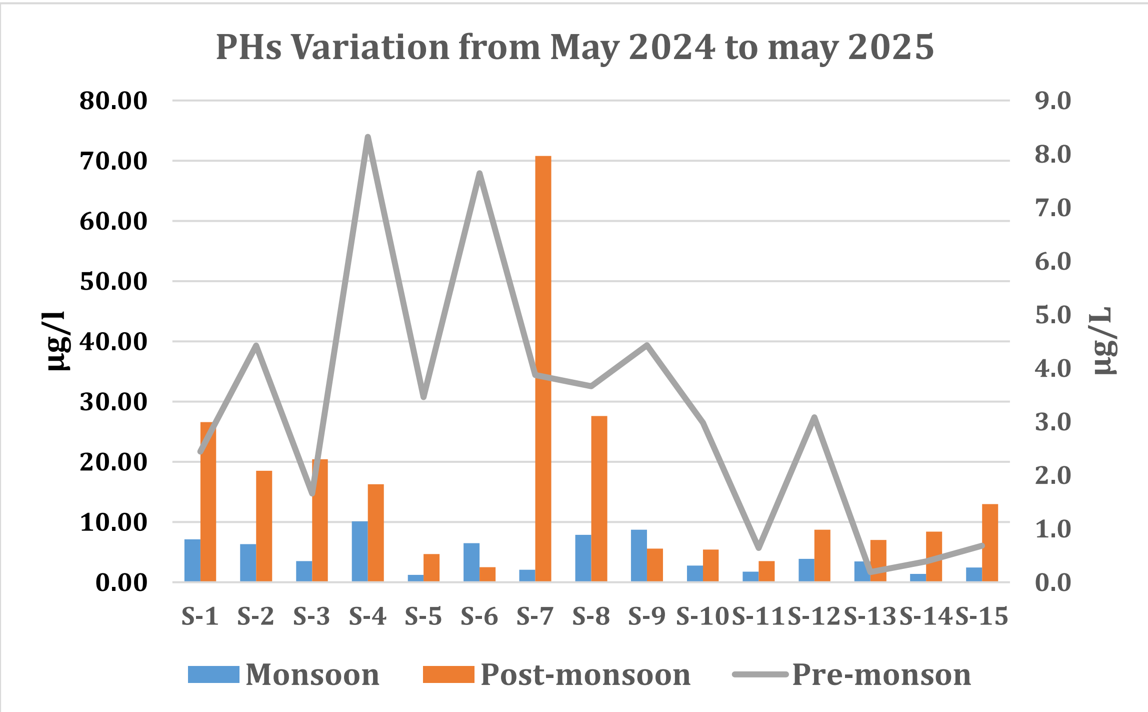


Figure 24 Seasonal Petroleum Hydrocarbon from May 2024 to May 2025

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4.1.3 Sediment

Sediment texture

The sediment texture of DPA environment and its premises is presented in figure 25. The textural content mostly include sand , silt and clay. The percentage composition varieds from season to season. Through out the study period from May 2024 to may 2025 ,average sand percentage is during monsoon is more followed by pre-monsoon and Post-monsoon. The clay percentage occupies 2nd percentage composition and the average percentage is more in post and Pre-monsoon followed by monsoon. Average percentage of clay more in post-monsoon followed by pre-monsoon and monsoon.

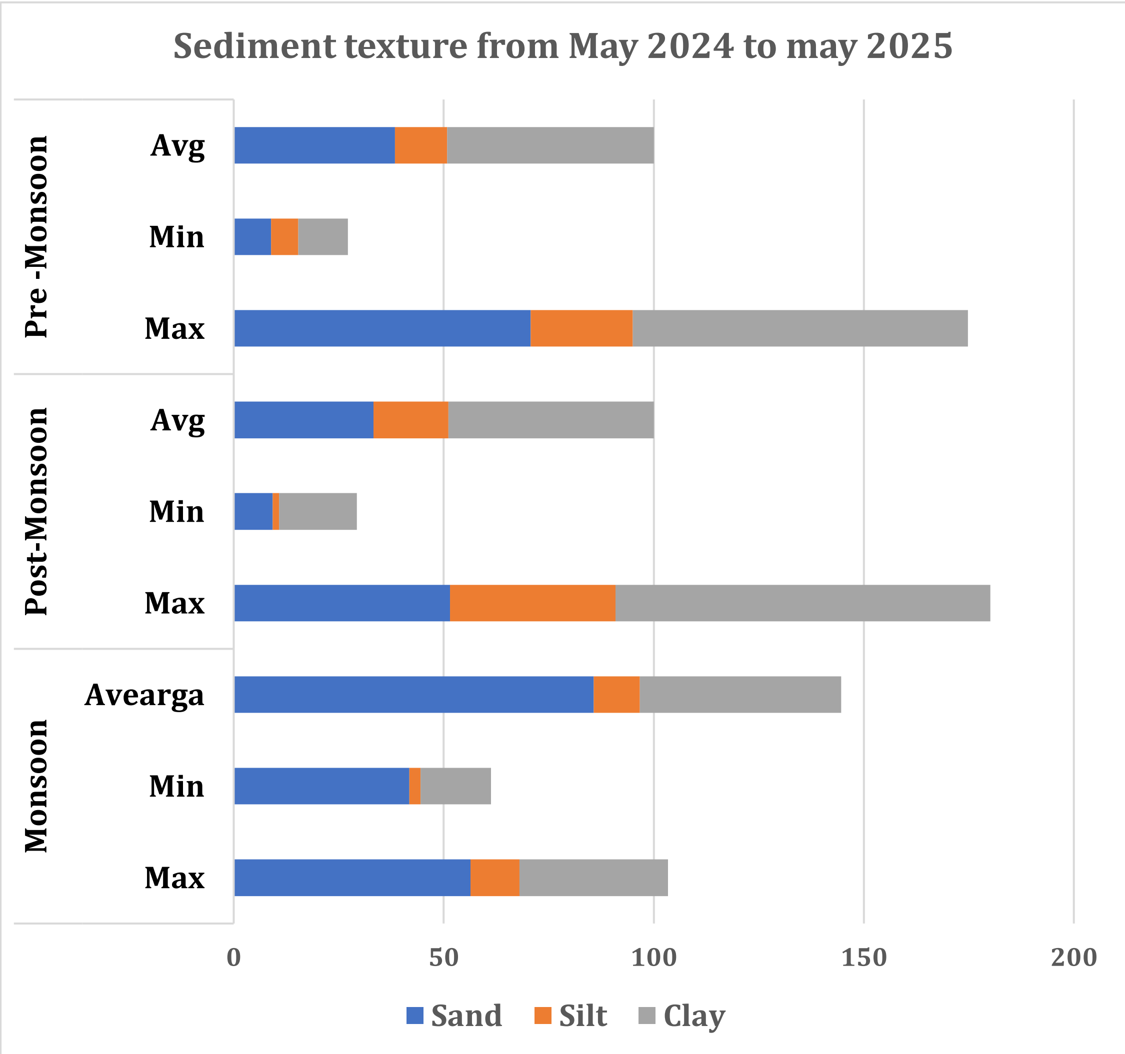


Figure 25. Soil textural chaacteristic from May 2024 to May 2025

4.1.4. Sediment total Organic Carbon (TOC)

The data on the total organic carbon of the sediment samples are presented (Figure 26). Among the station of DPA port area the maximum sediment carbon ranges from 1.2% to 3.2% and the minimum sediment carbon range was 0.5% to 2.4%. Station wise the highest sediment carbon was recorded at station S-12 during post-monsoon (3.2%), whereas lowest sediment carbon was recorded in station S-8 and S-9 during pre-monsoon (0.5%).

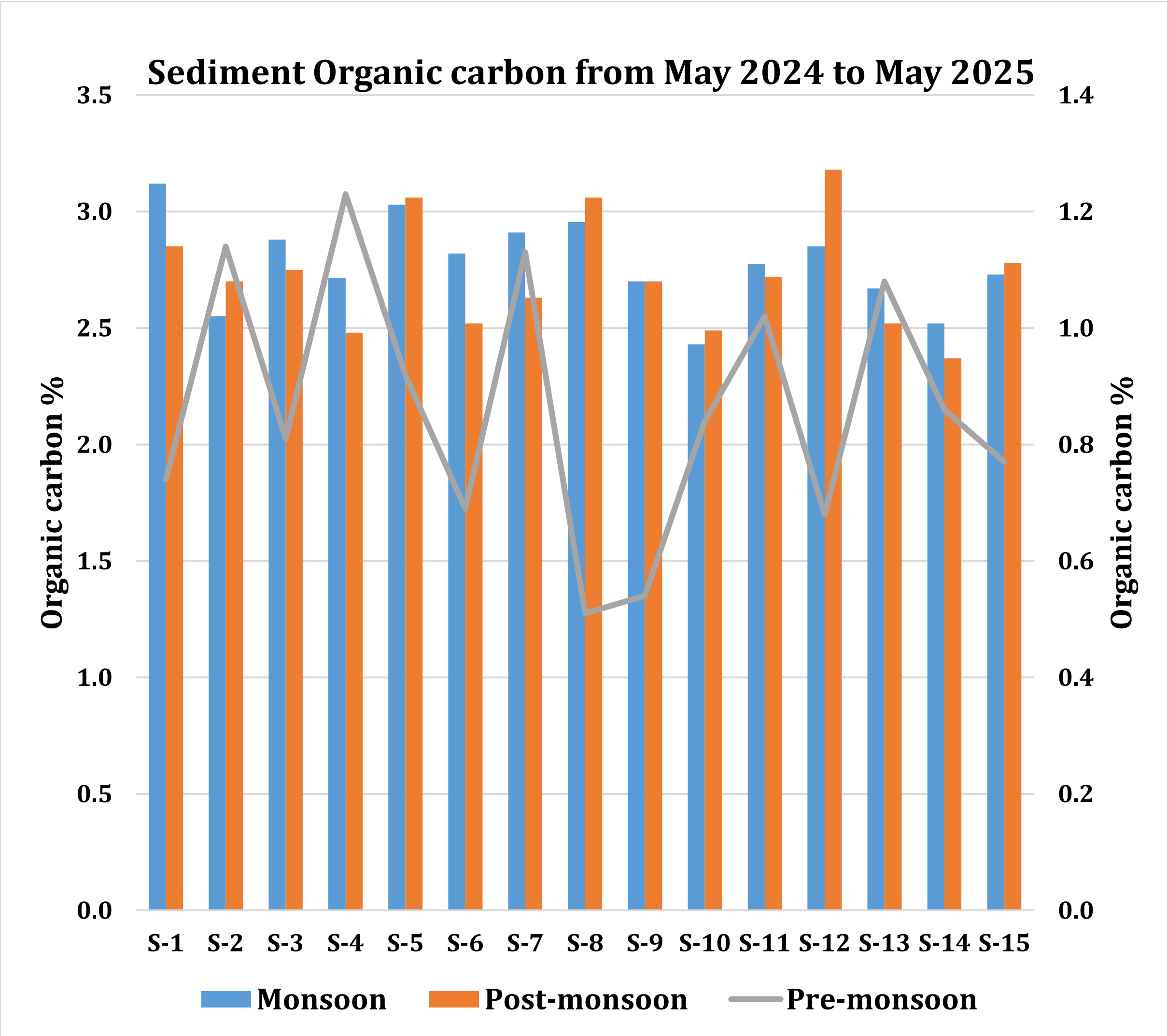


Figure 26. Sediment Organic carbon from May 2024 to May 2025

4.2. Biological characteristics water and Sediment

4.2.1. Primary productivity

Chlorophyll 'a' the photosynthetic pigment which can be used as a proxy for phytoplankton productivity and thus is an essential water quality parameter. Generally, the primary production of the water column is assessed from Chlorophyll 'a' concentration. It is well known that half of the global primary production being arbitrated by the activity of microscopic phytoplankton. . For the period of May 2024 to May 2025, the maximum Chlorophyll 'a' ranged from 0.0 mg/L to 2.98 mg/L inclusive of all the three seasons. The Chlorophyll 'a' value ranged from 0.12 mg/L to 2.98 mg/L during pre-monsoon while during monsoon, the range was recorded between 0.0 mg/L to 0.89 mg/L and during post monsoon, the range was found to be 0.04 mg/L to 0.65 mg/L. The seasonal variation of Chlorophyll 'a' among 15 stations is presented in Figure 27.

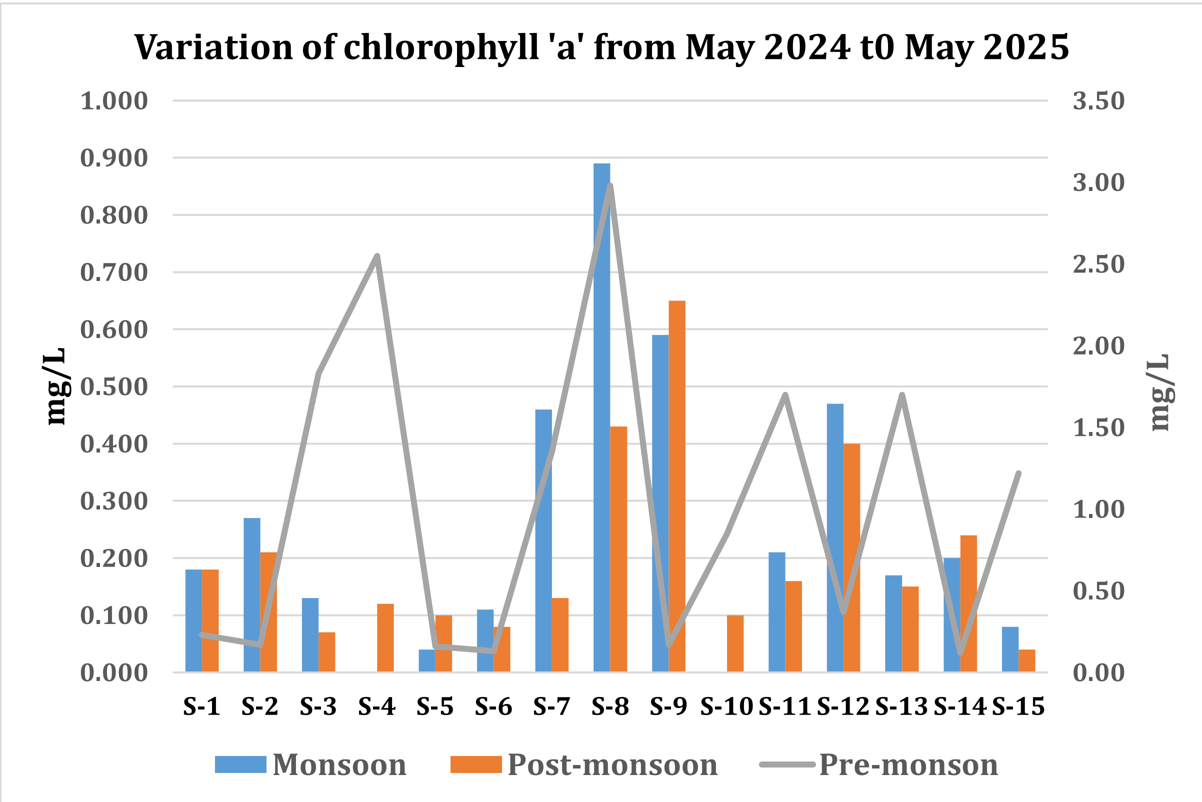


Figure 27. Concentration of Chlorophyl 'a' from May 2024 to May 2025

4.2.2. Phytoplankton

Phytoplankton are a key component of the ocean and freshwater ecosystems and provide many ecosystem services including oxygenation through photosynthesis which is estimated to be about half of the Earth's oxygen. Thus, they are important component of the functioning of ecosystems and climate regulation (Jacqueline et al.,2018). The carbon assimilation during photosynthesis by the phytoplankton enables the transfer of atmospheric carbon dioxide into the biomass which is stored in the cells and later pass on to the food chains and being cycled through the food webs. These microscopic producer community has been influenced by the negative impact from human developments and activities, and hence the service provision afforded by them should be accounted for in marine management processes (Jacqueline et al.,2018). Phytoplankton growth depends on the availability of carbon dioxide, sunlight, and nutrients. Phytoplankton, like land plants, require nutrients such as nitrate, phosphate, silicate, and calcium at various levels depending on the species. Some phytoplankton can fix nitrogen and can grow in areas where nitrate concentrations are low. They also require trace amounts of iron which limits phytoplankton growth in large areas of the ocean because iron concentrations are very low. Other factors influence phytoplankton growth rates, including water temperature and salinity, water depth, wind, and what kinds of predators are grazing on them (Lindsey and Scott,2010).

The numerous species of phytoplankton are the primary producers form the basis of marine food-webs, supporting production of higher trophic levels (a provisioning ES), and act as a sink of carbon dioxide. The spatial distributions of phytoplankton and rates of primary productivity are generally subject to bottom-up control, due to the tight coupling between light, temperature and nutrients. understanding of the spatial and temporal variability in phytoplankton parameters are accounted in marine management as these are correlated with physical and chemical factors of the water. The diatoms form the bulk of phytoplankton and the dinoflagellates are scarce. The phyto-plankton in the Gulf of Kachchh shows a primary peak in September and secondary peaks in January or June are instances of local blooms of more than one genus and species of diatoms.

Generic Status

The phytoplankton genera for the period May 2024 to May 2025 varied from 8 to 29 number with average variation of 16-23 number. Highest genera was reported during post-monsoon followed by monsoon and pre monsoon(Figure 28).

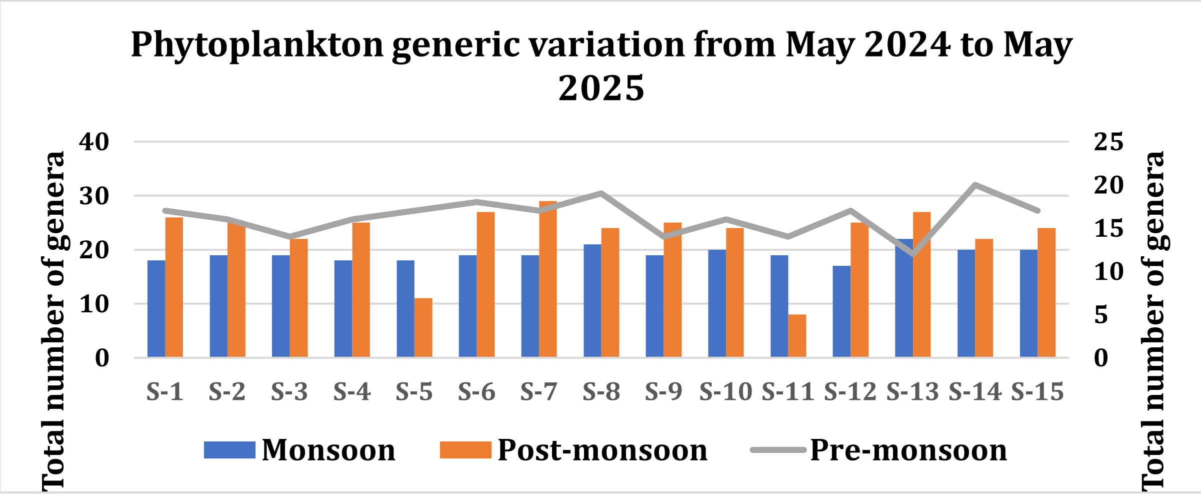


Figure 28. Seasonal variation of Phytoplankton genera from May-2024 to May2025

Percentage composition of phytoplankton

The percentage composition of different phytoplankton varied from 0.9% to 65.1% with average variation of 0.6% to 59.7% for the period May 2024 to May 2025. Four groups such as Pennales, Centrales, Dinophyceae , Cyanophyceae has been encounter during entire study period dominate by Pennales followed by Centrales and group Cyanophyceae represent less percentage of composition (Fig.29).

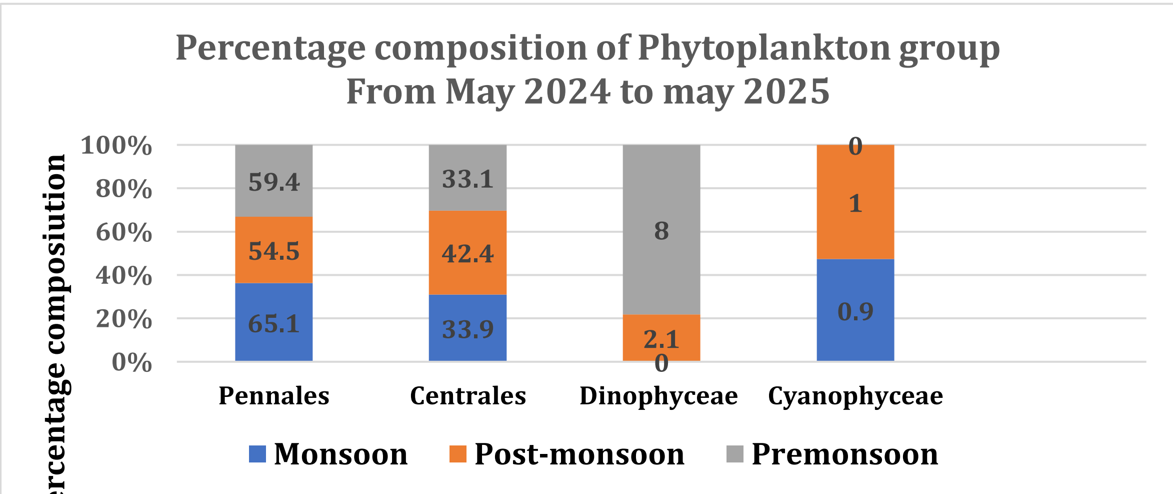


Figure 29 Percentage composition of different phytoplankton groupfrom May 2024 to May 2025

Percentage of occurrence

The percentage occurrence of phytoplankton for the period May 2024 to may 2025 was 13 to 100% . Highest percentage of occurrence was observed monsoon followed by post-monsoon and pre-monsoon. During monsoon 15 genera such as *Cheatoceros, Coscinodiscus, Dictylum, Eucampia, GyrosigmaMelosira, Navicula, Nitzschia, Odontella, Pleurosigma, Pseudonitzschia, Rhizosolenia, Synedra, Thalassionema, Thalassiothrix* represent 100% of occurrence. But in Post-monsoon and pre monsoon represent less number i.e 8 and 5 number of genera represent 100% of occurrence (Fig.30).

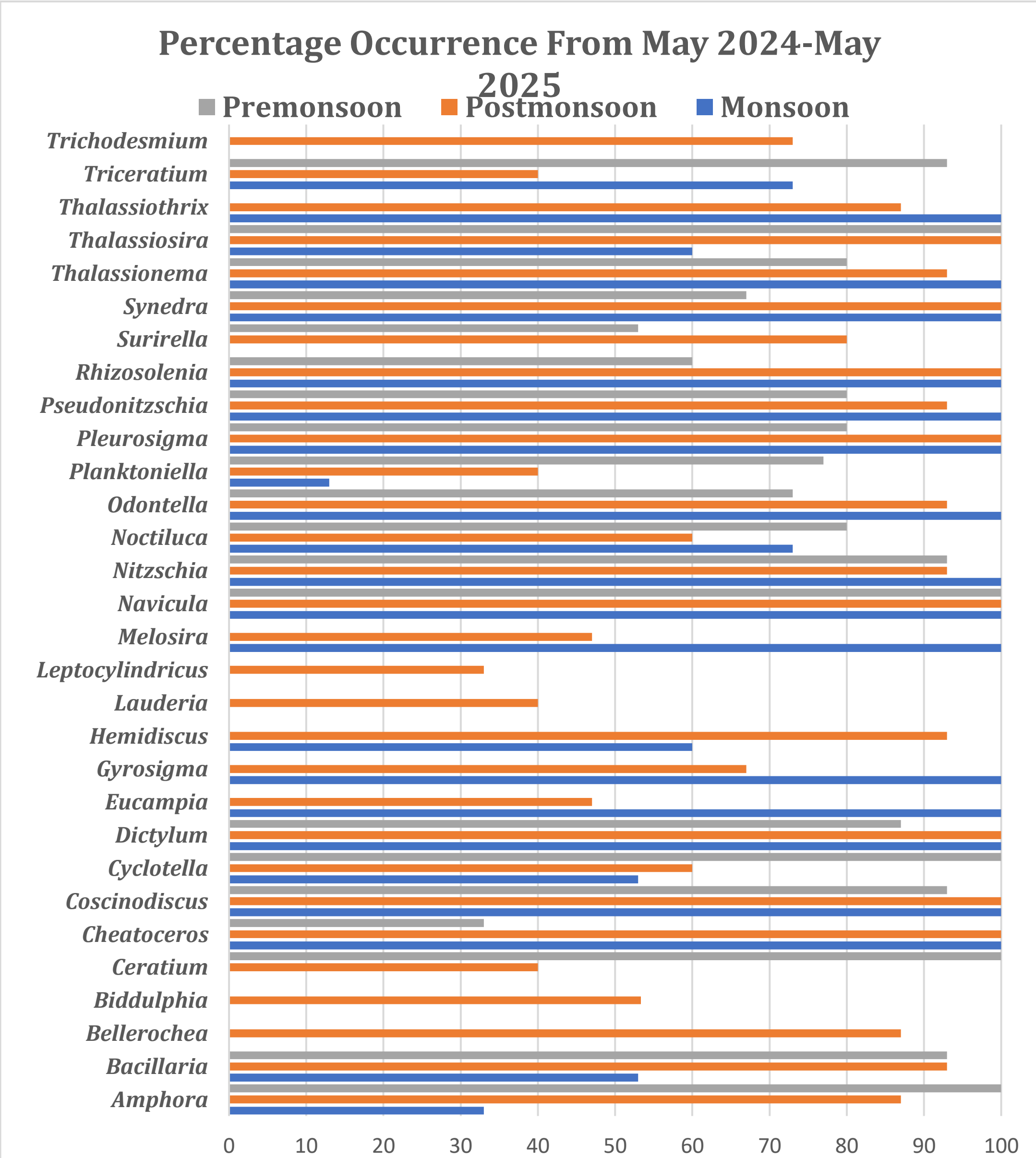


Figure 30. Percentage occurrence of phytoplankton genera from May 2024to May 2025

Phytoplankton density

The density of different phytoplankton group varied from 4000 No/L to 24320 No/L with average variation of 7,627 No/L to 24, 320. Highest phytoplankton density was observed in post-monsoon followed by Pre-monsoon and Monsoon (Fig 31).

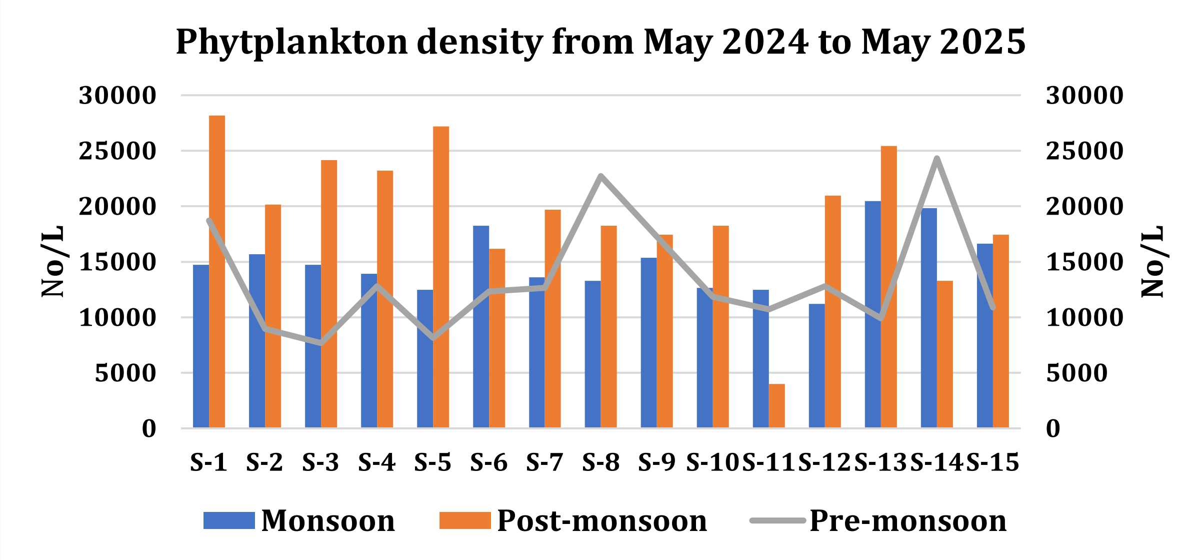


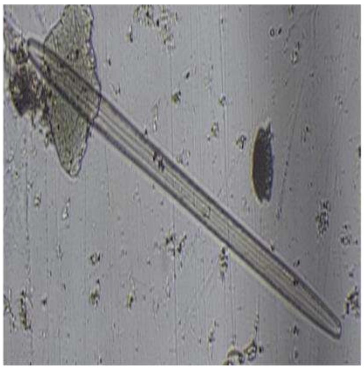
Figure 31. Seasonal variation Phytoplankton density during May 2024 to May 2025

Thallasionema sp.

Coscinodiscuss sp.

Triceratium sp.

Pleurosigma sp.



Synedra sp.

Ceratium sp.

Plate 8: Phytoplankton of Deendayal Port Authority

4.2.3. Zooplankton

These are the primary consumers that depends on phytoplankton for their feeding and constitute a second trophic level in food chain of marine ecosystem. The size of the zooplankton members varies greatly from microscopic to macroscopic occupying different depths in the pelagic realm. They constitute the primary food for several higher trophic level organisms which includes fishes, crustaceans and mollusks. Zooplankton provides the required amount of protein to the cultured fishes and crustaceans (Koli and Mule, 2012) as well. The zooplankton species quickly respond to the environmental changes and thus are used as bio-indicators for the assessment of aquatic environments (Sharma et al., 2007). Thus, zooplankton are of great ecological significance as they play important role of transferring organic matter from primary producer to secondary consumers like fishes (Kehayias et al., 2013). Zooplankton in the Gulf of Kachchhis dominated by copepods (Saravanakumar et al.,2017) while the microzooplankton is represented by Cilio-phora and Forminifera (Patel et al., 2017). Ramaiah (1997) stated that studies on zooplankton communities, especially copepods are of key importance in assessing the health of coastal ecosystems. The distribution of living organism is controlled by the variation in salinity of water and its variation caused by dilution and evaporation is most likely to influence the fauna in the coastal ecosystem (Sridhar et al. 2006). The density of zooplankton was found to be high during Post-monsoon and premosoon period, bimodal distribution, the primary peak occurring either in October or April and the secondary peak in March or December (Bhaskaran and Gopalakrishnan,2011). Similarly, there occurs gradual increase in number of organisms towards the offshore area with concomitant increase in diversity. The larval forms of echinoderms, cephalopods and brachiopods are usually confined to the offshore (Govindan et al.,1980).

Phylum and group status

The status of phylum and group of Zooplankton for the period 2024 to 2025 showed highest phylum and group during post-monsoon followed by pre-monsoon (Fig,32)

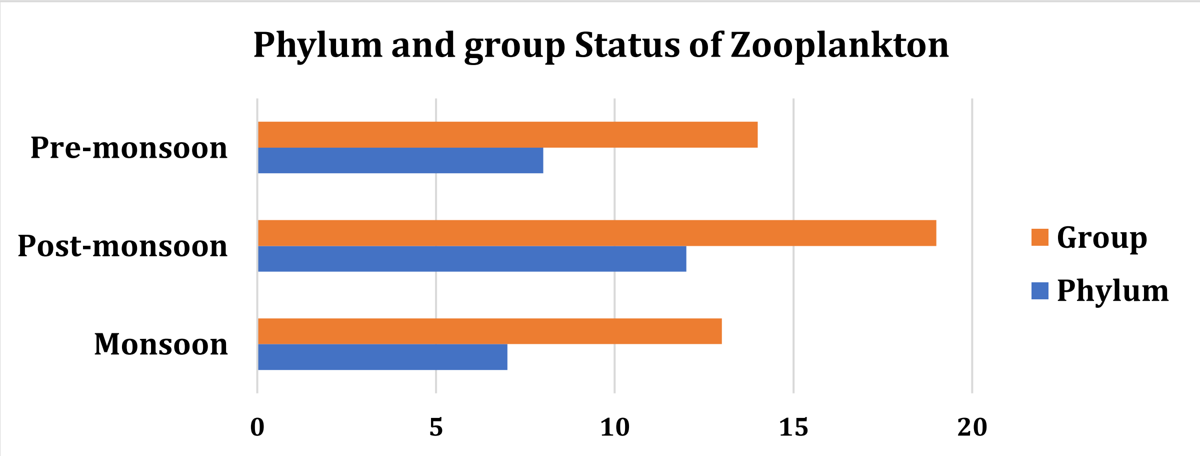


Figure 32. Status of Zooplanktonn and group and phylum from May 204 to May 2025

Generic Status

The generic status of Zooplankton from May 2024 to May 2025 varied from 13 to 37 in number with average variation of 16 to 32 in number. Highest number of genera was observed during Post- Monsoon followed by pre-monsoon and Monsoon (Fig.33)

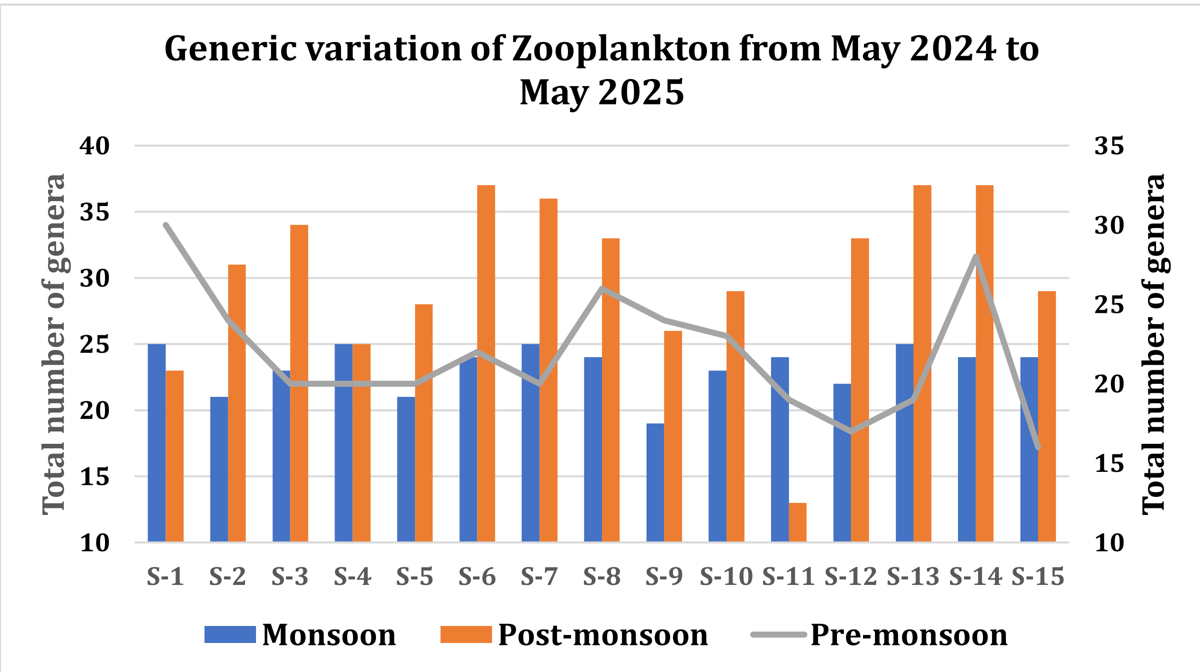


Figure 33. Generic Status of Zooplankton From May 2024 to May 2025

Percentage composition

The average maximum percentage composition of different zooplankton group varried from 26% to 31% with average variation of 29 %. Highest percentage of composition was contributed by *Copepoda-Calanoida* followed by Malacostraca and Tintinnida. Highest percentage of composition was observed in Post-monsoon and least percentage composition was observed in pre-monsoon (Fig.34).

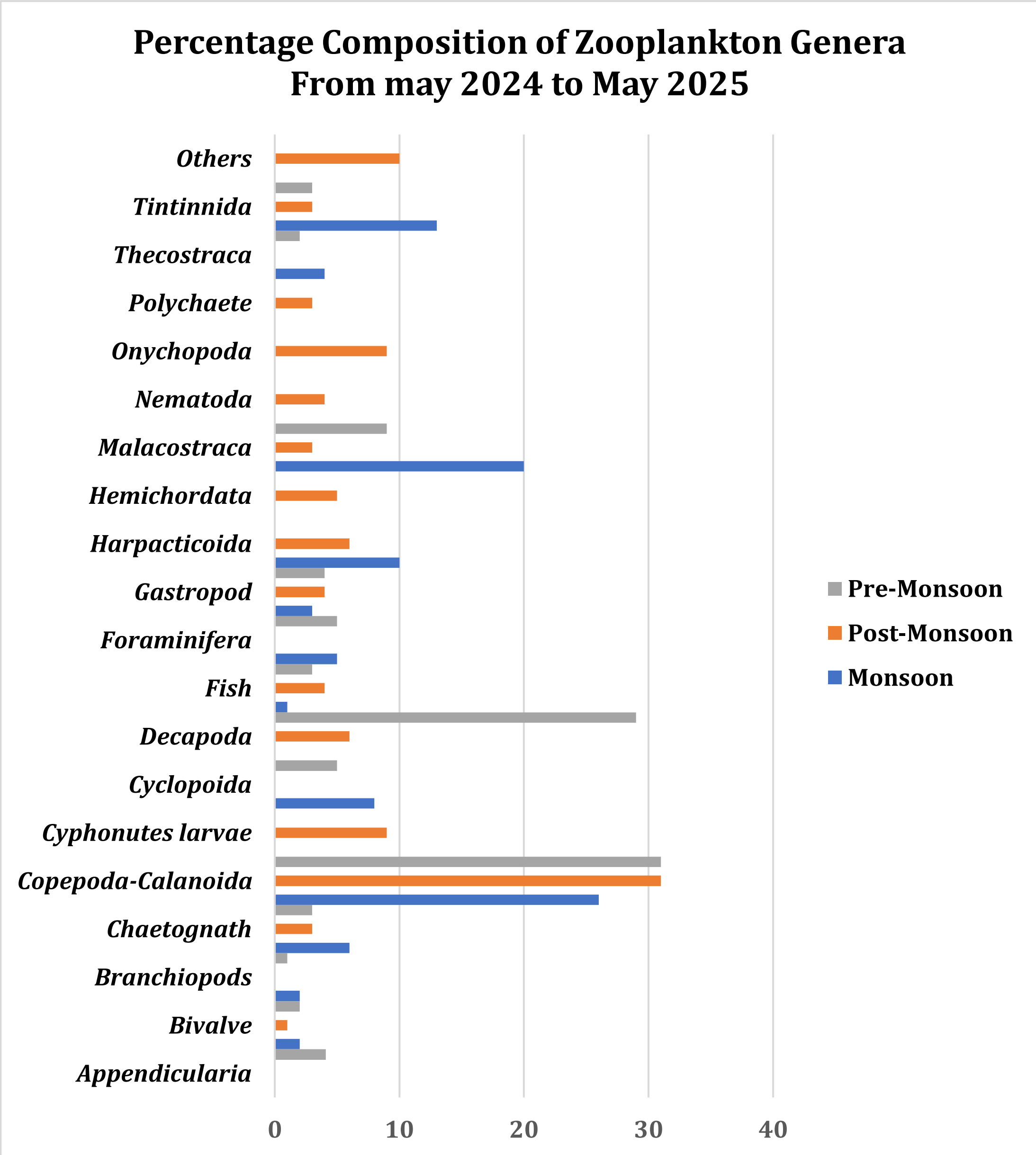


Figure 34. % Composition of Zooplankton Genera at DPA from May 2024 to May 2025

Percentage occurrence of zooplankton

The percentage occurrence of zooplankton from May 2024 to May 2025 was 7 to 100%. Highest percentage of occurrence was observed during monsoon i.e 12 genera such as Acartia, Acrocalanus, Bivalve larvae, Brachyuran larvae, Calanus, Cirripede nauplius, Codonellopsis, Eucalanus, Gastropod larvae,Globigerina, Microsetella, Tintinnopsis occurred 100% of occurrence. Similarly in Post monsoon 7 genera was found 100% of occurrence and during pre-monsoon. In Pre-monsoon least number of genera found 100% of occurrence where the genera Lucifer only found to be 100% of occurrence (Fig 35).

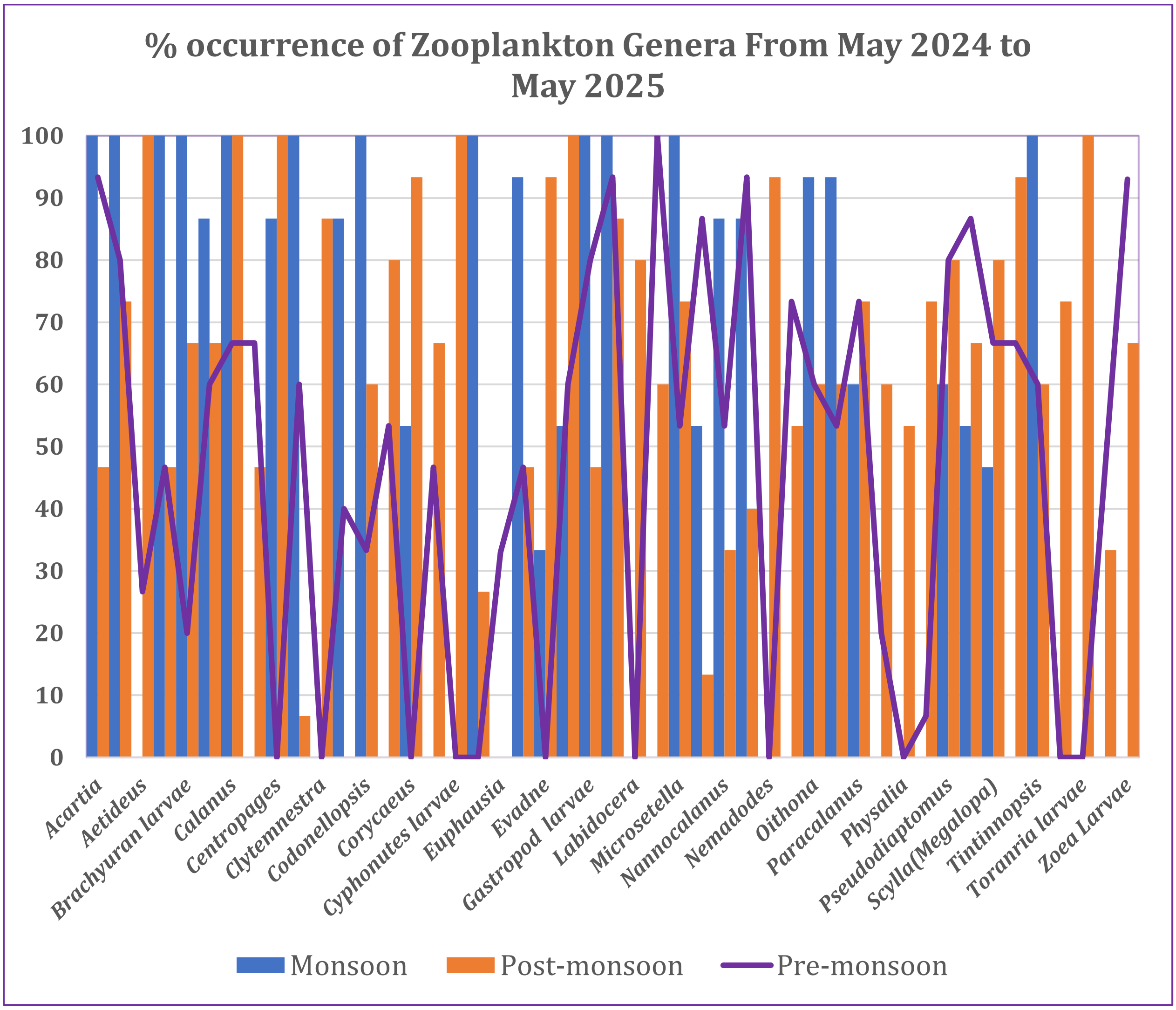


Figure 35. % Occurrence of Zooplankton Genera at DPA from May 2024 to May 2025

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Density of zooplankton

The density of zooplankton from May 2024 to May 2025was 8,000 No/L to 20,000 No/L with average variation of 7,653 No/L to 17,660 No/ L. Highest Zooplankton density was observed in Post-mon soon followed by pre-monsoon and Monsoon (Fig.36).

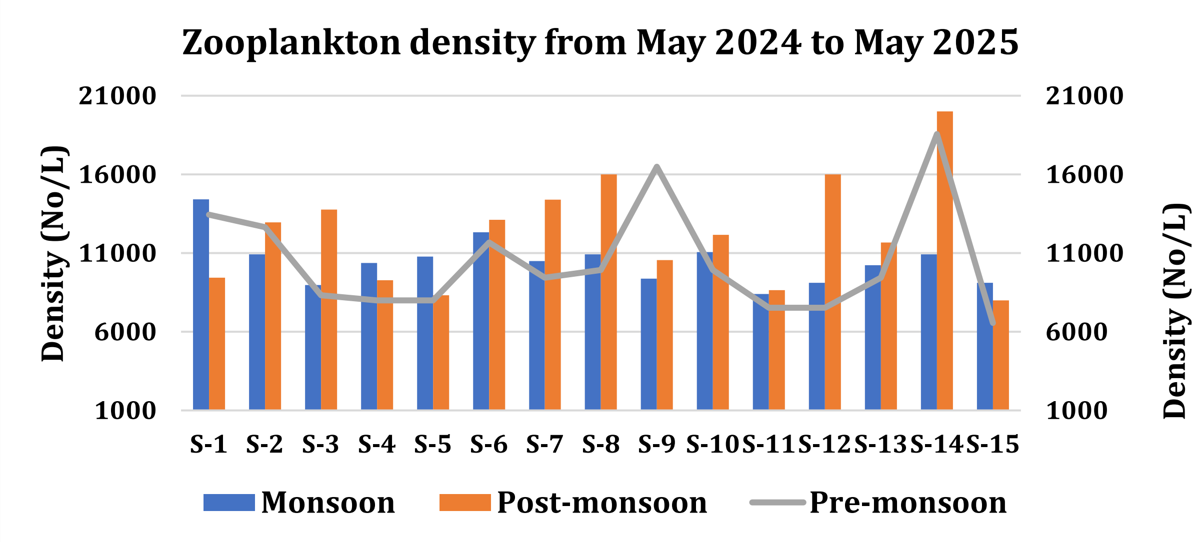
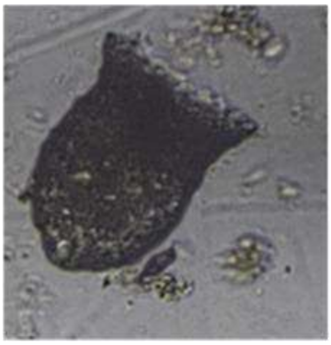
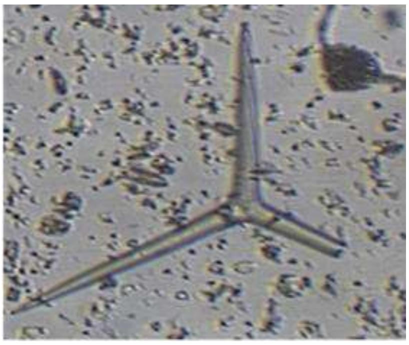


Figure 36. Density of Zooplankton in DPA form May 2024 to May 2025

***Paracalanus** sp.*



Tintinnopsis sp.



Sponge spicule

Calanoida copipod

Microsetella sp.

Plate 9: Zooplankton of Deendayal Port Authority

4.2.4 Intertidal Fauna

The intertidal zone, the interface between terrestrial and marine environments, represents one of the most dynamic and ecologically multifaceted ecosystems. Globally, the increasing utilization of the littoral zone for several developmental projects and human activities have contributed increasing level of habitat transformation and consequently degradation of this fragile ecosystem. Such degradation is manifested in the rapid loss of biodiversity, which poses a significant threat to the ecosystem's products and services (Liang et al., 2024).

The intertidal zone is often referred as the littoral zone is the area where the land is submerged temporarily due to the tidal water inundation, and where the benthic region of the ocean begins and below this zone is the sublittoral (shelf) zone, extending from the low tide mark to the shelf break, is permanently submerged. The Intertidal zone can include rocky ledges, sandy beaches, mudflats, salt marshes, and mangrove swamps and the benthic region has a variety of physical conditions, including depth, light penetration, and pressure. The intertidal zone is a marine habitat that experiences extreme and rapidly changing environmental conditions such as water Temperature, salinity, tidal amplitude, turbidity, along with substratum composition and organic matter and carbon content and the vegetation characteristics which are very much correlated with the fauna population density and distribution along the intertidal zone.

Faunal composition of intertidal macrobenthos

The survey of the intertidal Fauna of DPA Kandla area recorded the presence of 4 phyla (Arthropoda, Chordata, Mollusca). The faunal diversity was the highest for phylum Mollusca followed by Arthropoda and Chordata respectively (Fig.37).

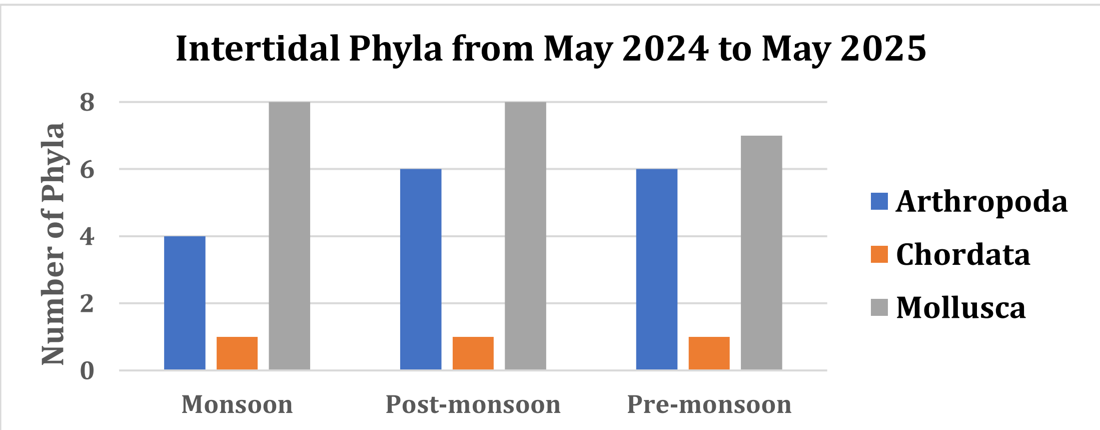


Figure 37. Intertidal faunal diversity in DPA from may 2024 to May 2025

Generic status

The generic status of intertidal fauna from May 2024 to May 2025 varied from 4 to 11 number with average variation of 4 to 10. Highest number of genera was observed during pre-monsoon followed by Post-monsoon and Monsoon (Fig.38)

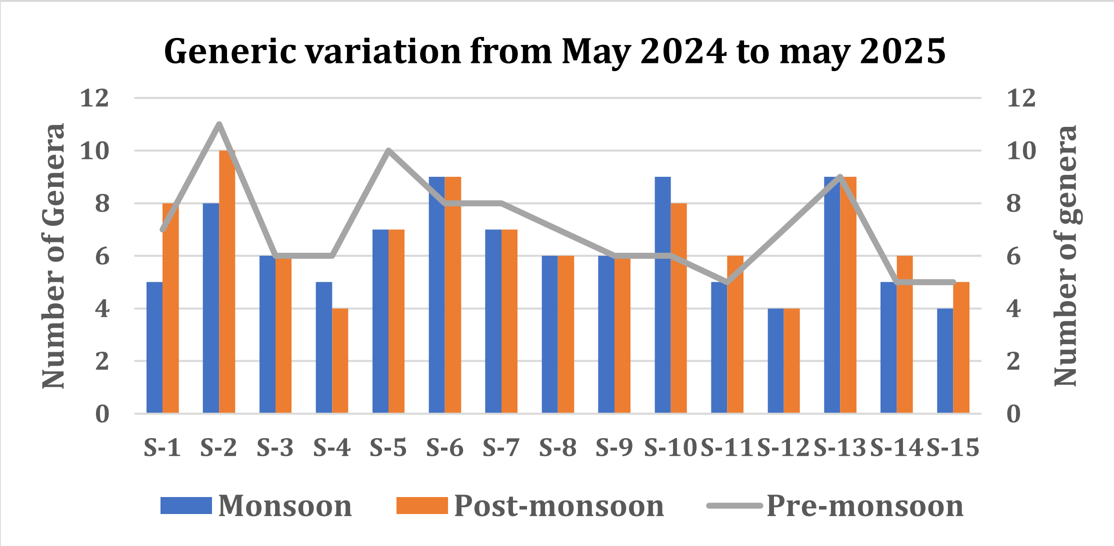


Figure 38. Generic Status of Intertidal Fauna in DPA from May 2024 to May 2025

Percentage composition of Intertidal Fauna

The percentage composition of Intertidal ranged from 0.2% to 245vwith average variation of 0.6% to 22% from May 2024 to May 2025.Highest organism contribute in pre-monsoon followed by followed by Monsoon and Post-Monsoon (Fig.39) .The organism such as *Austruca iranica*, *Austruca sindensis*, and *Austruca variegata* contribute highest percentage of composition.

Density variation of intertidal fauna

The density of Intertidal organism among different station was varied from 17No/m^2 to 133 No/m^2 with overall variation in 3 season was 18 No/m^2 to 97No/m^2 (fig 40). Monsoon contribute highest density of organism followed by Pre- and Post-Monsoon.

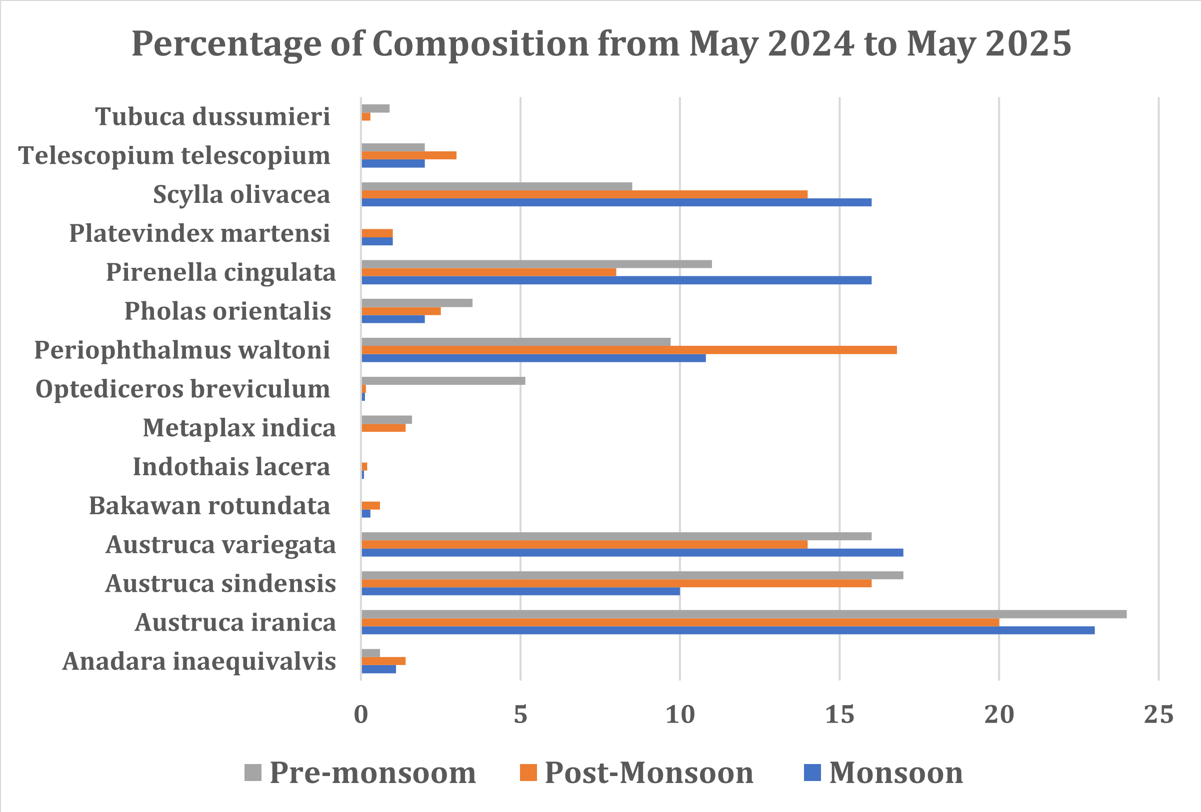


Figure 39.Percentage composition of Intertidal Fauna in DPA

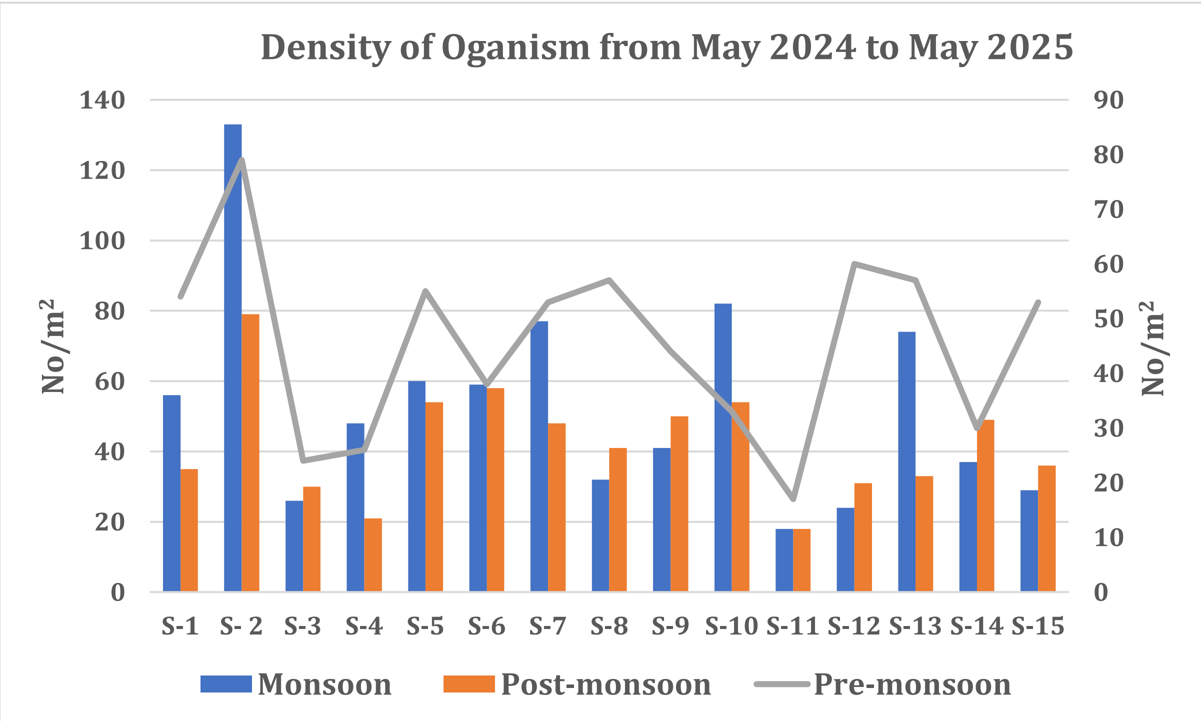


Figure 40. Density of Intertidal Fauna in DPA

4.2.5. Subtidal Fauna (Macrobenthos)

Subtidal ecosystems are permanently submerged due to tidal influence, whereas intertidal ecosystems are found between the high tide and low tide, experiencing fluctuating influences of land and sea. Macrobenthos are an important component of estuarine and marine ecosystems. Benthic fauna is an important component of marine ecosystems, providing key services including secondary production and remineralization. Being sedentary or having only limited mobility, benthic communities are particularly vulnerable to variations in environmental and ecological factors. As a result, they exhibit distinct spatial and temporal distribution patterns on small and large scales. Coastal areas are naturally highly dynamic, with several distinct habitat types coexisting nearby (e.g., estuaries and intertidal habitats) and supporting high biodiversity (Cowie and Woulds,2011). The abiotic factors structuring benthic communities include salinity, temperature, sediment characteristics, and oxygen availability, however, their relative importance varies among the different habitats. On a fine scale, biotic factors such as competition for food and space, predation, reproductive strategies, and life-history traits influence the distribution and abundance of individual species, in turn determining community structure. Moreover, coastal habitats are also the most impacted by anthropogenic pressures, from climate change-related warming and acidification to habitat degradation and pollution. Benthic fauna, through their diverse feeding modes and lifestyles, not only are affected by conditions in the sediment environment, but also actively influence sediment textural and geochemical properties, the flow regime of bottom waters, and, through exchange of particles and solutes between water and sediments, also regulate properties in overlying waters (Meysman et al., 2006)

All marine sediments are anoxic below a certain depth from the sediment surface and, consequently, sulphidic sediments have a worldwide distribution. Organic sediment enrichment occurs through vertical and advective accumulation of organic carbon from the decomposition of the organic matter. On bottoms where accumulation of organic matter happens and leading to the reduction of oxygen at low concentration. The oxygen deficiency may very well be the most widespread anthropogenically induced deleterious effect in me marine environment that causes localized mortality of benthic macrofauna.

Distribution and composition of subtidal macrobenthos

The number of macro benthic fauna of the various groups from the DPA port environment includes Annelida, Arthropoda, Mollusca and Nematoda. The number of various fauna from May 2024 to May 2025 raged from 1 to 11 with maximum contribution was during Post and pre-monsoon (Fig.41).

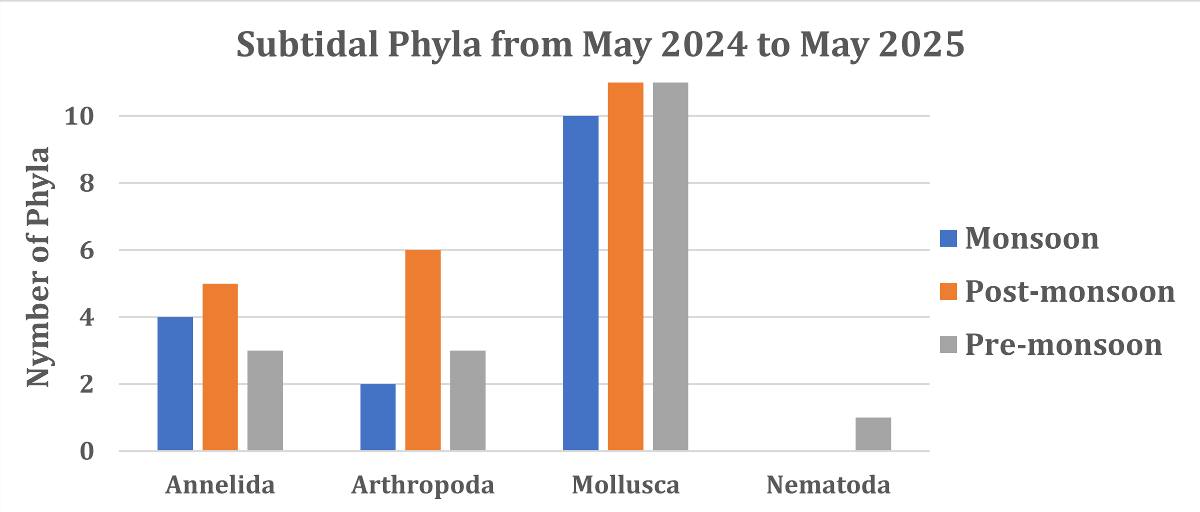


Figure 41. Distribution of Subtidal macrobenthos in DPA

Generic Status

The generic status of subtidal macrobenthos varied from 1 to 12 number with average variation of 2 to 10 number. Highest number of genera contributed during monsoon followed by pre-monsoon and Pre-monsoon (Fig.42).

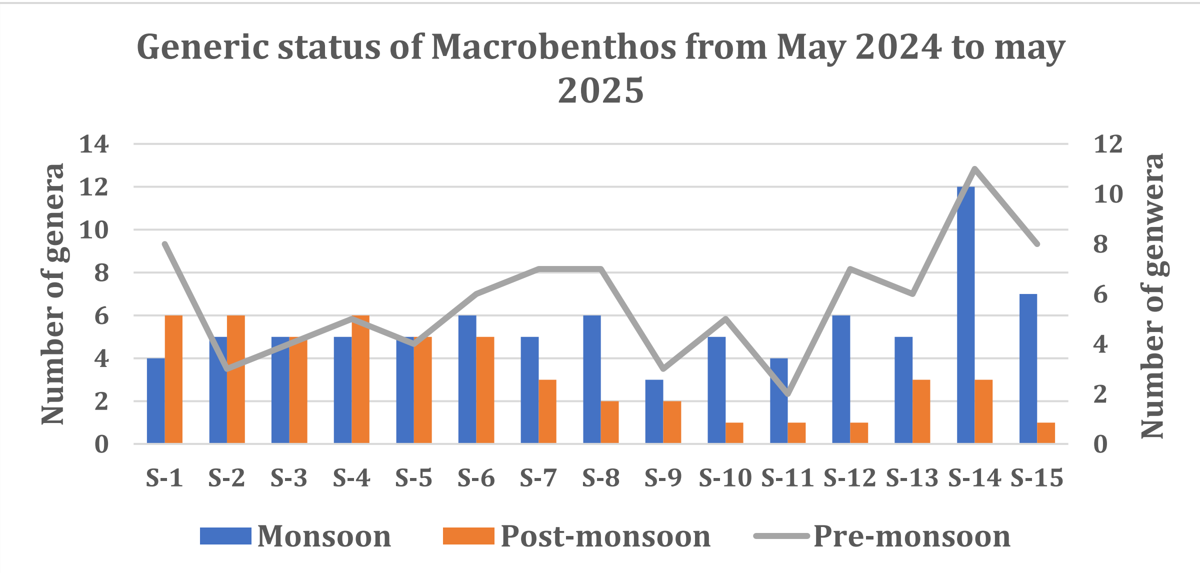


Figure 42. Generic status of Macrobenthos in DPA

Density of subtidal benthos

The average density and population of subtidal macrobenthos from May 2024 to May 2025 varied from 307 N0/m² to 507 No./m ² and 12 to 20 in number (Fig.43)

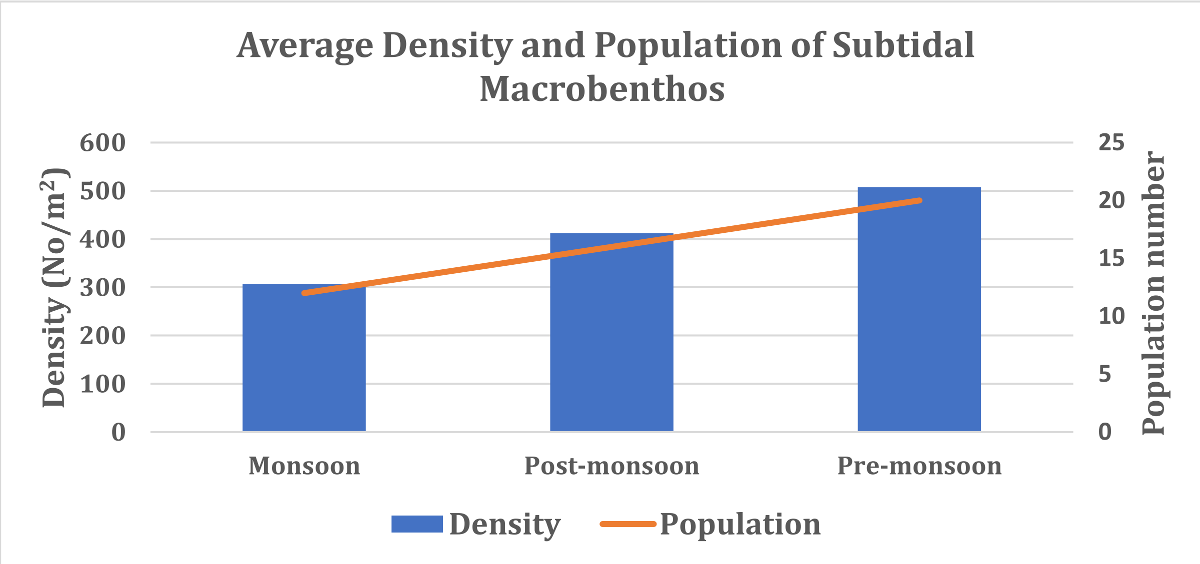


Figure 43 . Average Density of Subtidal macrobenthos in DPA

In station wise density of subtidal macrobenthos varied from 25 no/m² to 1150 no /m² with average variation of 100 no/m² to 754 no/m² . Highest dinsith was observed in Pre-monsoon and lowest was observed during post-monsoon (fig 44).

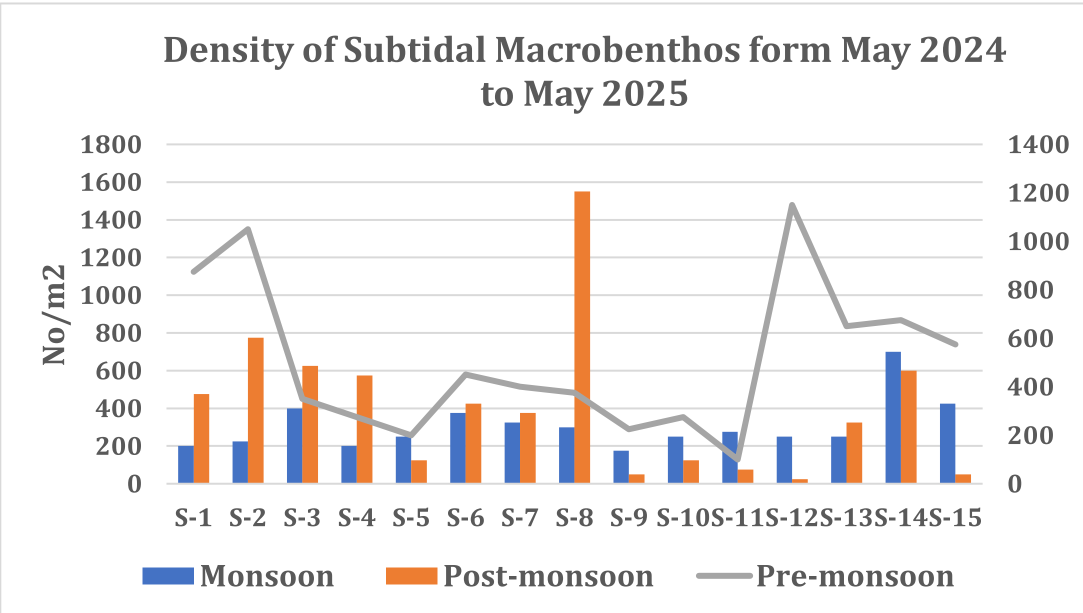


Figure 44 . Density of Subtidal Macrobenthos in DPA along different station

Percentage composition of Subtidal macrobenthos

The percentage composition of subtidal macrofauna varied from 0.4% to 31.8% with average variation of 1% to 26%.Highest percentage was contribution in Pre-monsoon ,followed by Post-monsoon and Monsoon (Fig 45).

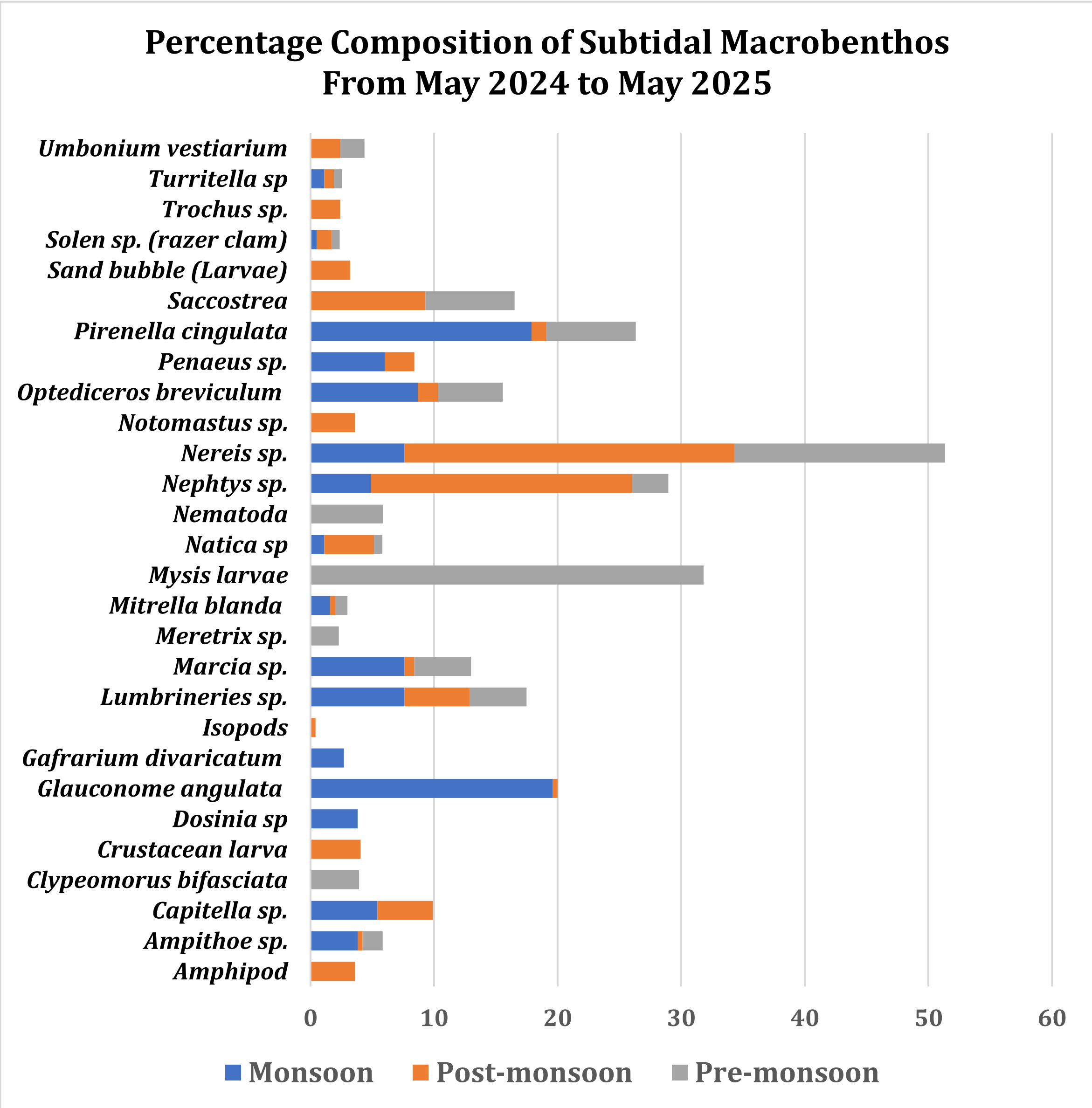


Figure 45. Percentage composition of Subtidal Macrobenthos in DPA

During the study period from May 2024 to May 2025 species such as *Mysis larvae*, *Nereis sp*, *Glauconome angulata* and *Pirenella cingulata* was dominated .

4.3. Mudflats

Mudflats and mangroves establish a major ecosystem of the DPA coastal region and the significance of ecosystem services rendered by mudflat is endorsed in Coastal Regulation Zone (CRZ, 2011) as it accords special status to highly productive zone. Mudflat has an assemblage of plant-animal-geomorphological entities. DPA has been surrounded by two major ecosystems such as mangroves and mudflats which support a number of ecosystem services like nursery grounds for fish and shellfishes and breeding/feeding grounds for the birds (Spencer and Harvey, 2012). The TOC concentration is a direct indicator of mudflat productivity and blue carbon sequestration

4.3.1. Bulk density of the sediment

The sediment bulk density varied from 1.10 gm/cm^3 to 1.89 gm/cm3 with overall average variation of 1.21 gm/cm^3 to 1.68 gm/cm^3 (Fig.46). Highest bulk density was observed in Pre-monsoon followed by post-monsoon and post-monsoon. Among the station highest BD was observed in Pre-monsoon at S-14 (1.89 gm/cm^3) and lowest was observed at S-10 in Pre-monsoon (S-10).

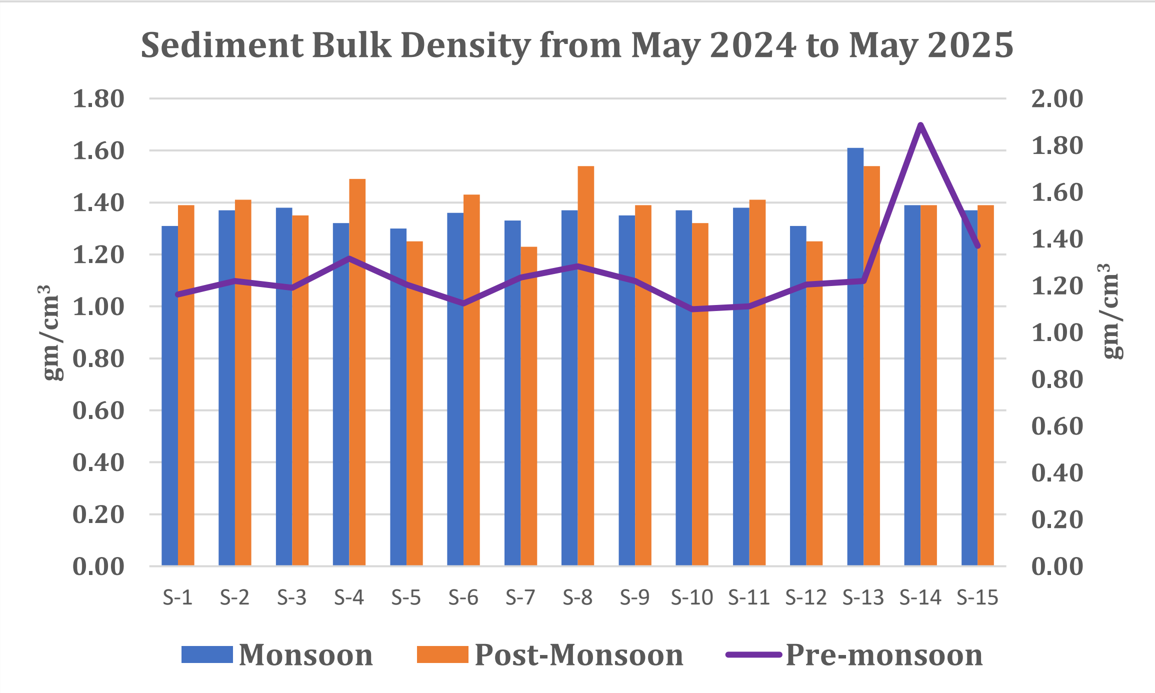


Figure 46. Seasonal variation of Sediment Bulk Density in DPA

4.3.2.Total Organic Carbon (TOC)

The sediment organic carbon of DPA varied from may 2024 to May 2025 was 0.5% to 3.2 % with average variation of 1.8% to 2.5%. Through out season the highest percentage of organic carbon was observed in post-monsoon followed by monsoon and pre-monsoon. Similarly lowest percentage of organic carbon was observed in pre-monsoon followed by equally percentage in monsoon and post-monsoon.

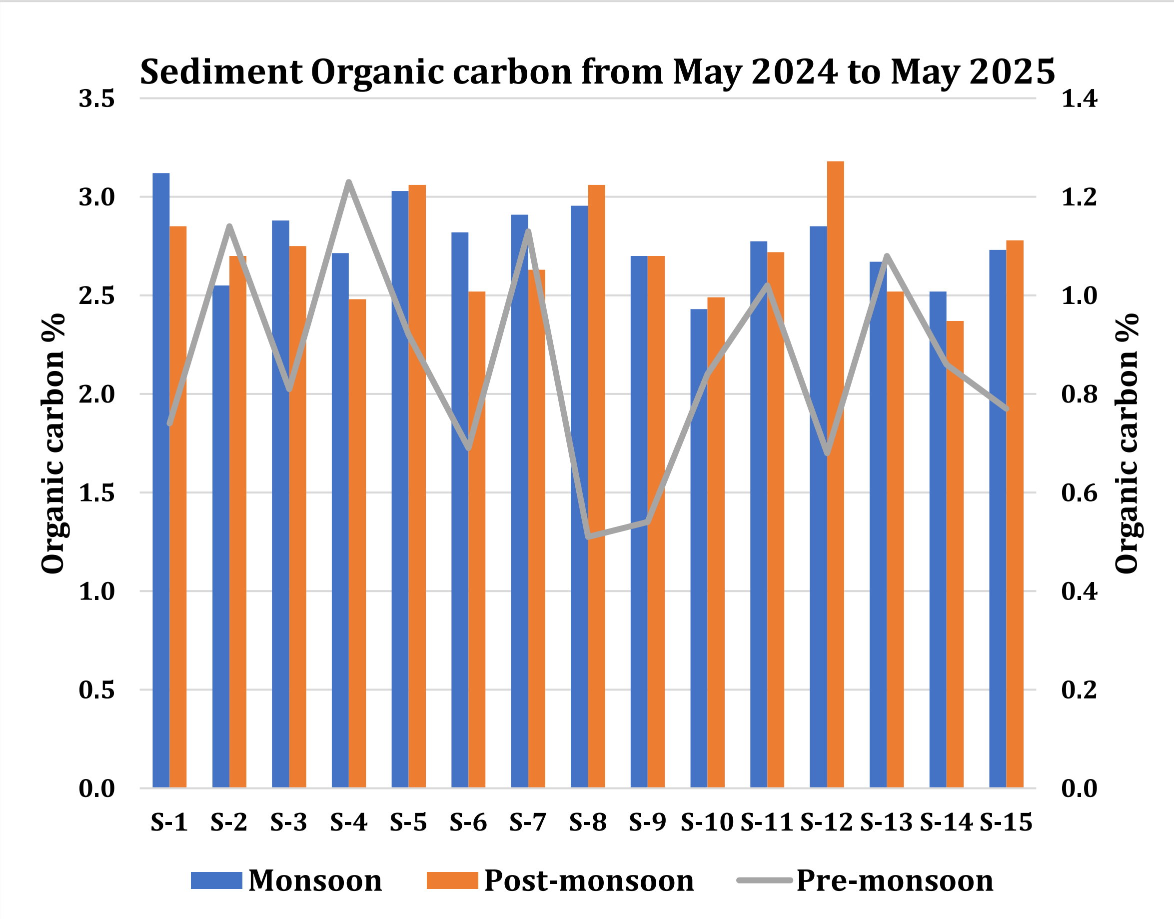


Figure 47. Seasonal variation Sediment Organic carbon in DPA

Among the station highest organic carbon percentage was contributed by S-12 during post monsoon and lowest percentage of organic carbon was observed during pre-monsoon at S-8.

4.4. Mangroves

Gujarat state has the longest coastline of India, with one of the rich coastal areas in terms of biodiversity, and major part of it is covered by mangroves. The mangrove cover in Gujarat ranks as the second largest in India, following the Sundarbans in West Bengal. Mangroves in Gujarat are distributed across four main regions: Kachchh, the Gulf of Kachchh, Saurashtra, and the Gulf of Khambhat including south Gujarat. Among these, Kachchh and the Gulf of Kachchh shows the major contribution of mangrove cover in Gujarat. Around 15 species of mangroves have been recorded across Gujarat's 13 coastal districts, though this number is subject to ongoing debate. However, Avicennia marina is the only species predominates in all the 13 coastal districts of Gujarat.

This unique ecosystem thrives in waterlogged, oxygen-deprived mud, typical of tropical and subtropical zones. The Kachchh coast is characterized by diverse habitats, including vast mudflats and small sandy beaches, shaped by extreme salinity, temperature variations, and tidal influences. These challenging conditions encourage mangrove species to adapt and flourish. Mangroves naturally enrich soil fertility by decomposing leaf litter and root systems, improving surrounding sediments. These ecosystems support a rich variety of flora and fauna, serving as essential breeding, nursery, and feeding sites for numerous marine and terrestrial species.

Despite their ecological significance, mangroves face persistent threats from human activities, such as deforestation, pollution, and climate change. Conservation strategies have been introduced to protect these invaluable ecosystems. The Gujarat Institute of Desert Ecology (GUIDE) has extensively studied and documented these ecosystems, providing insights into their vegetation, species diversity, ecological importance, and conservation status. Mangroves serve as critical habitats for marine and terrestrial wildlife, contribute to coastal protection, preserve biodiversity, and support local communities. The ongoing focus on research and preservation highlights the need for sustainable management practices to ensure their long-term survival. During the study period May 2024 to May 2024 4 species of mangrove such as *Avicenna marina* , *Aegiceras corniculatum* , *Ceriops tagal* and *Rhizophora mucronate* was observed (Plate 10).

4.4.1.Tree Density

Across three seasons of the study, monsoon 2024, post-monsoon 2024, and pre-monsoon 2025, a total of 15 mangrove sites in and around the Deendayal Port Authority (DPA) were assessed. During the monsoon 2024, the overall average tree density recorded was 2,189 trees/ha, with Tuna Creek exhibiting the highest mean density (2,535 trees/ha) and S-6 having the highest individual density (3,673 trees/ha). During post-monsoon 2024, the overall tree density recorded as 1,986 trees/ha, with Kharo Creek leading at 2,788 trees/ha and S-6 remaining the densest (3,156 trees/ha). During pre-monsoon 2025, the overall tree density recorded was 1,907 trees/ha and S-6 continued to show the highest density (3,113 trees/ha), however, major portion of S-11 was observed to go through extensive conversion into salt pans resulting the lowest density for the whole study period (872 trees/ha). The ongoing degradation highlights the pressing need for conservation measures to mitigate the impact of anthropogenic disturbances and preserve the ecological integrity of these mangrove ecosystems.

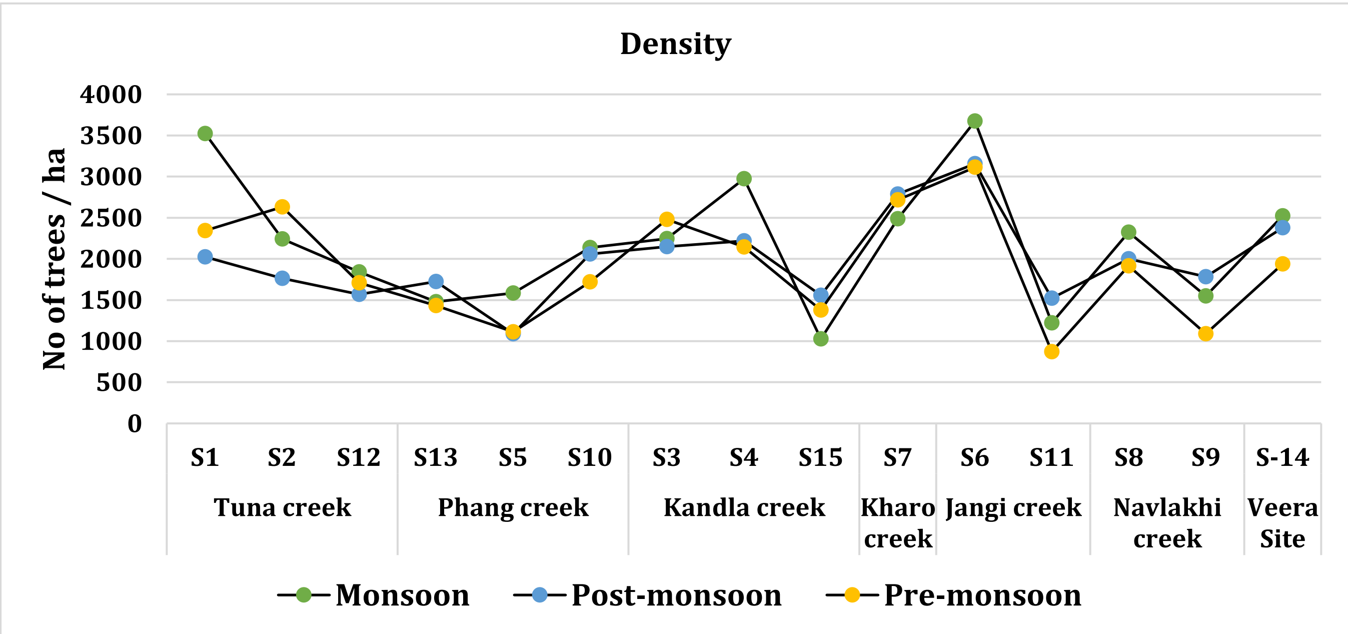


Figure 48. Average tree density during the three seasons study in 2024-2025

4.4.2.Tree Height

The study on mangrove tree height in the DPA Kandla region during 2024-25 revealed seasonal variations in growth. During the monsoon, of 2024, the overall average height of mangrove tree was recorded as 1.8 meters. The highest average was recorded at Veera coast (2 meters), followed by Tuna and Phang creeks (1.8 meters). Site-specific data showed the tallest trees at S-10 in Phang Creek (2.4 meters) and S-12 in Tuna Creek (2.3 meters). The height varied between 1.3 and 2.4 meters across the different locations. However, during the post-monsoon of 2024, the average height was recorded as 1.7 meters. Navlakhi Creek had the tallest mangroves reaching 3 meters while the overall average height was 2.2m. At S-10 in Phang Creek the average height of trees was 2.3 meters. The height of the plants recorded during this season ranged from 1.1 to 3 meters considering all the study stations. During the pre-monsoon of 2025, the average height was 1.6 meters, with Phang Creek recording the highest at 1.7 meters. Site-specific observations showed that S-10 in Phang Creek (2.2 meters) and S-2 in Tuna Creek (2.1 meters) were the maximum height of the plants. The height varied between 1 and 2.8 meters. Mangrove height is a key indicator of the health plants and the ecosystem. The taller trees provide greater protection against storm surges and coastal erosion.

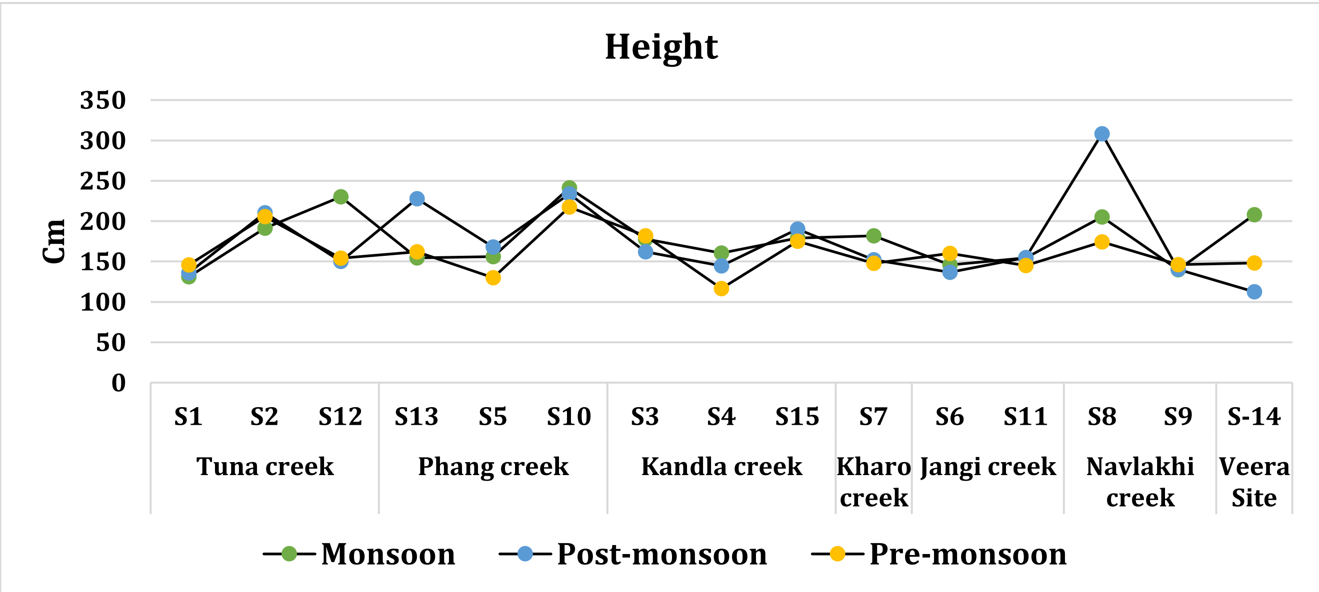


Figure 49. Average tree height during the three seasons study in 2024-2025

4.4.3.Canopy Crown Cover

During the monsoon, the average canopy cover across the mangrove study sites was 3.8 m^2. The highest average canopy cover was recorded at Navlakhi Creek (5.2 m^2), followed by Phang Creek (4.5 m^2). In station wise study, the highest canopy cover was recorded at S-10 (Phang Creek) and S-15 at Kandla Creek, while, S-1 at Tuna Creek, and S-4 at Kandla Creek showed comparatively lower average canopy cover. The post-monsoon survey of 2024 recorded an average canopy cover of 3.45 m^2. In this season the highest canopy cover was recorded at Navlakhi Creek (5.5 m^2), followed by Tuna Creek (3.8 m^2). In station wise observation, stations S-6 at Janghi Creek and S-4 at Kandla Creek recorded relatively lower canopy covers. During the pre-monsoon in 2025, average canopy cover was recorded as 2.25 m^2 across the mangrove study sites. The stations S-10 (4.9 m^2) at Phang Creek and S-15 (3.1 m^2) at Kandla Creek showed higher average canopy covers compared to other stations. However, stations S-4 (0.8 m^2) at Kandla Creek and S-7 (1.7 m^2) at Khari Creek recorded lower canopy covers. Such variations in canopy cover demonstrate how the local environmental factors shape the growth and progression of mangroves.

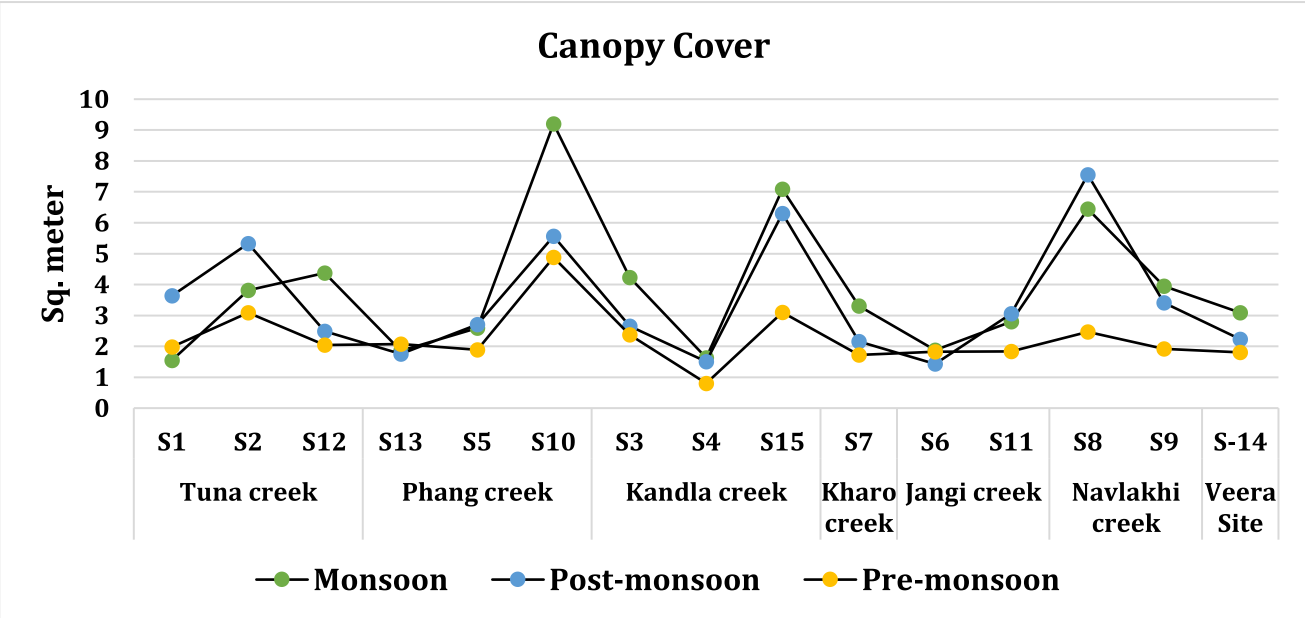


Figure 50. Average tree canopy during the three-season study during 2024-25

4.4.4.Basal Area (Girth)

During the monsoon of 2024, the average basal girth of the mangroves at the DPA sampling sites was reported to be 13 cm. The highest average basal girth was recorded at S-10 (22 cm) and S-8 (18 cm), located in Phang Creek and Navlakhi Creek respectively. The lowest average basal girth was reported at S-6 and S-9 (8 cm) in Janghi Creek and Navlakhi Creek, respectively. During the post-monsoon of 2024, the average basal girth recorded was 12 cm for all the sites while the highest average basal girth was 22cm observed at site S-10 in Phang Creek, followed by S-8 (20 cm) in Navlakhi Creek. In contrast, the lowest average basal girth 8 cm was noted at S-6 and S-14, situated in Janghi Creek and the Veera site respectively. During pre-monsoon of 2025, the average basal girth was recorded as 11 cm and the highest average basal girth were at S-10 (17 cm) in Phang Creek, followed by site S-15 (14 cm) in Kandla Creek. However, the lowest average basal girth was noted at site S-4 and site S-1, both measuring 8 cm, situated in Kandla Creek and Tuna Creek, respectively. Across the DPA Kandla region, Avicennia marina is the dominant species, recognized for its unique multiple-stem growth habit.

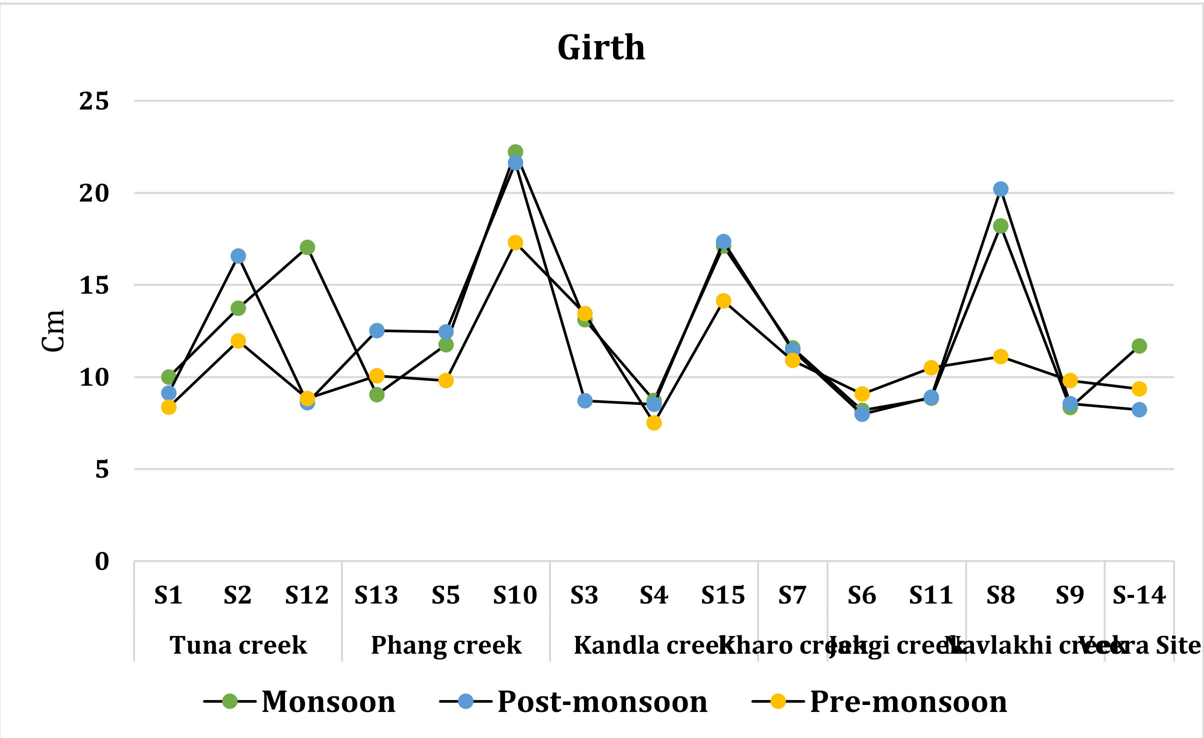


Figure 51. Average tree basal girth during three-season study during 2024-2025

4.4.5.Regeneration and Recruitment Class

During monsoon of 2024, the overall average regeneration class density was recorded as 29,692 plants/ha and the overall average recruitment class density was 5,308 plants/ha. In site-wise observations, the highest average regeneration class density was 73,000 plants/ha at S-8 which is followed by S-9 (52,000 plants/ha) both located along the Navlakhi creek area. For the recruitment class, the maximum plant density (average) was 11,750 plants/ha at S-7 located in the Kharo creek during this survey.

During the post-monsoon survey of 2024, the average density of the regeneration class was recorded as 24,467 plants/ha, while the average density of the recruitment class was noted as 4,785 plants/ha. The site-specific observations revealed that the highest average regeneration class density was at S-12, with 57,100 plants /ha, followed by S-1, which recorded 38,000 plants/ha, both situated in the Tuna Creek area. For the recruitment class, the maximum average density recorded was 10,725 plants per hectare at site S-12 in the Tuna Creek during the survey.

During the pre-monsoon survey of 2025, the average density of the regeneration class was observed at 23,100 plants /ha, while the average density of the recruitment class was3,819 plants/ha. In the station-specific observations the highest average regeneration class density was 46,000 plants/ha at S-11, followed by 36,700 plants/ha at S-3, situated in the Janghi Creek and Kandla Creek area respectively. For the recruitment class, the maximum average density recorded was 7,250 plants/ha at S-8 in the Navlakhi Creek during the survey.

The younger mangroves in these areas promise the future establishment of fully mature trees. These younger class mangroves play a vital role in stabilizing soil and capturing sediments, thereby preventing coastal erosion and maintaining the quality of nearby water systems

a.*Avicenna marina* b. *Aegiceras corniculatum* c. *Ceriops tagal* d.*Rhizophora mucronata*

Plate 10. Mangrove Species of DPA Port Authority

4.5. Halophytes

The halophytes are the plants that are adapted to live in coastal estuaries and salt marshes. It is common in arid and desert milieu which often have substantial salt accumulation. Technically these are the plants which have tolerance to moderate to high salt concentration in its growth substrate. Halophytes, that survive and reproduce in environments where the salt concentration is around 200 mM NaCl or more, constitute about 1% of the world's flora. (Timothy and Colmer, 2008). Halophytes are classified based on their growth conditions as obligate halophytes, facultative halophytes, and habitat-indifferent halophytes.

Percentage of Cover

In entire study period from May 2024 to May 2025 , highest percentage of cover contribute by the halophyte *Salicornia brachiate* (96% -100%) followed by *Sesuvium portulacastrum* (35-50%) , *Salvadora persica* (4% -60%) and *Aeluropus lagopoides* (7%-40%) in monsoon,Post-monsoon and Pre-monsoon. (Plate 11)

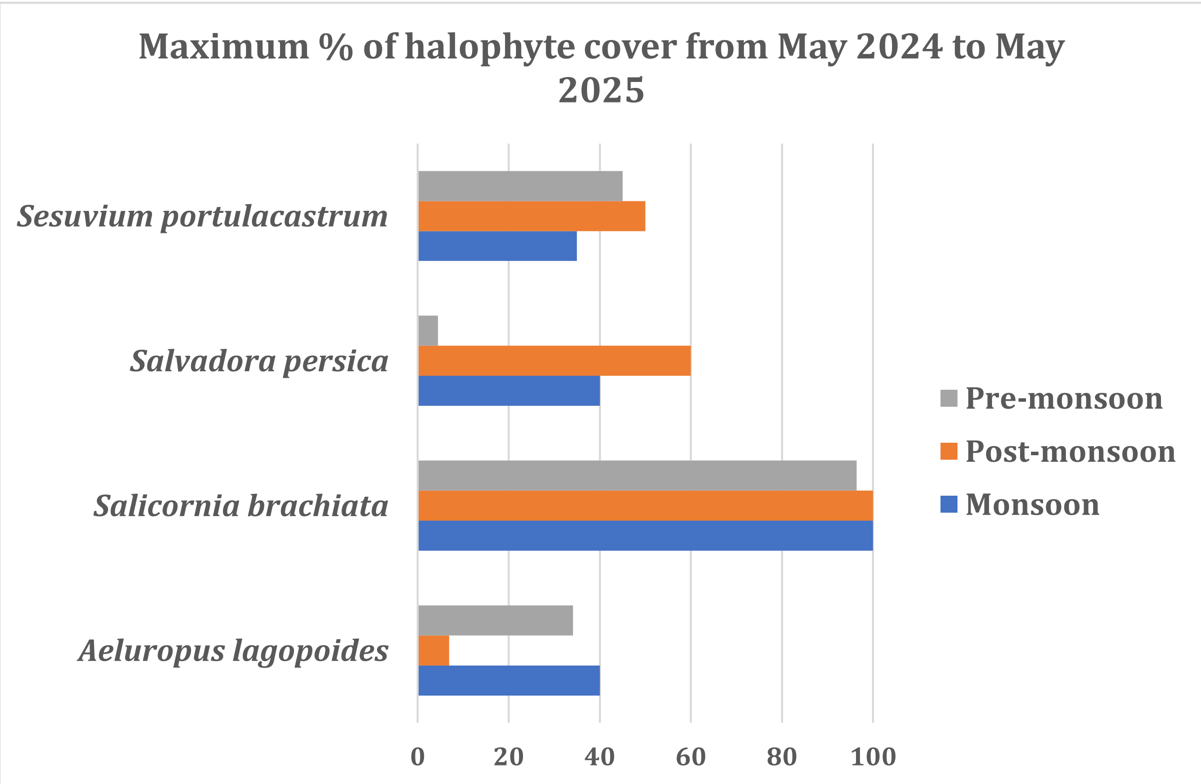
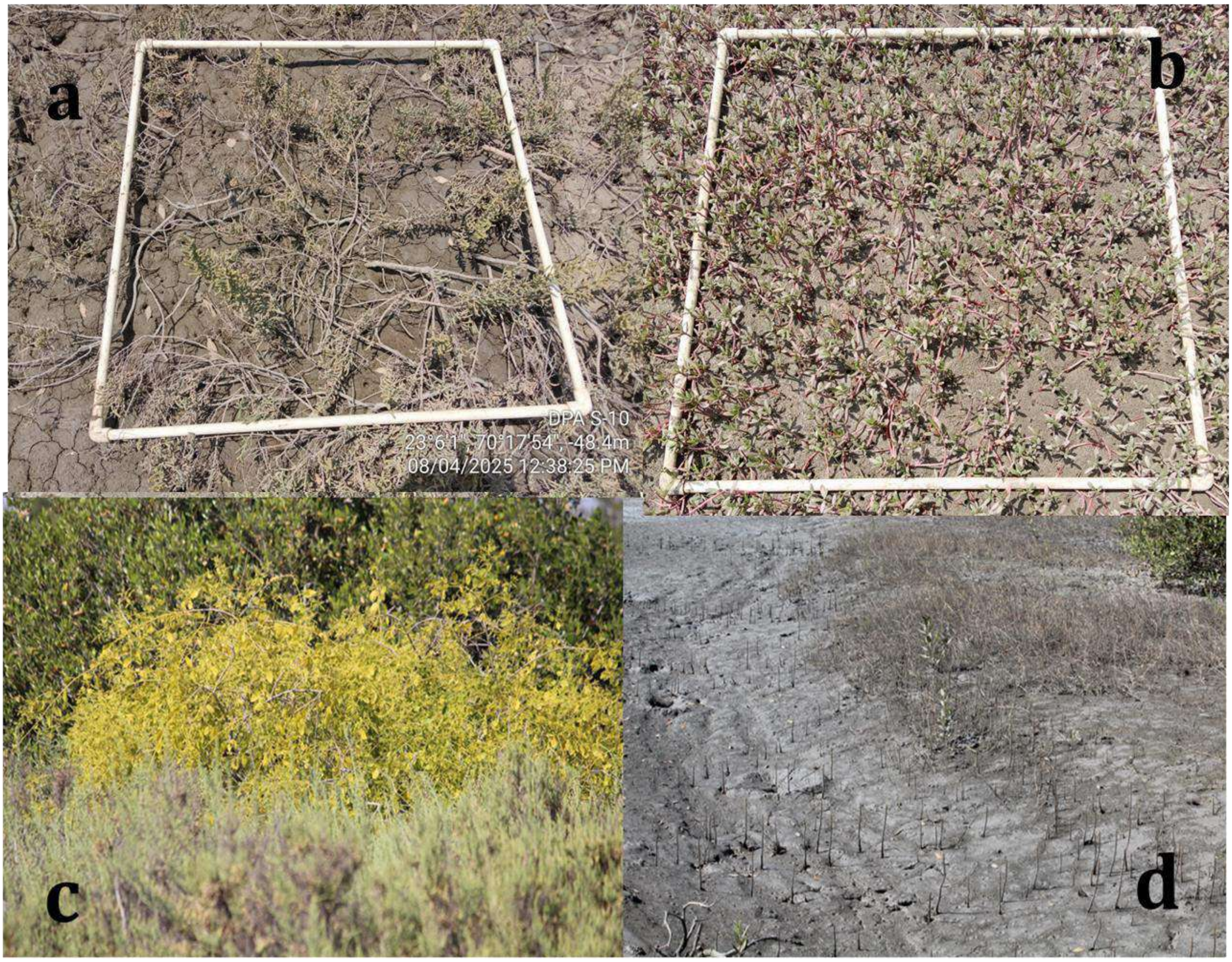


Figure 52. Maximum % cover of Halophytes in DPA and it periphery environment



a. Salicornia brachiata b. Aeluropus lagopoides c. Salvadora persica

d. Sesuvium portulacastrum

Plate 11: Halophyte species recorded along Deendayal Port Authority

4.6. Seaweeds &Seagrass

Both the seagrass and seaweed not observed entire study period from may 2024 to may 2025.

4.7.Marine fisheries

The Ichthyofauna diversity of the Gulf of Kachchh includes a total of 20 orders, 47 families and 96 species (Katira & Kardani 2017). Along the Sikka coast of Jamnagar where 112 ichthyofauna species belonging to 50 families, 12 orders, and 84 genera has been reported. Similarly, the localitynear the Marine National Park, in Jamnagar, Gulf of Kachchh reported 109 ichthyofauna species belonging to 58 families, 19 orders, and 93 genera (Brahmane et al. 2014). Apart from this, a recent study conducted by Sidat et al., (2021) reported 96 species which include 20 order and 47 families. During the field observation from May 2024-2025 , 0.5 kg to 5 kg of fish was catched in 1 km distance with 10 minutes and *Mugil cephalus* is only dominant species which is available in all the season (Plate12).

Plate 12 . Marine fisheries along DPA Jurisdiction

4.8.Reptiles

The saw-scaled viper *Echis carinatus sochureki* normally encountered during mangrove survey Monsoon and Post-monsoon at S-10 location

4.9.Marine mammals

Marine mammals was not observed in entire study period

4.10.Avifauna

Globally, avifauna has the highest level of diversity. Indian subcontinent comprehends around 1340 species of birds which contribute more than 15% of the world's bird species (Ali and Ripley 1987, Manakadan and Pittie 2001, Cox 2010, Grimmett et al. 2011). Thus, understanding the diversity and structure of bird communities to describe the importance of regional or local landscapes for avian conservation and assessment of avian diversity has become an important tool in biodiversity conservation (Safiq et al. 1997). The baseline data on diversity, distribution and species composition plays a significant role for identifying priority areas and formulating the species-specific conservation plan (Peterson et al. 2000, Colin 2000) and evaluate the habitat quality (Chettri et al. 2005, Manjunath and Joshi 2012). Mangrove forest is an important habitat for many bird species and provide high quality habitat for birds because they contain relatively safe nesting and roosting sites, and abundant prey (Nisbet, 1968; van Balen, 1989). Mangrove habitats harbor much of the world's tropical biodiversity and 50% of the world's mangrove forests have been lost as a result of clearing and alteration of coastlines (Duke, 1992). With continuing degradation and destruction of mangroves, there is a critical need to understand the biodiversity of the mangrove ecosystems (Vannucci, 2002). Mangrove vegetation provide a complaint niche for the myriad resident as well as passage migrant aquatic birds, which utilize the system in varying degree from feeding, roosting and breeding (Oswin, 2002).

While, numerous bird species use their foraging ecology to sustain a trophic level, making birds another key animal group in an ecosystem. Scavenging carcasses, eliminating vermin and insect pests, cycling nutrients, dispersing seeds, pollination, and pest control are some of these services. As scavengers and possible pollinators, they have a functional role in the ecosystem and are appropriately referred to as bio-indicators (Bruford 2002, Gregory *et al.* 2003, Parmar *et al.* 2016, Maznikova *et al.* 2024).

Status, Diversity and Distribution of avifauna in different station

The status and diversity of avifauna was studied in coastal areas of Deendayal Port Authority, Kandla, India for the 2024-25. The entire survey was comprehensively carried out by boat survey and walking along the fixed sampling station, for documentation of avifauna. A total of 64 species (34 species terrestrial and 30 aquatic bird) representing 11 order, 26 families and 46 genera were recorded during the study period (Annexture 1, Plate 13). Scolopacidae (nine species) were the most dominant family in terms of species richness followed by Ardeidae and Laridae (eight species), whereas Columbidae and Accipitridae (five species), whereas others represent less species (Fig.53).

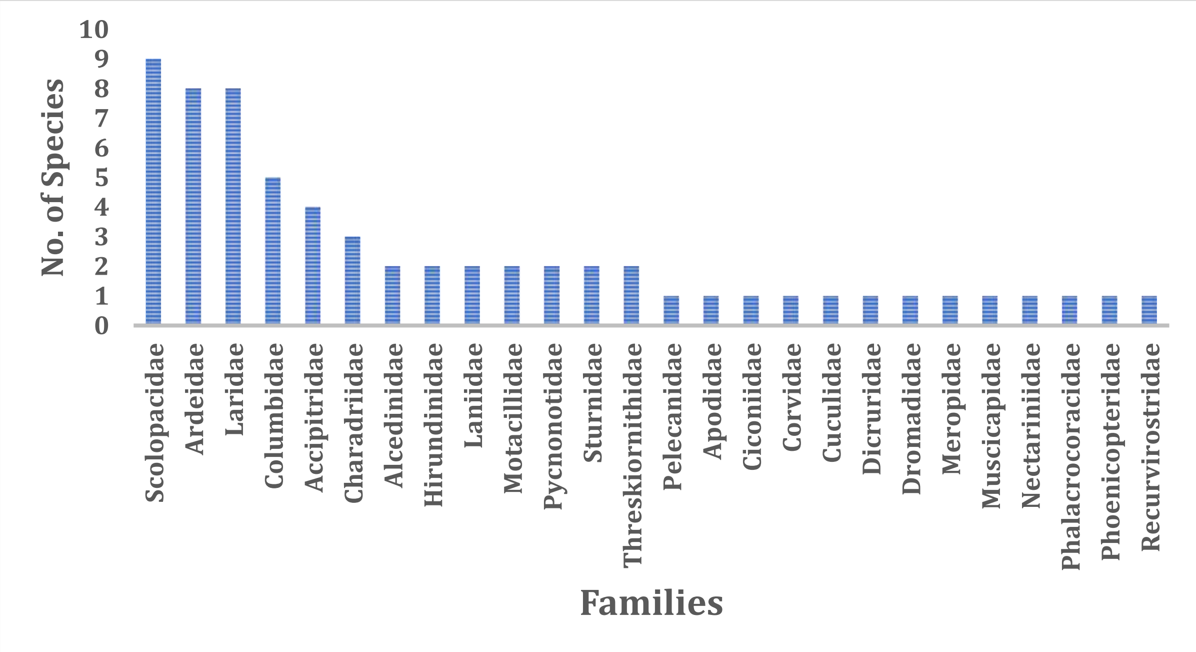


Figure 53. Distribution of families and species at the DPA , Kandla, India

Among the survey station, site 12 (55 species) were the most dominant with 41 genera and 24 families species richness followed by site 13 (53 species), sites 1, 2 and 7 have (47 species) and site 3 have 46 species and other sites have less species composition (Fig.54). The Shannon–Wiener diversity indices shows that site 13 (H=3.756), followed by site 12 (H=3.707), site 7 (H=3.642) and site 5 (H= 3.622), whereas others represent less diversity (Table 13). Based on the movement pattern 42 species (66%) of birds were residence, 18 (28%) are migratory and four (6%) species are regional migratory (Fig. 55).

Table 13. Site wise diversity indices recorded from DPA during 2024-25.

Sites	Taxa	Individuals	Simpson_1-D	Shannon_H	Evenness e^H/S	Margalef	Equitability_J
S-1	47	191	0.966	3.559	0.748	8.758	0.925
S-2	47	212	0.969	3.62	0.794	8.588	0.940
S-3	46	520	0.964	3.575	0.776	7.196	0.934
S-4	42	527	0.969	3.607	0.878	6.542	0.965
S-5	45	499	0.967	3.622	0.832	7.082	0.952
S-6	35	309	0.962	3.405	0.861	5.93	0.958
S-7	47	281	0.968	3.642	0.812	8.158	0.946
S-8	34	288	0.965	3.433	0.911	5.827	0.974
S-9	34	275	0.964	3.405	0.886	5.875	0.966
S-10	36	403	0.963	3.427	0.855	5.834	0.956
S-11	25	241	0.947	3.045	0.841	4.376	0.946
S-12	55	385	0.969	3.707	0.741	9.071	0.925
S-13	53	644	0.972	3.756	0.807	8.04	0.946
S-14	30	199	0.958	3.258	0.867	5.479	0.958
S-15	37	287	0.966	3.488	0.885	6.361	0.966

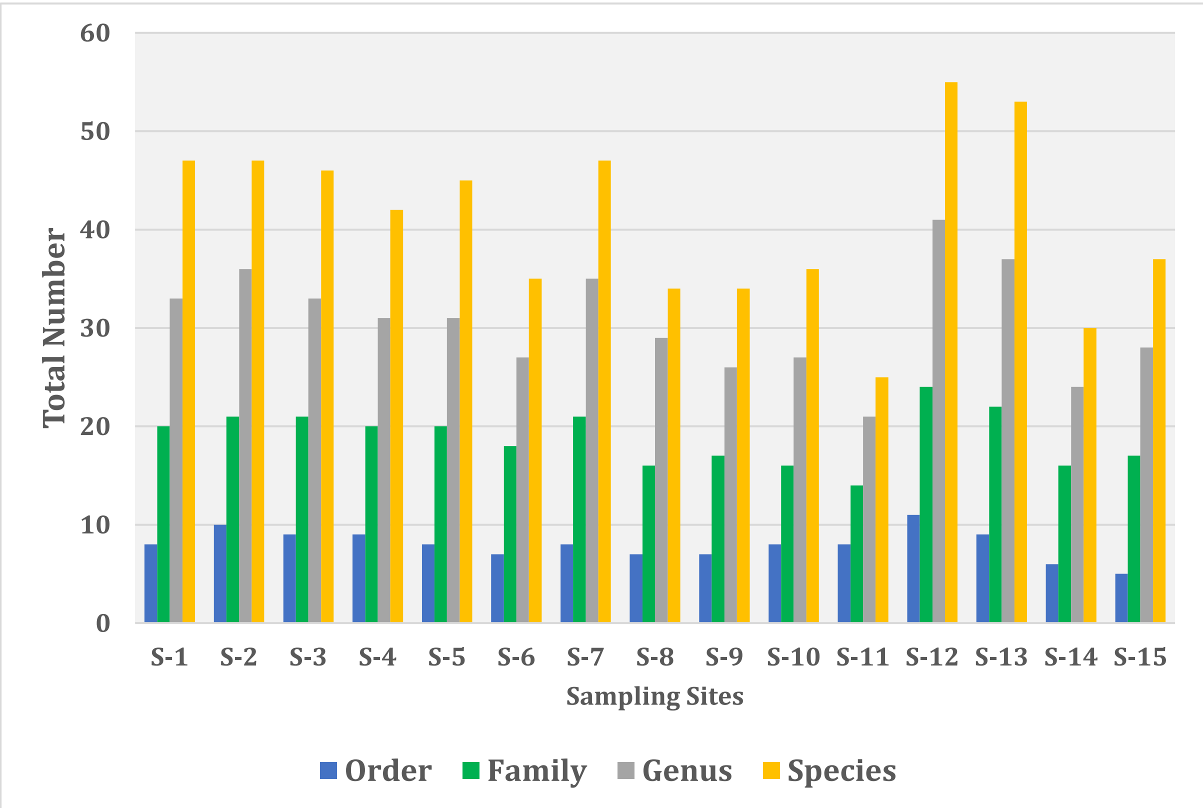


Figure 54. Station wise distribution of Avifauna from May 2024-May 2025 at DPA

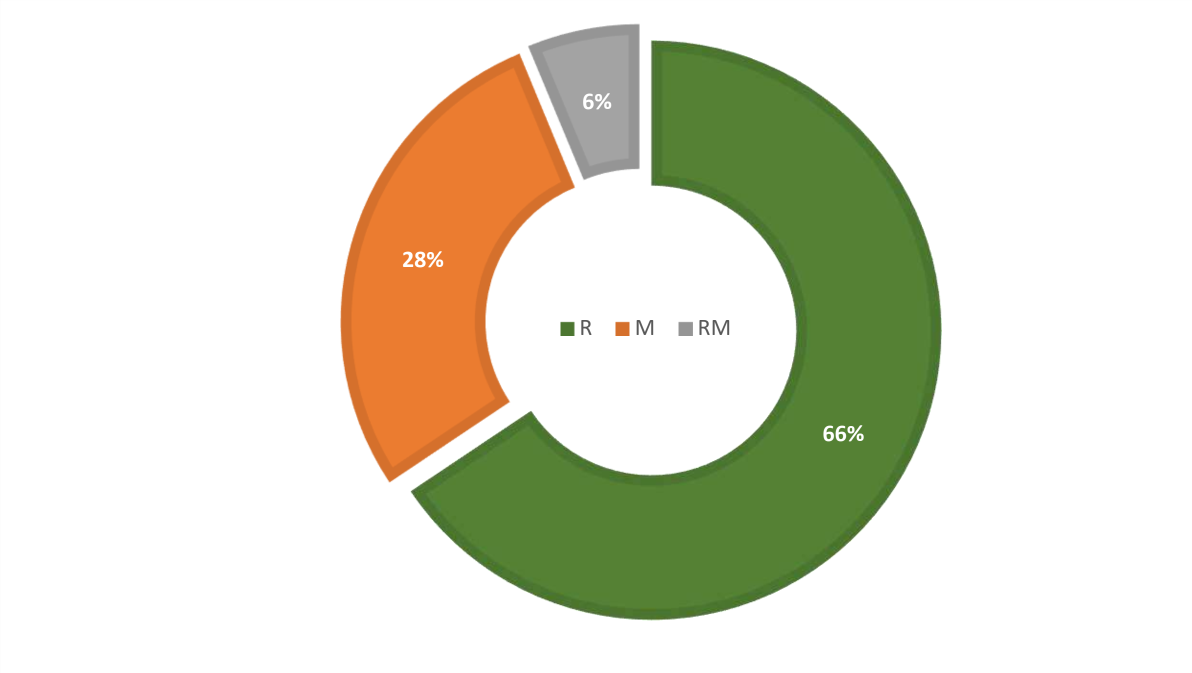


Figure 55. Behavioural status of avifauna from the DPA

Considering the abundance of the species during the study period, 34 taxa (53%) were recorded from terrestrial, 30 species (47%) from aquatic habitat. During the seasonal survey we have noted that, post monsoon season is most productive for avifauna in study area (Table.14)

Table.14. Season wise species recorded from study area

Sites	Monsoon	Post Monsoon	Pre-Monsoon	Overall
S-1	44	14	13	47
S-2	40	21	14	47
S-3	43	44	46	46
S-4	42	42	40	42
S-5	45	45	44	45
S-6	35	35	34	35
S-7	41	22	21	47
S-8	33	34	33	34
S-9	34	34	34	34
S-10	35	36	36	36
S-11	23	23	25	25
S-12	45	37	31	55
S-13	53	53	51	53
S-14	29	29	20	30
S-15	37	37	37	37
Total	**53**	**64**	**60**	**64**

Plate 13. Common and migratory birds from the Deendayal Port Authority, Kandla. (A) Western Reef Heron (*Egretta gularis*) (B) Black-headed Gull (*Chroicocephalus ridibundus*) (C) Eurasian curlew (*Numenius arquata*) (D) Grey Heron (*Ardea cinerea*) (E) Greater Flamigo (*Phoenicopterus roseus*) (F) Black-winged Stilt (*Himantopus himantopus*)

Based on the feeding guilds of recorded birds, it was found that carnivore, 20 species (31.35%) were insectivore, 17 species (26.56%) were piscivore were 14 species (21.88%) and 6 species of omnivores and others represents less (Fig 56).

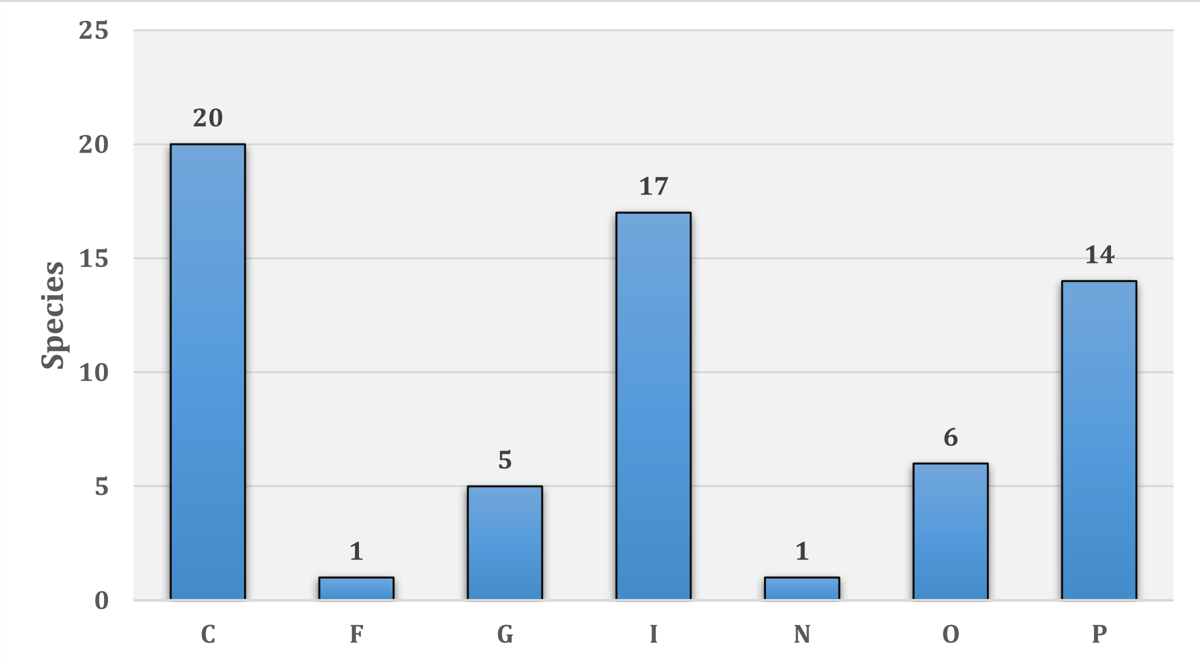


Figure 56. Status of foraging guild of avifauna recorded from Deendayal Port Authority, Kandla, India (C- Carnivore, F- Frugivore, G- Granivore, I- Insectivore, N- Nectarivore, O- Omnivore, P- Piscivore).

Among 64 species, only five species *viz.* Painted Stork *Mycteria leucocephala* (Pennant, 1769), Black-headed Ibis *Threskiornis melanocephalus* (Latham, 1790), Glossy Ibis *Plegadis falcinellus* (Linnaeus, 1766), Black-tailed Godwit *Limosa limosa* (Linnaeus, 1758) and Eurasian curlew *Numenius arquata* (Linnaeus, 1758) are under the Near Threatened (NT), whereas, River Tern *Sterna aurantia* (Gray, JE, 1831) is under vulnerable (VU) categories of IUCN Red List of Threatened Species. Moreover, four species (6.25%) River Tern *Sterna aurantia* (Gray, JE, 1831), Common Greenshank *Tringa nebularia* (Gunnerus, 1767), Black Kite *Milvus migrans* (Boddaert, 1783), Gull-billed Tern *Gelochelidon nilotica* (Gmelin, JF, 1789) and Shikra *Tachyspiza badia* (Gmelin, JF, 1788) were under the Schedule I, and species (90.63%) were under Schedule II categories of Wild Life (Protection) Act, 1972 (Fig 57) and the species rarefaction curve presented in figure 58.

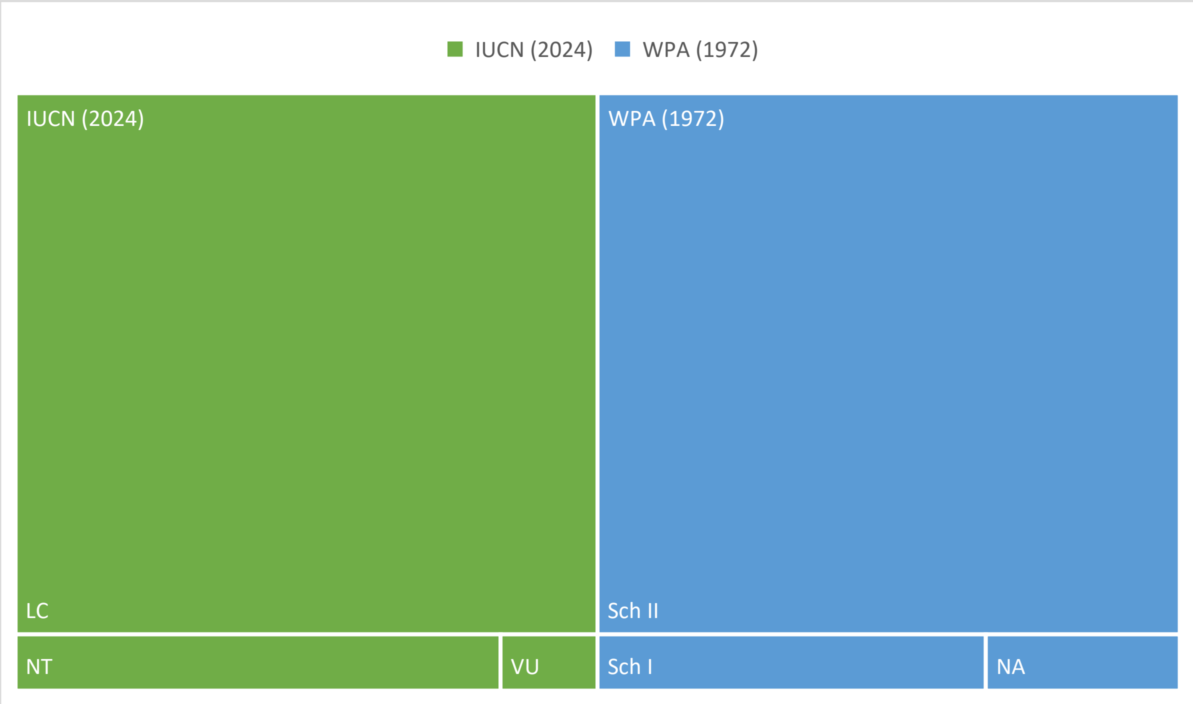


Figure 57. Status of threatened species recorded from Deendayal Port Authority, Kandla, India (Sch=Schedule, LC=Least Concerned, VU= Vulnerable, NT= Near Threatened).

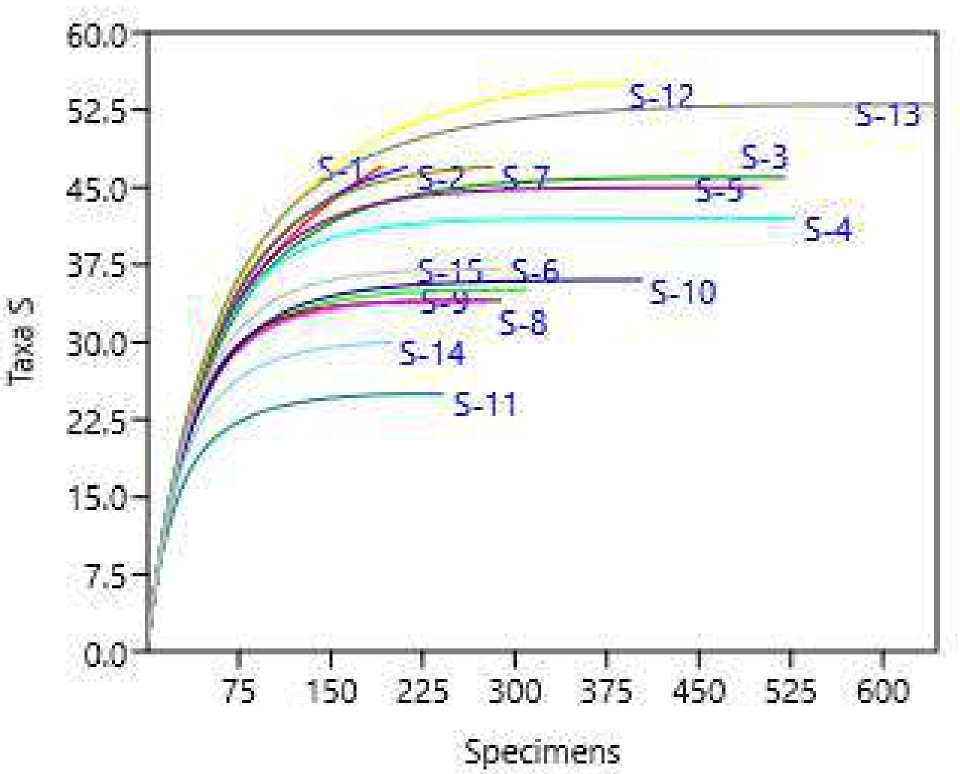


Figure 58. Species rarefaction curves of different sampling sites in study area.

5. Discussion

5.1.Physico-chemical status of Deendayal Port Authority Environment

Water quality of coastal water reveals the state of the overall environment. The quality of water determines the biological and other resources in the marine environment. However, water quality parameters in marine environment vary to a great extent, influenced by the climate,water currents and movements, input of pollutants in the form of effluent and sewage out fall and so on. The geophysical and geo-chemical factors such as shape and size of the coastal areas, prevailing currents, temperature, salinity, tidal impacts, directions of prevailing winds and influx of fresh water also influence the quality of water in the nearshore marine environment. The creeks and the intertidal zones are well known for the biodiversity and their role in the ecological services arewell documented. mangroves are now recognized as one of the most effective nature based solutions for climate change adaption and to reduce disaster risk (Sunkur, 2023). To assess the health of mangrove forest is inevitable in the monitoring programme in which extensive field survey is carried out to select the representative sites for data collection. The plant growth characteristics indicates the status of the mangrove cover for which the height,canopy dimension, Girth, as well as the number of different age groups of plants are considered. The DPA port and the influencing environment are surrounded by the mangroves and tidal flat with marshes are potential carbon stocks which are conserved and restored. Yet,the various human interventions due to the port related activities tendto impair the water and sediment quality which in turn affect the biological productivity. In this regard some of the most influencing physical and chemical water and sediment are considered for the seasonal study from the 15 selected sites. The plankton and benthic fauna diversity, Chlorophyll 'a' are also recognized as indicators of the health status of the environment (Adams,2002). The rate of variations in the different stress indicators in the water are followed in the monitoring process to evaluate the impacts that are likely to occur both in the near future as well as in the long term at the present rate of occurrence.

Temperature and pH

Water temperature in DPA port area generally varies in the range 12°C to 30.°C. However, the present study shows a increased range of water temperature in Kandla DPA port in previous year of 2023-2024. Water temperature Port region varies during monsoon, ranged from 23°C to 30°c to while in post monsoon observation, the value ranged from

12°c to 27°c to . However, in pre monsoon the values were noted in the range of 25°c to 29°C.The monsoon water temperature has been recorded as high (30°C). There is no vertical variation in temperature of marine water in Kandla Port area due to lack of thermal stratification in Creek (NIO,1998). This is because of the strong currents, high tidal impact and low depth of the harbour areas. The currents influence vertical mixing and restrict the stratification of water layer in the harbour area. High temperature during pre- monsoon attributed to high rate of evaporation and less rain fall.

pH

The pH of seawater of DPA Port area varied in the range of 7.3 to 8.5. Generally, the pH of seawater is controlled by Carbonate and biocarbonate system and falls in the narrow range of (0.2-0.3). pH was alkaline during summer and showed downward pattern up to monsoon and remained alkaline during postmonsoon, (Vajravelu et.al 2018). Changes in pH will depend on the factor like the removal of CO2 by photosynthesis through bicarbonate degradation, fresh water influx, reduction in salinity and temperature and decomposition of organic matter (Rajasegar et al., 2002).

Salinity

As temperature influences the salinity of marine water in the tropics, water in DPA region has higher salinity in the range of 36ppt 47ppt during 2023-2024 but at present the salinity ranged 32ppt to 42 ppt which is quite lower in previous year . Highest salinity observed during monsoon and Post-monsoon (42ppt) at station S-8. The higher salinity towards open sea regions around S-8 due fresh ingress of seawater in gulf region and localized effects of seepage of high saline (brine) water from salt marshes and saltpans of salt industries (Zingde& Anand ,1996). Hundreds of salt industries in and around Kandla Port use seawater with salinity in the range of 35 to 50 ppt. They release 'bittern' remains of salt after manufacturing, which has salinity as high as 250 ppt in Kandla Creek, thereby increasing the salinity in isolated regions of port areas (Chhaya, & Chhaya, 1997). Lack of fresh water from catchments coupled with higher evaporation is the cause of higher salinity in Kandla Port area. In the Little Gulf of Kuchchh water salinity has been recorded as high as 50 ppt (NIO,1998).

Dissolved oxygen

DO is consumed in marine ecosystem by the respiration and decaying organic matter in the water column. Loads of high organic matters may deplete the DO to its minimum level, which can be detrimental for the aquatic life. A severe depletion of DO may lead to 'Eutrophication' in an aquatic system. However, no such event has been reported in Kandla port region so far. DO in marine water of DPA region has been found in the range of 2.9 mg/l to 8.2 mg/l for in 3 seasons May 2024 to May 2025. The current range of dissolved oxygen in the marine water of Kandla Port region conforms to the designated best use for Salt pans, Shell fishing, Mariculture and Ecologically Sensitive Zone. For ecologically sensitive zone not less than 3.5mg/l at any time in a year (or 5.0 mg/l at 60 percent saturation level) of DO is essential for the protection of aquatic life. But in presentation observation less content of do in monsoon at S-7 might be due certain nutrient load from mangrove environment.

Total Suspended Solids

Suspended solids in Deendayal port area varied in the range 205 mg/l to 729 mg/l. Generally, the suspended solids in the Deendayal region are high and vary to a great extent from the inner port region to the out harbour region and further towards outer Gulf..The higher value of suspended solids and their variations across the stations in the inner Gulf including Kandla Port regions results from the dispersion of sediment loads due to strong currents and tidal influence Zingde& Anand (1996).

Turbidity

The Kandla Port areas fall under inner Gulf of Kuchch, there is a high turbulence in the· Creek, due to strong an ocean currents and tidal influence. Therefore, the turbidity of tropical seas is higher than other tropical and subtropical seas. The marine water turbidity is expressed in Nephelo Turbidity Unit (NTU). Water turbidity in DPA Port region has been recorded in the range of 16 NTU to 489 NTU. 2023-2024 at present 2024-2025 the turbidity 20 NTU to 489 NTU. Generally, water turbidity is high due to high organic load of mud and silt. (Omprakash, 1997) Higher turbidity of marine water at the DPA Port regions may also be associated with the washed sediment from mangrove environment and partially dredging activities, which is done on a regular basis along the Kandla Creek.

Nutrients

Nutrients in marine water such as Nitrate and Nitrite ,Phosphate and silicate are very crucial for the marine life. Their increase in concentration enhances the primary productivity in marine water. Nonetheless, excessive concentration sometimes can be detrimental to the aquatic life especially in creeks, estuaries and bays where there is a restricted water exchange. These increased nutrients lead to an excessive growth of algae resulting in eutrophication in some extreme cases (NIO,1998). During the period of May 2024 to May 2025 covering 3 season with respect to nutrient concentation it was observed that the concentration were with in permissible limit to marine life expect phosphate concentration which is quite higher from 3.16mg/l to 73.24mg/l which might be due to handling of cargo in port area ,input of sewage and industrial effluent to creek environment

Petroleum Hydrocarbon (PHs)

Petroleum hydrocarbons in the water column of Deendayal port area have been found in the range of 0.3 µg/l to 85.8µg/l for the period 2023 and 2024. For the period may 2024 to May 2025 the PHs ranged from 0.19 µg/l to 70.80 µg/l. High range of petroleum hydrocarbon results from the spills and leakage during the handling of crude petroleum products at the Port especially at oil terminals (NIO,2002).

5.2.Biological status of Deendayal Port Authority Environment

Biological resources of a marine area reflect the overall environment of the region in question. The coastal areas especially bays, creeks and estuaries are rich in biota and are habitat of many marine species. Usually, ports are also built in these areas for their geographical advantages. The port and harbour activities in these locations disturb the habitat of many marine biota. However, in the process many habitats are also created for marine biota. The Gulf of Kachchh is an example of such habitat and has been considered to be rich in biodiversity. Kandla port has been built right in the gulf and has been serving this region nearly seventy years.

Chlorophyll 'a' Phytoplankton and Zooplankton

In general the basic parameters of marine biota like Chlorophyll 'a' and Phytoplankton are observed to be moderate in their values but similar to those prevailing along the coastal waters of India (NIO,2002). During the period May 2024 to May 2025 the Chlorophyll 'a' concentration 0.04 mg/l to 2.89mg/l which is quite satisfactory for port environment.

The index value of both phytoplankton and Zooplankton of 3 season shows moderate environmental status (Fig.59).

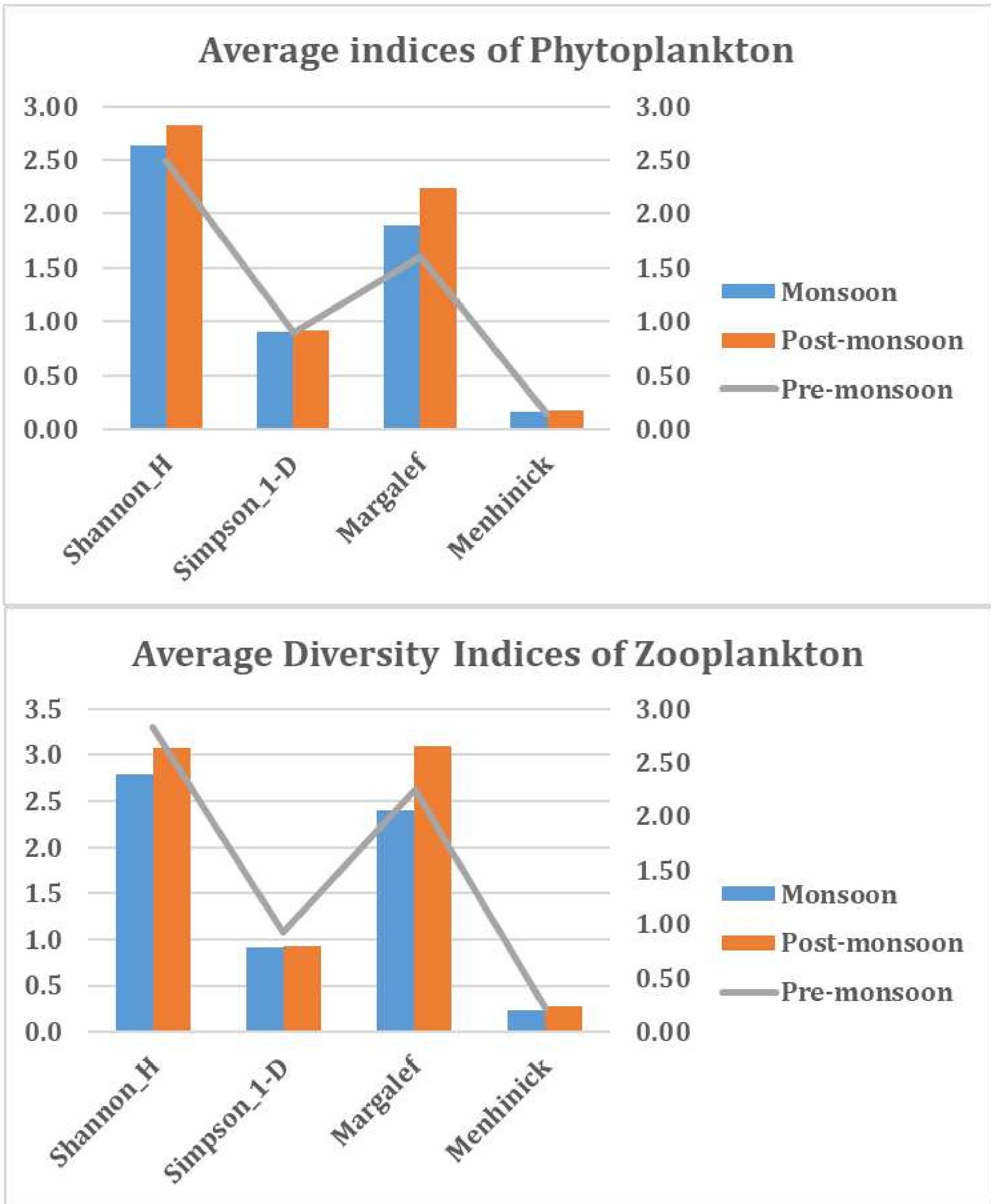


Figure 59 Diversity indices of Phytoplankton and Zooplankton

As per Shannon Wiener's rules the aquatic environment i.e both soil and water classified as very goodwhen H' value is greater than four (>4), whereas the good quality represents the H' value with a range of 4-3, similarly moderate-quality (H' value 3-2), poor quality (H' value 2-1) and very poor-quality H' value significantly less than one (<1). Presently DPA port and its periphery environment has been influenced by contaminants deposited from industries and the cargo movements. Accordingly, species diversity decreases at sites with poor water quality. As deduced from the Shannon diversity index values between 3-4 overall 3 season representing the moderate quality of environmental status dominated by the few genera such as Coscinodiscus sp. and Synedra sp,and copepod sp. A community dominated by relatively few species indicates environmental stress (Plafkin et al., 1989). According to Staub et. al (1970) species diversity index value between 3.0 to 4.5 represents slightly polluted and the lightly polluted environment, the index value characterizes 2.0-3.0, similarly, moderately polluted environment shows index value of 1.0-2.0 and finally, the heavily polluted environment index value is 0.0-1.0. While considering the overall index values it is inferred that the study sites can be included under the category of lightly polluted environment.Natural geographical processes such as strong currents and higher tidal influence have been responsible for the high turbidity and suspended solids which in turn reduce the light penetration thereby reducing the growth of Plankton and primary productivity.

Intertidal Fauna

Macrofaunal communities did not show much spatial and temporal variation in their components at 15 sampling locations. The distribution of intertidal Fauna seems to be entirely governed by the environmental parameters like Physico-chemical and biological characteristics of the ambient milieu. Generally, intertidal Fauna on the Kachchh coast scope a harsher environment with relatively high salinity, wide temperature fluctuations, seasonal fluctuation of different hydrological parameters and a high sedimentation rate. The water suspended solids (SS) were generally found due to the dispersion of fine sediment from the bed and the intertidal mudflats due to tidal movements at the mouth of the Kachchh coast (Kandla).

An earlier study by Saravanakumar et al. (2007) revealed the presence of five intertidal Fauna in the mangrove environments along the Kachchh coast, with a diversity index such as Shannon_H, Simpson_1-D, Margalef and Menhinick ranging from 1.84 to 2.45 in 2023 to 2024 at present from may 2024 to may 2025 it is 0.77 to 1.66. The species composition and diversity indices reported during 2018-2019, 2019-2020, 2020-21, and 2021-2022 2022-2023 and 2023 to 2024 did not vary significantly in the DPA port environment. It was understood that the intertidal fauna community in the Kachchh mangrove had not varied much in terms of its species diversity. An earlier study by Saravanakumar et al. (2007) revealed the presence of five intertidal Fauna in the mangrove environments along the Kachchh, with a diversity index ranging from 1.84 to2.45. During the 2023 to 2024 average Shannon diversity indices varied from 1.51 to 1.6 similarly the Margalef and Simpson indices ranged from 1.43 to 1.5 and 0.7 to 0.73 and similar patter the index value also run parallelly (Fig. 57). According to Magurran (1991), the Shannon diversity index of >3.0 indicates a healthy coastal environment. However, diversity indices around the DPA coastal environment were <2.0, indicating that the lower moderate faunal diversity.In the present observation, the species composition of the benthic macrofauna showed dominance in the Phyla Molluscs, Arthropoda, Annelida, Nematoda, Nemertea and Chordata. Previously, Ansari et al. (1986), Mohammed (1995) and Kumar (2001) recorded the presence of the Molluscs, Arthropoda, Annelida, and Chordata in various parts of Indian coastal waters.

Subtidal Fauna

The Shannon diversity indices ranged from 0.65 to 1.77, similarly Margalef and Simpson indices ranged from 0.75 to 2.18, 0.35 to 0.80 during 2023 -2024 . The results obtained from this study represent and the indices such Shannon_H,Simpson_1-D, Margalef, and Menhinick reflect similar moderate to lower environmental status for the period 2024-2025 (Fig.61). There is a need for an in-depth study of Fauna and their interactions in mangrove ecosystems. Also, practices directed at managing mangrove resources should go hand in hand with conservation strategies.Mahapatro et al. (2011) documented the macrofaunal diversity in Bhitarkanika (Odisha coast) mangroves, and the diversity ranged from 1870 No/m2. Ramakrishna et al. (2011) recorded the population structure and density of macrofaunal from the Andaman and Nicobar Islands and documented diversity from 1015 No/m2 in the. In the Gulf of Katchh, Saravanakumar et al. (2007) documented that from 1999 to 2000.

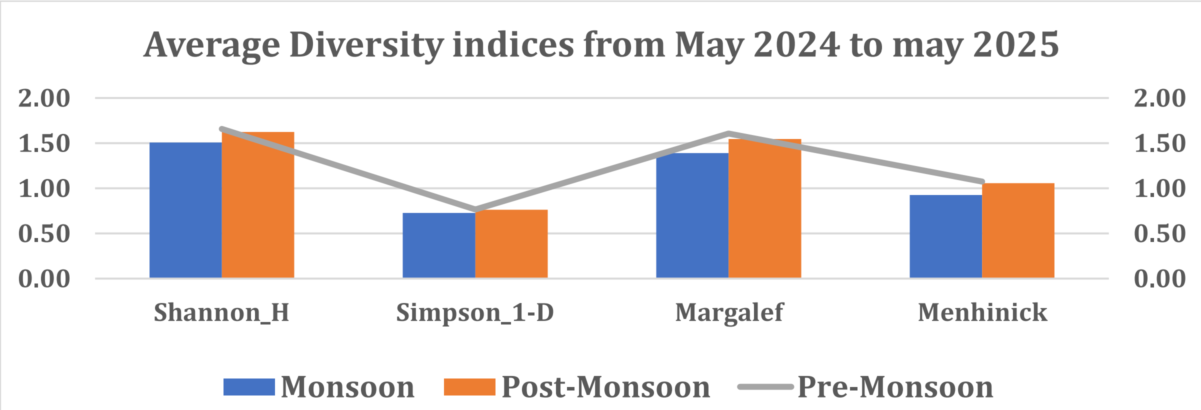


Figure 60. Average diversity indices of intertidal fauna of DPA

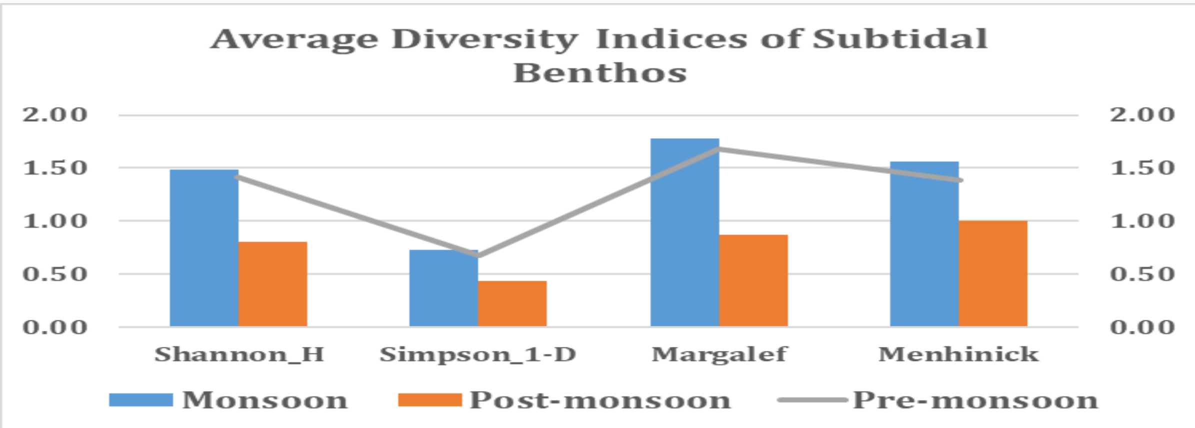


Figure 61 Average diversity indices of Subtidal fauna of DPA

6. Impact identification and Evaluation

The Deendayal Port, Kandla, in Kachchh district is surrounded by a large number of port associated industries and salt pans and salt processing industries. There are a number of minor and creeks that are connected to the Gulf of Kachchh. The DPA has been the prominent industrial and transport facility primarily associated with the inter connected creek environment which influences the open oceanic zone. The adjacent marine zone is well known for the multitude of the biological resources however, the very sensitive ecosystems like coral reefs, sea grass meadows and salt marshes are not found within the 10 km radius of the DPA port Jurisdiction, and the direct impacts are not experienced.

The general consequences of the port associated activities, particularly on the free-floating microscopic animals and plants, the macrofauna inhabiting the sub-tidal and Intertidal habitats and the birds have been well known, in this respect it is imperative to analyze the major impacts and to put forth effective mitigation measures.

Routine dredging Impact

- Dredging and dredge spoil disposal activities for port development and maintenance can induce short and long-term impacts on aquatic systems, namely degradation of marine resources such as fisheries and other aquatic biota.
- Dredging activities often disturb sediments reducing visibility and transparency of water.
- Dredging activities potentially affect not only the site itself, but also the surrounding areas, through a large number of impact factors such as turbidity, sedimentation, resuspension and release of contaminants which can be within the site or to the nearby area on a temporary or over a long period.
- **Impact on Air quality of the Port premises**
- Emissions from burning waste materials and the escaping dust particles due to handling of fine-particulate materials such as fertilizers and minerals causing air pollution in port areas.

Impact on Avifauna

Impact-I Location of the Deendayal port site in the close vicinity of the ecologically sensitive terrestrial ecosystem (migratory route, breeding and nesting sites of avifauna) may impact the overall biodiversity values due to the project associated activities such as A. Habitat degradation due to pollution

B. Loss of habitat and population of faunal groups

C. Overall impact on biodiversity of the protected area

Evaluation: The Deendayal SEZ project site located in the mid of the Deendayal Port area surrounded by port associated industrial sectors, predominately salt industries. There is no any ecologically sensitive ecosystem (Protected Areas) located within 10 km radius of the project site. Due to the prevailing land use no impact on protected areas was foreseen. Further the study area also not reported any migratory route of major animal groups, nesting and breeding sites of avifauna.

Impact on threatened flora and Fauna – Inter-tidal coastal habitat.

Impact 2: Direct loss of inter-tidal habitat like mangrove and saltpan will impact the threatened floral and faunal species existing within it due to; Loss of inter-tidal habitat (mangrove) and degradation due to project associated activities will overall population status of threatened aquatic avifauna.

Evaluation: As per land use land cover study, the project area dominated by intertidal habitats like, Mangrove, creeks and salt pans. The study area reported total 5261 birds belong to 64 species (Annexure 1). However, this list includes only five species *viz.* Painted Stork *Mycteria leucocephala* (Pennant, 1769), Black-headed Ibis *Threskiornis melanocephalus* (Latham, 1790), Glossy Ibis *Plegadis falcinellus* (Linnaeus, 1766), Black-tailed Godwit *Limosa limosa* (Linnaeus, 1758) and Eurasian curlew *Numenius arquata* (Linnaeus, 1758) are under the Near Threatened (NT), whereas, River Tern *Sterna aurantia* (Gray, JE, 1831) is under vulnerable (VU) categories of IUCN Red List of Threatened Species. Moreover, four species (6.25%) River Tern *Sterna aurantia* (Gray, JE, 1831), Common Greenshank *Tringa nebularia* (Gunnerus, 1767), Black Kite *Milvus migrans* (Boddaert, 1783), Gull-billed Tern *Gelochelidon nilotica* (Gmelin, JF, 1789) and Shikra *Tachyspiza badia* (Gmelin, JF, 1788) were under the Schedule I of Wildlife Protection Act, 1972 (amendment 2022).Since the study area beyond 5 km supports large extent of similar (Inland wetlands and Salt pans) habitat types and supports large number of aquatic birds, the overall impact on few aquatic threatened avifauna reported in the study area would be minimal (Annexure 1). In spite of that, implementing, proper mangrove plantation activity can take care of this minimal impact. Further, no endangered aquatic birds reported in the study area.

7. Mitigation

Adopting mitigation techniques for reducing the carbon concentration in the atmosphere through green belt/plantation, conservation of water and energy in the agriculture and several production sectors have been very much familiar. Various other considerations to control air and water quality in the port and influencing environment have been suggested and implemented in many states. Depending on the physical and chemical characteristics of the dredged material, disposal may be confined, unconfined or treated prior to release in open water, along the shoreline, or on land. Ultimately, EMMP acts as a comprehensive manual for environmental protection, reduction in carbon (GHG) emission and finally it helps in converting major ports into "Green Ports". The ultimate goal of a Green Port Plan program is to achieve long-term environmental, societal and economic benefits through resource conservation, waste reduction and pollution prevention. The Green Port Program unifies the Port's environmental sustainability goals (in many key areas) by way of setting measurable goals and evaluating progress in each area on an annual basis.

Pollution control

The major health impacts of pollution from ports are related to the gaseous and particulate emissions arising from the combustion of petroleum products and coal leading to various respiratory tract diseases, cardiovascular disease, lung cancer and also climate change related issues. Petroleum contamination is a very common problem these days arising from leaking tanks, oil spill, and gas into the surrounding water and soil and takes long time for reclamation by bioagents or physical and chemical treatments. A process called thermal soil remediation helps in the remediation of contaminated soil which can be reclaimed and reused by this method.

The possible soil contamination due to spillage of oil residues, petroleum products, cement, paint, plastics, non -degradable solids etc. are to be handled effectively by scrupulous preventive management guidelines. The laborer and officials should be aware of the extent of damage they can bring on the ecosystem and in turn to human as well through the process of biomagnification through the marine food chain. In this regard any potentially contaminated soils from construction activities must be handled, transported and disposed off in accordance with the Environmental Management Act (EMA) and its Regulations of Government of India.

Afforestation

The port authority should take up plantation of various kinds according to the space, soil types and water availability. Also, it is utmost necessary to carry out promotion compensatory mangrove and associated vegetation plantation along the shoreline at the suitable tidal level with the common species. The development such green belts surrounding the whole project area will enhance the integrity of the ecosystem and provide ecological and economic services at large on a long and regular basis. The plantation needs to be carried out with higher density of seedlings to realize high survival rates and growth performance considering the past experiences in the coast and the type of natural stands existing along the shores of the creek system as well.

Mangrove plantation

The Green Port Program is an umbrella program designed to achieve the Port's environmental sustainability goals by adopting appropriate afforestation programs to develop large green belt areas at all prospective locations. The afforestation would not only contribute to the aesthetics but also would serve as a 'sink' for the pollutants released from the station and would thereby protect the quality of ecology and environment in and around the projects. Green belt will help in supporting the biological diversity, controls soil moisture, erosion control and coastal protection, increase the rate of ground water recharge and act as carbon sink to reduce climate change. Green cover interventions capture the fugitive, attenuate the noise, subside the particulate matter in the air and reduce the temperature in the surroundings. The mangrove plantation is expected to support the avifauna diversity of the local environment. It is recommended that construction activities to be restricted during the non-migratory season of the birds (November – February) to avoid disturbance to the migratory species as the Kachchh wetlands serve as major wintering grounds, located in the major central Asia fly way. Since the intertidal zone of the creeks comprising the mangroves and salt pan habitats support many benthic fauna including finfishes and shell fishes, aquatic and terrestrial migratory birds, the protection of these productive environments is very much essential for the restoration of the biodiversity and the livelihood of the fishermen. The above suggested mangrove plantation needs to be monitored for the next five years till it attains maturity and later on evaluation of the ecosystem and economic services rejoiced by the community in view of the evolving climate change related issues. The monitoring of the mangrove and coastal zone should include the study of species composition, population characteristics, growth rate of plants, abundance of the flora and fauna in order to estimate the diversity and health status at every season of the entire environment.

Soil erosion control

Shore line substratum erosion is a major threat to the intertidal habitats in DPA port jurisdiction. Often the rate of erosion is severe in the port environment due to the continuous vessel movement and the churning effect induced hydrological regime and other natural causes. During the present study it was noticed that few creeks stretch in Kandla are susceptible to erosion due to high water currents and tides. The dual purpose of controlling erosion and promoting intertidal biodiversity could be best achieved by installation of artificial reef structures, limestone rocks, laterite, cement and granite as well as bio reefs. Artificial coastal structures are cheap and installation is easy and adaptable and for better results it can be supplemented with the addition of a substrate that will support marine organisms as that of the natural intertidal and sub tidal environment. The structural diversity of the artificial reef will determine the diversity of marine organisms utilizing the created habitat. Artificial reefs once built will last for decades and would enrich marine biodiversity in a short period of time by providing ideal habitat for sessile and free-living benthic organisms and their larvae. Natural materials such as dead shells can be used for building artificial reefs and are environment-friendly. Reef balls are another form of artificial reef increasingly used in western countries to create sustainable marine reef habitat which may be easily attempted at Deendayal port Areas. Both reef balls and artificial reefs being inexpensive and locally available, can be built in different creek systems of the port jurisdiction. Application of coir mats are also suitable to control the shoreline erosion in the mangrove patches and open shore in conjunction with the rocky and cement structures.

Phosphate mitigation

- Optimizing fertilizer and detergent application in the households and industries
- Creating awareness among the stakeholders
- Planting perennial crops or crop rotation to avoid bare fields, which experience higher erosion and phosphate runoff.
- Planting trees and shrubs around fields to absorb excess nutrients.
- Restricting runoff from livestock rearing areas and maintaining treatment systems for sewage
- Bioremediation methods to be adopted for the removal phosphorous in agriculture and waste water.
- The most reliable and most frequently applied removal process is chemical phosphorus precipitation by addition of metal salts. Dissolved phosphorus is converted to solids which are removed from the waste water together with the sludge.
- The decay of the organic material produced by photosynthesis under aerobic conditions again results mainly in mineral phosphorus compounds in the sediments with low availability. Under anaerobic conditions decomposition process results in the release of phosphorus in dissolved and therefore easily accessible form.
- By precipitation with calcium cations manifold reactions are known, which are hard to predict. High phosphorus removal efficiency can be achieved at pH-controlled crystallisation of calcium hydroxyapatite which has a very low solubility product.

8. Conservation and Management Plan

Conservation of biodiversity is considered as the key component for administration of natural assets. Biodiversity is an all-encompassing concept that describes the magnitude of ecological diversity addressing the wide range of life associated with different types ecosystems. Biodiversity conservation is the protection and management of the biotic ad abiotic resources for sustainable development and existence and preservation of the diverse species, Sustainable utilization of species in the ecosystem along with the maintenance of the life-supporting systems are essential for the functioning of the various ecological processes. It is an integral part of any commercial activity and infrastructure development in the marine environment. Emphasis is given towards the reinstatement of the physical, chemical and biological characteristics of the coastal ecosystem which are much complex and vulnerable on which the human is highly dependent. Management of the marine biodiversity is the prime concern in the development of Ports and harbors which occupy the fragile continental shelf which is highly productive and harbors numerous living resources. Hence Environmental Management Plan (EMP) is considered as an important component in any developmental activity with sustainable management goals which are to be fulfilled within a time frame. Thus, EMP aims to suggest concrete measures that would mitigate the impacts paving way for maintaining the integrity of the project environment.

Development of ports involves effective management plan towards environmental wellbeing that guarantees both sustainable port growth and a healthy ecosystem functioning in its vicinity. There is a need for innovative solutions for port development which are in harmony with the ecosystem and which are robust or adaptable under change. The recent trends like growth of global trade, increasing vessel movements and size, modernize port facilities, driving urgent investments in ports have been found negatively impact water quality and marine flora and fauna. This simultaneously calls for sustainable and inclusive development which ensures productive nature of its marine environment.

The port authorities mandate to their activities environmentally sustainable and benign need to understand the marine ecological setting of their ports including water quality, biotic components and the factors that impact them. In spite of all the pressures, the ecosystem continues to deliver many services which are often intangible. In order to maintain these services intact, it is imperative that different biotic and abiotic components of the port environment are to be sustainably managed in the long run.

Accordingly, Deendayal Port has initiated several environmental management measures as mandated by the MoEF &CC from time to time with the purpose of maintaining and preserving its terrestrial and coastal environmental integrity.

The following measures have been taken by the port authorities:

Ongoing Environment Management Measures by DPA

A holistic and comprehensive study on the marine ecology of the port including different marine faunal and floral components and preparation of a management plan based on the results obtained has been initiated as per the specific condition No. xviii of the EC & CRZ Clearance accorded by the MoEF & CC, GoI dated 19/12/2016. The results of the seasonal observations on the environmental characteristics and biodiversity of the intertidal zones have been compiled along with the conservation plan recommendation for three consecutive years (2017 to 2021). Mangrove plantation has been carried out to the tune of 900 ha in Sat Saida Island, 150 ha in Nakti creek, 450 ha in Kantiyajal by Deendayal Port. The black mangrove Avicennia marina was used in these plantation activities as this species is more suitable to the existing environmental condition of this coast.

Based on the information gathered through the seasonal studies on the different biotopes and the biodiversity along with the mangrove, macrofauna, plankton density and diversity, productivity of mudflat and avifauna for the period 2018-2022 within the limits of the Deendayal port, it is evident that the impact is insignificant since management action plans are showing positive responses to a large extent in spite of the climate change induced impacts on the marine ecosystem. This project aims to draw a holistic management framework for conserving the Marine Biodiversity and Ecology of the DPA port marine environment which include many biotopes such as mangroves, intertidal and subtidal realms, mudflats and salt marshes, each serving as an abode for a variety of fauna and flora. Given the economic importance of DPA port and the increasing national and global demand for sustainability, it is planned to study the marine ecology of this port seasonally, with the long term objective of rendering the port existence and operations environmentally sustainable. The proceeding section outlines management initiatives to be undertaken by the port authorities for holistic management of marine biodiversity within the port limits envisaging several facilities will be built within port premises in the future.

Intertidal and Subtidal Biodiversity Management

The intertidal zone constitutes the coastal environment where land and sea meet, i.e., the area between extreme high-water springs (EHWSs) and extreme low water springs (ELWSs). The subtidal zone lies below the lowest water level beyond the intertidal zone. Both these zones provide habitats for various marine fauna and flora and needs to be managed effectively for the overall wellbeing of the ecosystem. In addition, intertidal zone biodiversity index did not vary very much in the recent years but the population density has not increased and remained stable. The intertidal zone may be susceptible to natural and anthropogenic pressures such as soil erosion, industrial pollution, continuous dredging and sedimentation. Hence, interventions are required to mitigate or support the natural recovery of the fauna in the bottom sediment. The sedentary benthic species produce a large number of their larva as an adaptation for their survival which get attached to the mangrove surfaces and metamorphose into adults and also serve as food for several fishes and shellfishes. Hence, soil erosion control interventions could help to improve the restoration of many benthos and plankton productivity. In the DPA vicinity, intertidal and subtidal zones are mostly dominated by clayey substratum admixed with silt and there are no rocky or sandy shores. The intertidal belts of the study area support many biological elements indicating the overall health of the ecosystem.

Mangrove Management

The mangrove cover in the vicinity of DPA is 23.967km^2 encompassing the major and minor creek systems within its limit of which the port infrastructure occupies only ~1% of the total area. Establishment of facilities is a continuous process and the expansion of infrastructure over the coming years will bring remarkable changes in the landscape and seascape in and around the port area. Mangrove environment will continue to be stable and balanced if there are no external stressors such as change in hydrology, elevation and slope, soil and water salinity and pH, soil texture and wave energy are maintained in a natural condition without wide fluctuations. In addition, human centered stress factors such as resource collection, camel grazing, tree felling and other habitat modification activities are to be minimized. Generally, micro-topography controls the distribution and well-being of mangroves, and physical processes play a dominant role in the formation and their functioning through reproduction, seed germination and establishment of young plants. The mangrove forests undergo self-repair over a period of time, provided that the normal tidal hydrology is not disrupted and the availability of water borne seeds are not blocked. Regular monitoring of mangrove hydrology through simple scientific methods will go a long way in maintaining ecosystem balance. The natural regeneration capacity of the stand is to be assessed by quantifying the degree and extent of the entrance of younger classes such as saplings into the mature tree category. The ratio between these different size classes will indicate the dynamic state of the mangrove forest. Only if the natural seedling recruitment is not occurring does the system requires an assisted recovery by plantation and physical amendments. The present study displays that natural regeneration in the studied mangrove formations is expected, as indicated by the entry of younger classes into adult categories. In addition to *A. marina,* three species namely, *Rhizophora mucronata, Ceriops tagal* and *Aegiceras corniculatum*, have been recorded sporadically within DPA limits. It is strongly recommended that in all the future plantation efforts, these additional species also could be selected at appropriate locations and tidal levels.

Conservation of Island

Islands support a rich marine fauna, flora and avifauna diversity and deserve special conservation efforts. Land cover classification of Sat Saida Island using GIS tool revealed sparse and dense mangroves, mudflats and halophytic vegetation other than mangroves are other prominent land cover categories. Though equipped with all the features to support a dense mangrove formation, the Sat Saida Island has sparse and scrubby plants confined mostly to creek banks. Different elevation features of the Island render the reduced flooding rate at the interior regions results in sparse and open mangrove formations. This Island could be an ideal site for mangrove plantations while implementing plantation activities, other mangrove restoration and rehabilitation activities with biophysical amendments such as desilting the existing the minor creeks could help to increase the mangrove cover in this Island. These physical activities in the mangrove lined minor creeks will increase tidal flooding and hydro-period and convert sparse to dense mangroves in due course of time. The Deendayal port authority has already carried out 1400 ha of mangrove plantation since 2006 with good success rate in various locations and additional 100 ha is in progress.

Management plan to improve the water quality in the port area

- The drains and outfall should be cleaned regularly to avoid anaerobic decomposition and also for proper flow of water/wastewater. This will also enable the characterization of wastewater and calculation of waste load.
- Domestic and canteen wastewater should be discharged only after proper treatment.
- The solid waste generated from the canteen and other diffused sources should be collected and disposed properly for which modern purification system should be established.
- The discharge of oil waste into the sea from the following main sources should be controlled
    1. Discharge of oil waste from liquid chemical corridor area. This liquid waste is generated during tanker cleaning, and oil spills during filling operations,
    2. Oil spills at berth during unloading operations.
    3. Tanker ballast discharge from ships.
- Bulk material should not be disposed into the sea. All drains and roads should be cleaned before the rainy season to avoid runoff from land to sea carrying a myriad

of pollutants, including chemicals that may be impose oily discharges in and around the port.

Management plan for marine fisheries

Regular dredging activities in the Port area can impact marine fauna and the flora particularly the phytoplankton and seaweeds. The fishes and other fishery resources such as shrimps and crabs are distracted through noise and vibration levels, water quality and habitat loss along with food sources. Generally, fishes in the water column are free swimming in nature, they tend to avoid the turbid areas and move to safer zones. Once the turbidity increase becomes reversed due to sedimentation and dispersion by current and wave influences, the fishes are expected to occupy the area. Hence, there will be virtually no impact on fish due to dredging in the long term. The dredging is usually carried out on the main channel of the creeks, the impact on the fishes are minimum during the dredging phase. The most important potential impact would be the rise in suspended solid load, which hinders the photosynthesis of the producer communities, especially the phytoplankton and affects the pelagic food chain. The high turbidity due to heavy suspended solids load during dredging and reclamation can result in the clogging of the gills of the filter feeding organisms, thereby causing asphyxiation.

Co-Management with the Community

Management program for mangroves is feasible in the case of Deendayal Port Authority since all the mangrove formations are under its legal control and hence any management program could be implemented without any sectoral conflicts with forest or any other government departments. It was proven in many instances that involving the stakeholder communities in the surrounding villages will yield better results in mangrove management. Though the population in the port surroundings has different livelihood activities, fishermen community could be targeted to involve in community-based mangrove management.

The fishermen in the villages such as Vera, Khari Rohar, and Tuna close to the port could be involved by forming “Samithies” for the conservation of mangroves with possible funding resources. The communities are expected to involve in the plantation and management activities for which awareness campaign and interactive sessions are to be conducted time to time and the feedback and experiences are to be recorded and duly acknowledged. The community’s resource dependency, perception about the conservation of mangroves and associated flora and fauna and their level of involvement in such resource management activities are to be assessed before forming such a community-based organization. They could be assigned the specific task of conserving the mangroves by involving them in plantation/restoration activities, physical protection and other conservation measures. This could be taken up as part of the port's CSR activity.

Mannagement plan for Avifauna

1. Direct and indirect impact on ecologically sensitive ecosystems

The Deendayal SEZ project site is located in the mid of the Deendayal Port area surrounded by port associated industrial sectors and salt industries. Since there are no Protected Areas located within 10 km radius of the SEZ site, impacts on sensitive ecosystem was not visualized.

2. Loss of Inter-tidal habitats - Coastal

- The project proponent (Deendayal Port Authority) should take up compensatory mangrove plantation in and around the project area
- The plantation needs to be carried out with fourfold density of seedlings compared to the natural mangrove density of the Kandla creek area and to maintain the density at the required level
- This mangrove plantation expected to support mangrove associated bird species and thereby enhance the avifauna diversity of the local environment
- Since the intertidal (mangrove and creeks) and salt pan habitats supports few thousands of aquatic and migratory species, the project proponent should plan the establishment /construction activities (if any) should be planned non migratory season (November – February) to avoid the disturbance to the migratory species.
- The above suggested mangrove plantation needs to be monitored at least for the next five years till it attains maturity with the expert team to understand the growth rate and enhancement and assemblage of associated faunal species.
- Since the area located in the Intertidal habitat and adjacent areas supports thousands of aquatic avifauna, the project proponent (Deendayal Port authority) should take up long-term (five years) Ecological Monitoring Program of the creek, mangrove and salt pan habitats to assess the change in avifaunal diversity due the any developmental activities take place in the future project.

Phosphorus management

Anthropogenic inputs of nitrogen (N) and phosphorus (P) from agriculture, aquaculture, wastewater treatment, urban runoff, and burning of fossil fuels, are now reported to exceed the natural inputs worldwide (CENR, 2000, NRC, 2000). The nutrient enrichment has led to deadly blooms of phytoplankton and seaweeds, coral reef deterioration and altered ecosystem functioning. As marine ecosystems continue to experience land use change, rising sea levels, altered weather patterns, and global warming, the threat of nutrient enrichment is predicted to intensify.

It is understood that mangrove wetlands can alleviate nutrient pollution through rapid nutrient uptake, long-term burial, or denitrification, thus protecting surrounding marine waters and organisms (Valiela and Cole, 2002). However, coastal wetlands themselves are still vulnerable to the impacts of nutrient enrichment. In this circumstance studies have reported that due to high rates of nutrient uptake and denitrification, nutrient enrichment can have direct and indirect impacts on mangrove trees (Kaplan et al., 1979; Seitzinger, 1988).

The blue-green algae (Cyanobacteria) blooms are predominantly), tend to grow in high density under situations of low ratios of nitrogen to phosphorus. numerous long-term studies have pointed out that reducing inputs of a single nutrient: phosphorus could control the incidence of algal bloom and also by introduction of iron, alum, or other compounds to sequester phosphorus in sediments. This management is possible in inland water bodies.

In creeks and coastal environments, the water is dynamic in nature mitigation measures are in general impractical. It is recommended that it is necessary to identify the possible primary sources of input and to control awarenessdrive are to be implemented to the concerned community, industries and the government bodies.The influx of sewage ,land run off from the cropland and the industries are major sources of phosphorus/phophates into aquatic systems. Traditional wastewater treatment methods do not fully remove phosphates, leading to their accumulation even though modern filtration technologies can effectively eliminate phosphates which are expensive. Many countries have imposed strict regulations on the use of phosphate-containing detergents and implemented laws to reduce phosphate pollution.

Phosphates are salts of phosphoric acid formed with the reactions of metals and there is dihydrogen phosphate that dissolves in water while the hydrogen phosphate is less dissolution in water. In water, phosphorus exists in the form of inorganic, organic, and organo-mineral compounds and is also part of the cells of aquatic organisms. Notably, inorganic compounds have the highest bioavailability. Today, phosphates in marine and freshwater systems present a significant environmental challenge. Human waste is a natural source of phosphorus. In this context it is understood that improper sewage treatment could lead to higher level of phosphate-phosphorus in the coastal water bodies. These effluents contain biological phosphorus as well as phosphate components from detergents, food products, etc. When phosphorus and nitrogen levels in water become excessive, microorganisms receive more nutrients, leading to rapid reproduction. This process, known as eutrophication, reduces oxygen levels, kills fish, and makes water treatment more complex due to the increased biomass.

Petroleum hydrocarbon Management

Increasing petroleum consumption and a rise in incidental oil spillages have become global concerns due to their persistent nature and toxicity to aquatic and terrestrial living organisms. Various physicochemical and biological treatment strategies have been studied to tackle them and their impact on environment. Combinations of biological, chemical, and eco-toxicological techniques are used for this process while monitoring the efficacy of bacterial products and nutrient amendments to stimulate the biotransformation of contaminated soil. One of such approaches in this regard in the marine environment is the use of microbial processes due to their being “green” and also apparent low cost and high effectiveness. Different hydrocarbon removal levels were observed with bacterial augmentation (*Beta proteobacterium* and *Rhodococcus ruber*), exhibiting a total petroleum hydrocarbon (TPH) reduction of 61%, which was further improved to a 73% reduction using bacterial augmentation combined with nutrient amendment (nitrogen, potassium, and phosphorus). Mixed bacterial consortia isolated from the hydrocarbon-contaminated soil samples were used

Chemical treatments suggest agents like dispersants, solidifiers, and chemical oxidants are the remediations are grouped. The surfactants present in dispersants help to break down oil slicks into smaller droplets,then undergo rapid dilution by transferring it into the water and are degradable. This method makes oil spills less harmful for living organisms and the marine life. Nokomis 3-F4, Slickgone NS,Finasol OSR 52, SPC 1000™, Neon AB3000, ZI-400, Corexit 9500, Corexit 8667, and Saf-Ron Gold are some of the examples of chemical dispersants.

Bioremediation is a cost-efficient method used for the treatment of petroleum consisting of biodegradable hydrocarbons and indigenous microbes. Biological techniques are more economical and proficient than physicochemical techniques.. Three distinctive approaches are adopted in the context of bioremediation, namely, bioaugmentation, biostimulation and bioventilation. Bioaugmentation is used to enhance the performance of the microbial population through the addition of bacterial with specific catabolic activities, strains or enrichment consortia to increase the rate of contaminant degradation.Many microorganisms are responsible for increasing the surface area of the substrate by excreting emulsifiers including *Bacillus licheniformis, Pseudomonas putida, Bacillus cereus, Pseudomonas aeruginosa, Bacillus subtilis,* and *Bacillus laterosporus* are well known for degradation of oil pollutants. The water should maintained be suitable for the normal growth of the oil degrading microbes so that by natural processes by itself the PHCs will be degraded under with time.The biodegradation rates are improved by the biosurfactant's addition which increases the elimination and solubility of these pollutants.

It is recommended that proper measures should be taken to avoid the introduction of petroleum related products from the ports, during the loading and unloading of consignments , navigation channel maintenance and such activities.

9. Summary and Conclusion

The physico-chemical characteristics during the entire year was dynamic with respect to sptio-temporal situation in the gulf environment. The phytoplankton genera for the period May 2024 to May 2025 varied from 8 to 29 number with an average of 16-23. The highest number of genera was reported during post-monsoon which is followed by monsoon and pre monsoon. The Zooplankton for the period 2024 to 2025 showed high number of representatives of phylum and group during post-monsoon followed by pre-monsoon than the monsoon period.

It is imperative to create strong baseline data on the marine environment in the port vicinity in tune with the spatial extent of developmental activities. Continuous marine ecological monitoring study since May 2017 focused on the biological diversity and productivity of the mudflats. Based on the detailed investigations of marine ecological components and the possible impacts of the DPA port environment, it could be concluded that the effects on the various biotic components are minimal and confined to high activity areas only with limited impacts on the surroundings. From the results of the studies conducted by GUIDE, 2017 to 2024, it was inferred that there was no significant variation with respect 2024 to 2025 on the taxa/genera/species composition as well as fauna and plankton community, eventhough the values of and in term of phosphate and petroleum hydrocarbon compounds were slightly increased. The mangrove tree category density has shown higher values in all the sampling locations in the Deendayal port Authority and its creek environments.

In this respect it is recommended that In addition to the monitoring of the biological parameters, of the water and sediment in the creeks, petroleum hydrocarbons and phosphate level in the port environment to be assessed intensively in future in order to sort out the more effective management plans in the mangroves and the encompassing creek environment nearer to the Deendayal Port Authority .

Knowledge of marine species diversity is incomplete, however, studies have highlighted an increase in the rate of decline in the population density of many vulnerable species with space and time due to several reasons including habitat destruction and alterations and the related stresses. The biodiversity of the coastal zone has been explored more extensively than the deep offshore areas due to the accessibility for sampling. These areas are considered to be highly productive due their shallow and dynamic nature suitable for the growth of the flora , phytoplankton, seaweeds and sea grasses. The, bio-geochemically more active zone provides all the major,minor and trace elements for the floating micro flora as well as the macroscopic algae and sea grasses that flourishes in the nearshore environments. The abiotic physical and chemical parameters of the water in all the study sites are found to be within the optimum level during the seasonal assessment. The prevailing higher turbidity of the water due to the high tidal currents inhibits the primary productivity of the phytoplankton and the benthic algae and seagrass. However, there exists several diatoms which have higher adaptive features to survive under such circumstances as evidenced from the present study. There are indicator species to assess the biodiversity status of ecosystems, the keystone species, such as the coral reefs, sea grasses and macro algae which are specific for the benthic habitat. These groups of plants and the fauna require clear water, optimum temperature aided through the high rate of light penetration through the water column. The absence of the seaweeds and seagrass beds could be well correlated with the relatively high level of suspended particles in the water in the selected study sites. The sediment entire creek environment bottom substratum is dominated by fine clay which holds organic and inorganic elements and acts as a sink for essential nutrient elements for the multitude of micro algae which are the primary source for the pelagic and benthic food chain, including the fin fishes and shell fishes in the creek as well as the nearby oceanic zone. The concentration of petroleum hydrocarbon at some locations is higher than the admissible level in the coastal waters. This chemical compound is highly hydrophobic in nature and tends to attach to the surface film of the water. Though the degradation is a slow process it has been distributed to longer distances and tends to settle down as tarballs. Also, the residues if such particles persist for longer duration, affects the pelagic communities and ultimately the fishes and higher vertebrates. In the Kandla adjacent creek complex such incidents have not been reported and fishing is a regular activity in the mangrove environment by the fishermen who have a valid registration from the port Authority.

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Annexture 1. Checklist of Avifauna recorded during the pre-monsoon season from the Deendayal Port Authority, Kandla, India.

Sl. No.	Order, Family, Common & Scientific Name	MS	FS	IUCN 2024	WPA, 1972	Habitat
A	**CHARADRIIFORMES**					
1	**Charadriidae**					
1	Little ringed plover *Charadrius dubius* Scopoli, 1786	R	C	LC	Schedule II	A
2	Red-wattled Lapwing *Vanellus indicus* (Boddaert, 1783)	R	I	LC	Schedule II	T
3	Yellow-wattled Lapwing *Vanellus malabaricus* (Boddaert, 1783)	R	I	LC	Schedule II	T
2	**Dromadidae**					
4	Crab-plover *Dromas ardeola* Paykull, 1805	M	C	LC	Schedule II	A
3	**Laridae**					
5	Common tern *Sterna hirundo* Linnaeus, 1758	RM	P	LC	Schedule II	A
6	Little tern *Sternula albifrons* (Pallas, 1764)	R	P	LC	Schedule II	A
7	River Tern *Sterna aurantia* (Gray, JE, 1831)	R	P	V	Schedule I	A
8	Caspian gull *Larus cachinnans* Pallas, 1811	M	P	LC	Schedule II	A
9	Lesser black-backed gull *Larus fuscus* Linnaeus, 1758	M	C	LC	Schedule II	A
10	Black-headed Gull *Chroicocephalus ridibundus* (Linnaeus, 1766)	M	O	LC	Schedule II	A
11	Brown-headed Gull *Chroicocephalus brunnicephalus* (Jerdon, 1840)	M	P	LC	Schedule II	A
12	Gull-billed Tern *Gelochelidon nilotica* (Gmelin, JF, 1789)	M	P	LC	Schedule I	A
4	**Recurvirostridae**					
13	Black Winged Stilt *Himantopus himantopus* (Linnaeus, 1758)	R	C	LC	Schedule II	A
5	**Scolopacidae**					
14	Black-tailed Godwit *Limosa limosa* (Linnaeus, 1758)	M	O	NT	Schedule II	T
15	Common Greenshank *Tringa nebularia* (Gunnerus, 1767)	M	I	LC	Schedule I	T
16	Common Redshank *Tringa tetanus* (Linnaeus, 1758)	M	I	LC	Schedule II	A
17	Common Sandpiper *Actitis hypoleucos* (Linnaeus, 1758)	M	I	LC	Schedule II	A
18	Eurasian curlew *Numenius arquata* (Linnaeus, 1758)	M	C	NT	Schedule II	A

19	Green Sandpiper *Tringa ochropus* Linnaeus, 1758	M	I	LC	Schedule II	T
20	Marsh Sandpiper *Tringa stagnatilis* (Bechstein, 1803)	M	C	LC	Schedule II	T
21	Temminck's stint *Calidris temminckii* (Leisler, 1812)	M	C	LC	Schedule II	T
22	Whimbrel *Numenius phaeopus* (Linnaeus, 1758)	M	P	LC	Schedule II	A
B	**COLUMBIFORMES**					
6	**Columbidae**					
23	Blue Rock Pigeon *Columba livia* (Gmelin, JF, 1789)	R	G	LC	NA	T
24	Spotted Dove *Spilopelia chinensis* (Scopoli, 1786)	R	G	LC	Schedule II	T
25	Eurasian Collared Dove *Streptopelia decaocto* (Frivaldszky, 1838)	R	G	LC	Schedule II	T
26	Laughing Dove *Spilopelia senegalensis* (Linnaeus, 1766)	R	G	LC	Schedule II	T
27	Red Collared Dove *Streptopelia tranquebarica* (Hermann, 1804)	R	G	LC	Schedule II	T
C	**CORACIIFORMES**					
7	**Alcedinidae**					
28	Common Kingfisher *Alcedo atthis* (Linnaeus, 1758)	R	P	LC	Schedule II	A
29	White-throated Kingfisher *Halcyon smyrnensis* (Linnaeus, 1758)	R	C	LC	Schedule II	T
8	**Meropidae**					
30	Green Bee-eater *Merops orientalis* Latham, 1801	R	I	LC	Schedule II	T
D	**PELECANIFORMES**					
9	**Pelecanidae**					
31	Great White Pelican *Pelecanus onocrotalus* Linnaeus, 1758	M	P	LC	Schedule II	A
10	**Ardeidae**					
32	Cattle Egret *Bubulcus ibis* (Linnaeus, 1758)	R	C	LC	Schedule II	T
33	Great Egret *Ardea alba* (Linnaeus, 1758)	R	P	LC	Schedule II	A
34	Indian Pond Heron *Ardeola grayii* (Sykes, 1832)	R	C	LC	Schedule II	A
35	Intermediate Egret *Ardea intermedia* (Wagler, 1829)	R	P	LC	Schedule II	A
36	Little Egret *Egretta garzetta* (Linnaeus, 1766)	R	C	LC	Schedule II	A
37	Grey Heron *Ardea cinerea* Linnaeus, 1758	R	P	LC	Schedule II	T
38	Western Reef Heron *Egretta gularis* (Bosc, 1792)	RM	P	LC	Schedule II	A

39	Purple Heron *Ardea purpurea* Linnaeus, 1766	R	C	LC	Schedule II	A
11	**Threskiornithidae**					
40	Black Headed Ibis *Threskiornis melanocephalus* (Latham, 1790)	R	C	NT	Schedule II	A
41	Glossy Ibis *Plegadis falcinellus* (Linnaeus, 1766)	R	C	NT	Schedule II	T
E	**CICONIIFORMES**					
12	**Ciconiidae**					
42	Painted Stork *Mycteria leucocephala* (Pennant, 1769)	R	C	NT	Schedule II	A
F	**PHOENICOPTERIFORMES**					
13	**Phoenicopteridae**					
43	Greater Flamingo *Phoenicopterus roseus* Pallas, 1811	RM	C	LC	Schedule II	A
G	**PASSERIFORMES**					
14	**Corvidae**					
44	House Crow *Corvus splendens* (Vieillot, 1817)	R	O	LC	NA	T
15	**Dicruridae**					
45	Black Drongo *Dicrurus macrocercus* Vieillot, 1817	R	I	LC	Schedule II	T
16	**Hirundinidae**					
46	Barn Swallow *Hirundo rustica* (Linnaeus, 1758)	RM	I	LC	Schedule II	T
47	Wire-tailed Swallow *Hirundo smithii* Leach, 1818	R	I	LC	Schedule II	T
17	**Laniidae**					
48	Bay-backed Shrike *Lanius vittatus* Valenciennes, 1826	R	I	LC	Schedule II	T
49	Brown shrike *Lanius cristatus* Linnaeus, 1758	R	I	LC	Schedule II	T
18	**Motacillidae**					
50	White Wagtail *Motacilla alba* Linnaeus, 1758	M	I	LC	Schedule II	T
51	Yellow Wagtail *Motacilla flava* Linnaeus, 1758	M	I	LC	Schedule II	T
19	**Muscicapidae**					
52	Oriental Magpie Robin *Copsychus saularis* (Linnaeus, 1758)	R	I	LC	Schedule II	T
20	**Nectariniidae**					

53	Purple Sunbird *Cinnyris asiaticus* (Latham, 1790)	R	N	LC	Schedule II	T
21	**Pycnonotidae**					
54	White Eared Bulbul *Pycnonotus leucotis* (Gould, 1836)	R	O	LC	Schedule II	T
55	Red-vented Bulbul *Pycnonotus cafer* (Linnaeus, 1766)	R	O	LC	Schedule II	T
22	**Sturnidae**					
56	Common Myna *Acridotheres tristis* (Linnaeus, 1766)	R	O	LC	Schedule II	T
57	Brahminy Starling *Sturnia pagodarum* (Gmelin, JF, 1789)	R	I	LC	Schedule II	T
H	**SULIFORMES**					
23	**Phalacrocoracidae**					
58	Little Cormorant *Microcarbo niger* (Vieillot, 1817)	R	P	LC	Schedule II	A
I	**Apodiformes**					
24	**Apodidae**					
59	House Swift *Apus nipalensis* (Hodgson, 1837)	R	I	LC	Schedule II	
J	**ACCIPITRIFORMES**					
25	**Accipitridae**					
60	Black-winged Kite *Elanus caeruleus* (Desfontaines, 1789)	R	C	LC	Schedule I	T
61	Black Kite *Milvus migrans* (Boddaert, 1783)	R	C	LC	Schedule II	T
62	Oriental Honey Buzzard *Pernis ptilorhynchus* (Temminck, 1821)	R	C	LC	Schedule II	T
63	Shikra *Tachyspiza badia* (Gmelin, JF, 1788)	R	C	LC	Schedule I	T
K	**CUCULIFORMES**					
26	**Cuculidae**					
64	Asian Koel *Eudynamys scolopaceus* (Linnaeus, 1758)	R	F	LC	Schedule II	T

Note: FG- Feeding Guild, C- Carnivore, F- Frugivore, G- Granivore, I- Insectivore, N- Nectarivore, O- Omnivore, P- Piscivore; MS-Migratory Status, R- Resident, M- Migratory, RM- Resident Migrant; IUCN- International Union for Conservation of Nature, LC- Least Concern, NT-Near Threatened, VU- Vulnerable

Annexure – C

सत्यमेव जयते

Forests & Environment Department

Government of Gujarat

Monthly Environmental Monitoring Plan Report (EMP report)

For

"Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Dahej-Hazira-Ghogha for a period of 3 years"

(13th August to 12th September 25)

Final Report

Submitted to:

Deendayal Port Authority (DPA), Kandla

Report Issue No.: **GEMI/835(14)/2025/51**

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Certificate

This is to certify that the Monthly Environment Monitoring Plan (EMP) report for the period 13th August to 12th September 2025 for the work entitled, **"Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Dahej-Hazira-Ghogha for a period of 3 years"** has been prepared in line with the work order no. **EG/WK/4751/Hazira & Ghogha/285** dated 18/04/2023 allotted by Deendayal Port Authority.

The report has been delivered as per the terms and conditions of the work order Sr. No. 4(3).

Mitasl
Authorized Signatory
S. S. O. & Lab Head

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ABOUT THIS DOCUMENT

Gujarat Environment Management Institute (GEMI) has been assigned with the project **"Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Dahej-Hazira-Ghogha for a period of 3 years" (Final EMP report for 13th August to 12th September 25) by Deendayal Port Authority, Kandla.** Under the said project, the report titled "Monthly Environmental Monitoring Plan Report *(Final EMP report for 13th August to 12th September 25*)" is prepared.

Name of the Report:	Monthly Environmental Monitoring Plan (EMP report) for "Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Dahej-Hazira-Ghogha for a period of 3 years" *(Final EMP report for13th August to 12th September 25)*
Version:	1.0
Report Issue No.	GEMI/835(14)/2025/51
Report Issue Date:	18/11/2025
Prepared by:	Mr. Nirav Nakar, Assistant Environmental Engineer Ms. Ankita Modi, Assistant Environmental Engineer
Contribution by:	Mr. Harsh Pathak (Project Assistant) Mr. Het Trivedi (Project Manager, Ghogha) Mr. Hitesh Dhabe (Project Assistant) Mr. Milan Vadaliya (Project Manager, Hazira)
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Approved by:	Dr. Jaipal Singh, IFS, PCCF & Director

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Chapter 1. Introduction

1.1 Introduction

Deendayal Port Authority (DPA), Erstwhile Kandla Port Trust, is one of the 13th major ports in India and is located on the west coast of India, in the Gulf of Kutch at 23001'N and 70013'E in the state of Gujarat in India. DPA has commissioned Ro-Ro/Ro-Pax facilities at Hazira and Ghogha, Gujarat. This waterfront is proposed to be operated for berthing and unberthing of ROPAX Ferry vessels to load and unload vehicles along with embarking and disembarking passengers. The travel time between Ghogha and Hazira has reduced from 10 hours to 3.15 hours with the start of the Ro-Ro ferry service. The road distance from Surat to Bhavnagar is 360 kilometers. Whereas the sea route distance is 67 nautical miles only. So, Ro-Ro/Ro-Pax vessels are deployed to reduce travel time and thereby, reduce carbon emission. In compliance with the conditions stipulated in statutory clearances viz. Environmental/CRZ Clearance from the Ministry of Environment & Forest, CRZ recommendations from the state Forest & Environment Department, and NOC from the State Pollution Control Board (SPCB), and to ensure implementation of the project in an environmentally sustainable manner in & around the project site, it is important to monitor the environmental status and prepare an effective environmental monitoring and management plan of the port facility for sustainable development.

In this regard, DPA proposes to formulate a detailed and effective environmental monitoring and management plan by conducting monthly environmental monitoring for its onward submission to the statutory bodies.

Under the said study, monitoring of the various aspects of the environment such as Ambient air, DG stack emissions, meteorology, drinking water, soil, noise, and marine environment- Water, Sediment & Ecological characteristics for the locations at Hazira, Dahej & Ghogha for 3 years needs to be carried out.

This report includes the monthly Environmental Monitoring Plan (EMP) report for monitoring carried out for the month of 13th August to 12th September 25

1.2 Locations for environmental monitoring

Finalized monitoring locations as per the preliminary site visit report are shown in **Table 1** and **Figures 1 to 3**. The monitoring photographs are shown in **Figure 4**.

Table 1: Locations of environmental monitoring components

Locations	Sample code	Latitude	Longitude
Ambient Air Monitoring			
Admin building at Ghogha Ro-Ro ferry	AM-G	21.673483	72.284497
Terminal building at Hazira Ro-Ro ferry	AM-H1	21.077458	72.657147
Staff accommodation at Ro-Ro ferry at Hazira	AM-H2	21.0775717	72.6551994
Admin building at Ro-Ro ferry service at Dahej	AM-D	21.666383	72.561889
Drinking Water Monitoring			
Canteen building at Ghogha Ro-Ro ferry	DW-G	21.677216	72.283060
Terminal building at Hazira Ro-Ro ferry	DW-H	21.077399	72.657189
Canteen building at Ro-Ro ferry service at Dahej	DW-D	21.66435	72.563489
Noise Monitoring			
Admin building at Ghogha Ro-Ro ferry	N-G	21.673481	72.284464
Terminal building at Hazira Ro-Ro ferry	N-H1	21.077458	72.657147
Staff accommodation at Ro-Ro ferry at Hazira	N-H2	21.0775717	72.6551994
Admin building at Ro-Ro Ferry Service at Dahej	N-D	21.666383	72.5561889
Meteorological Data Monitoring			
Admin building at Ghogha Ro-Ro ferry	M-G	21.673483	72.284497
Terminal building at Hazira Ro-Ro ferry	M-H	21.077458	72.657147
Admin building at Ro-Ro Ferry Service at Dahej	M-D	21.666383	72.561889
Soil Quality Monitoring			
Terminal building at Ghogha Ro-Ro ferry	S-G	21.67496	72.284388
Near Terminal building at Hazira Ro-Ro ferry	S-H	21.076353	72.657294
Ro-Ro ferry service at Dahej	S-D	21.666037	72.563489
Marine Water, Ecology and Sediment Monitoring			
Near Ro-Ro ferry terminal at Ghogha	MA-G1	21.67954	72.29433
Away from Ro-Ro ferry terminal at Ghogha and along the ferry route from Ghogha to Hazira	MA-G2	21.665054	72.336313
Near Ro-Ro ferry terminal at Hazira	MA-H1	21.07577	72.65839
Away from Ro-Ro ferry terminal at Hazira and along the ferry route from Hazira to Ghogha	MA-H2	21.072114	72.657794
Near Ro-Ro ferry Service at Dahej	MA-D	21.65988	72.56365
DG stack emission Monitoring			
Near substation-3 at Ghogha Ro-Ro ferry	DG-G	21.6739638	72.2835000
Generator Room near Terminal building at Hazira Ro-Ro ferry	DG-H	21.0775041	72.6563279
Near Substation-1 at Dahej Ro-Ro ferry	DG-D	21.665902	72.562056

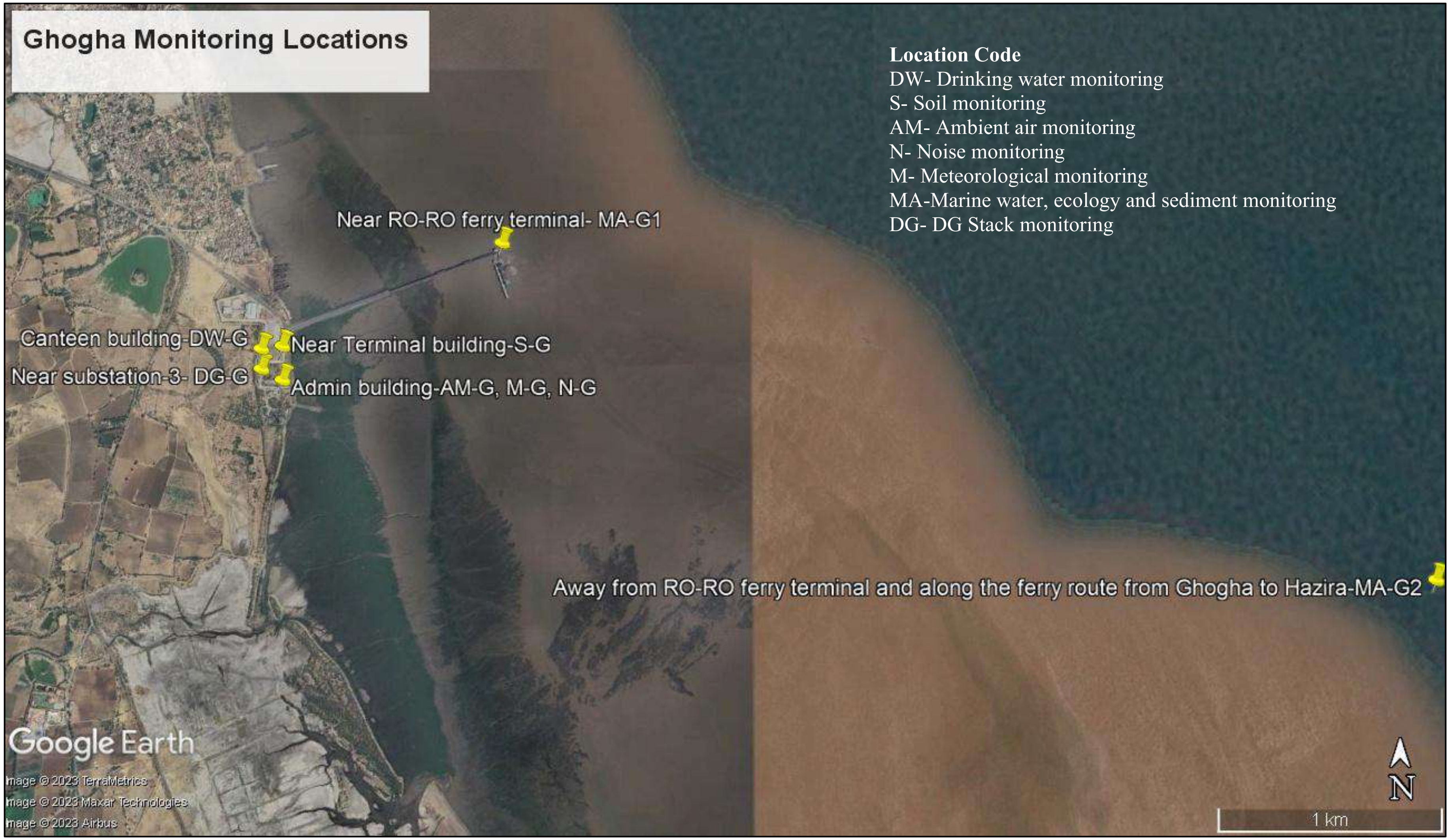


Fig. 1: Sampling locations at Ghogha

Fig. 2: Sampling locations at Hazira

Fig. 3: Sampling locations at Dahej

Fig. 4: Photographs of environmental monitoring

1.3 Details of environmental monitoring components

Detailed plan of environmental monitoring components and its parameters is shown in **Table 2.**

Table 2: Detailed plan of environmental monitoring components

Sr. No	Parameter	No. of locations	Frequency	Parameters
1.	Ambient air quality monitoring (4 locations)	1 at Ghogha, 2 at Hazira and 1 at Dahej	Twice a week	PM_{10}, $PM_{2.5}$, Sulphur dioxide, Oxides of nitrogen, Carbon monoxide
			Once in a month	Hydrocarbons, Benzene, Volatile Organic Compound, Non-methane VOC
2.	Drinking water monitoring (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Once in a month	Odor, Color, pH, Turbidity, TDS, TSS, Conductivity, Chloride, Calcium as Ca, Magnesium, Total hardness, Sulphate as SO_4, Nitrate as NO_3, Nitrite as NO_2, Fluoride as F, Sodium as Na, Iron as Fe, Potassium as K, Manganese, Total chromium, Hexavalent chromium, Copper, Cadmium, Arsenic, Lead, Zinc, Mercury, Salinity, Free residual chlorine, Microbiological (MPN)
3.	Noise level monitoring (4 locations)	1 at Ghogha, 2 at Hazira and 1 at Dahej	24 hrs period once in a month	Leq (Day) & (Night)
4.	Soil quality monitoring (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Once in a month	Total Organic Matter, Organic Carbon, Inorganic Phosphate, Texture, pH, Conductivity, Particle size distribution & Silt content, SAR, Water holding capacity, Aluminum, Chromium, Nickel, Copper, Zinc, Cadmium, Lead, Arsenic, Mercury
5.	Meteorological data monitoring (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Daily	Wind speed, Wind direction, Rainfall, Humidity, Temperature, Solar radiation
6.	DG emissions (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Once in a month	Particulate Matter, Sulphur dioxide, Oxides of nitrogen, Carbon monoxide, Carbon dioxide
7.	Marine water quality (5 locations)	2 at Ghogha, 2 at Hazira	Once in a month	Odor, Color, pH, Turbidity, TDS, TSS, Conductivity, DO, Particulate organic carbon, COD, BOD, Silica,

Sr. No	Parameter	No. of locations	Frequency	Parameters
		and 1 at Dahej		Phosphate, Sulphate as SO_4^-, Nitrate as NO_3, Nitrite as NO_2, Sodium as Na, Potassium as K, Manganese, Iron as Fe, Total chromium, Hexavalent chromium, Copper, Cadmium, Arsenic, Lead, Zinc, Mercury, Oil & grease, Floating material (scum), Microbiological (MPN), Density
8.	Marine water quality for biological monitoring (5 locations)	2 at Ghogha, 2 at Hazira and 1 at Dahej	Once in a month	Chlorophyll-a, Pheophytin, Productivity (Net & Gross), Biomass; Relative abundance, species composition and diversity of phytoplankton; Relative abundance, species composition and diversity of zooplankton; Relative abundance, species composition and diversity of benthic invertebrates; (Meio, Micro and Macro benthos), Particulate oxidizable organic carbon, Secchi disk depth
9.	Sediments quality (5 locations)	2 at Ghogha, 2 at Hazira and 1 at Dahej	Once in a month	Texture, Organic Matter, Inorganic Phosphate, Silica, Phosphate, Sulphate, Nitrite, Nitrate, Calcium, Magnesium, Sodium, Potassium, Aluminum, Copper, Chromium, Nickel, Zinc, Cadmium, Lead, Arsenic, Mercury

1.4 Sample collection, preservation, storage and transportation to GEMI's Laboratory

Sampling of water and wastewater samples was carried out by 'GEMI's sampling protocol for water and wastewater' approved by the Government of Gujarat vide letter no. ENV-102013-299-E dated 24-04-2014 under the provision of the Water (Preservation and control of pollution) Act 1974. Soil sampling was conducted as per the 'Soil sampling manual by GEMI' published in November 2016. Whereas, for the other components of the environment such as ambient air, noise, & marine ecology, the guidelines/manuals brought out by CPCB were followed. The sampling was carried out by GEMI's trained manpower. The details of the environmental samples and their respective standards are summarized in **Table 3.**

Table 3: Details of sample collection and analysis method for each environmental component

Sr. No.	Type of sample		Manual/ Standards and Protocols	Instruments
1.	Ambient air	IS 5182 (Part 23): 2006	PM_{10}	Respirable Dust Sampler (RDS) conforming to IS:5182 (Part-23): 2006
		IS:5182 (Part:24):2019	$PM_{2.5}$	Fine Particulate Sampler (FPS) conforming to IS:5182 (Part-24): 2019
		IS:5182 (Part-2):2001	SO_x	Gaseous attachment conforming to IS:5182 (Part-2):2001
		IS:5182 (Part-6):2006	NO_x	Gaseous attachment conforming to IS:5182 (Part-6): 2006
		GEMI/SOP/AAQM/11; Issue no 01, Issue date 17.01.2019: 2019	Carbon monoxide	Sensor based Instrument
		IS 5182 (Part 11): 2006	Benzene	Low flow air sampler conforming to IS:5182 (Part-11): 2006
		IS 5182 (Part 11): 2006	VOC	Low flow air sampler conforming to IS:5182 (Part-11): 2006
		IS: 5182 (Part 17): 1979	Hydrocarbon	Aluminized plastic bags with on/off valve conforming to IS 5182 (Part 17):1979
		IS: 5182 (Part 17): 1979	Non-methane VOC	Aluminized plastic bags with on/off valve conforming to IS 5182 (Part 17):1979
2.	DG emissions		IS: 11255 and USEPA Method	Sensor based flue gas analyzer (Make: TESTO, Model 350) Stack Monitoring Kit
3.	Meteorological data		Installation of automatic weather stations to get periodic meteorological data as per the requirement	Automatic Weather Stations (AWS)

Sr. No.	Type of sample	Manual/ Standards and Protocols	Instruments
4.	Water (Drinking water, Surface water)	Sampling protocol for water & wastewater approved by the Government of Gujarat vide letter no. ENV-102013-299-E dated 24-04-2014 under the provision of Water (Preservation and Control of Pollution) Act 1974.	For drinking water- Titration apparatus, pH meter and conductivity meter Sample collection method: Grab sampling For marine water - Niskin sampler
5.	Soil and Marine sediments	Soil sampling manual by GEMI published in November 2016	For sediment sample collection –Van veen grab sampler
6.	Noise	IS 9989:2014	Noise meter
7.	Marine ecology	Technical guidance book – An introduction to aquatic biomonitoring using macro-invertebrates,2021 by CPCB	The sampling of the benthic invertebrates will be carried out with the help of D-frame nets, whereas the sampling of zooplankton and phytoplankton shall be carried out with the help of plankton nets (60 micron and 20 micron).

1.5 Environmental monitoring plan for 13th August to 12th September 25

The Environmental monitoring was carried out for Ambient air, Soil, Drinking water, Noise, Meteorology, DG stack, and Marine environment – water, sediment and ecology. The detailed environmental monitoring plan for the period from 13th August to 12th September 25 is given in Table 4.

Table 4: Environmental monitoring plan for Dahej, Hazira, and Ghogha, 13th August to 12th September 25

Sampling and Monitoring Team	Mr. Harsh Pathak (Project Assistant) Mr. Het Trivedi- Project manager (Ghogha), Mr. Hitesh Dhabe- Project Assistant (Dahej), Mr. Milan Vadaliya- Project manager (Hazira)				
Task	**Actual Monitoring Dates**				
	Project sites				
Monitoring of Drinking water, Soil, Noise, Marine Water, Sediments and ecology	**Dahej**	**Hazira-1**	**Hazira-2**	**Ghogha-1**	**Ghogha-2**
Soil monitoring	**20-08-2025**	**20-08-2025**	-	**29-08-2025**	
Drinking water	**20-08-2025**	**20-08-2025**	-	**29-08-2025**	-
Marine water, sediments and ecology	**20-08-2025**	**20-08-2025**	**20-08-2025**	**29-08-2025**	**29-08-2025**
Noise monitoring	**14-08-2025**	**20-08-2025**	**30-08-2025**	**28-08-2025**	-
Monitoring of DG stack	**26-08-2025**	**18-08-2025**	-	**04-09-2025**	-
Monitoring of ambient air	**18-08-2025**	**19-08-2025**	**19-08-2025**	**19-08-2025**	-
	19-08-2025	**20-08-2025**	**20-08-2025**	**20-08-2025**	-
	21-08-2025	**25-08-2025**	**25-08-2025**	**25-08-2025**	-
	27-08-2025	**28-08-2025**	**28-08-2025**	**28-08-2025**	-
	29-08-2025	**01-09-2025**	**01-09-2025**	**01-09-2025**	-
	01-09-2025	**02-09-2025**	**02-09-2025**	**02-09-2025**	-
	02-09-2025	**08-09-2025**	**08-09-2025**	**08-09-2025**	-
	03-09-2025	**09-09-2025**	**09-09-2025**	**09-09-2025**	-
Meteorological monitoring	**13th August to 12th September 25**				

Chapter 2. Results and observations of environmental monitoring at Dahej, Hazira & Ghogha

2.0 Monitoring of various environmental components

Monitoring of various environmental components was carried out at the locations listed in **Table 1** above. Details of each component have been mentioned below.

2.1 Ambient air monitoring

Air monitoring was carried out at four locations: 1 at Dahej, 2 at Hazira, and 1 at Ghogha. The monitoring cycle was twice a week for 24-hour sampling. Sampling for benzene, hydrocarbon, non-methane VOC, and VOC was done once a month. **Table 5** shows the results of ambient air monitoring.

Table 5: Result of ambient air quality monitoring

Sr. No.	Parameters	NAAQ Standards, 2009 (Industrial, Residential, Rural & Other areas) for 24 hours	Location code: (AM-D)							
			Sampling Date							
			18-08-2025	19-08-2025	21-08-2025	27-08-2025	29-08-2025	01-09-2025	02-09-2025	03-09-2025
1	PM_{10} (µg/m^3)	100 (µg/m^3)	141.94	98.39	93.54	89.73	90.45	81.95	73.97	91.10
2	$PM_{2.5}$ (µg/m^3)	60 (µg/m^3)	15.23	9.90	11.89	13.49	14.83	18.99	19.03	11.56
3	SO_2 (µg/m^3)	80 (µg/m^3)	33.69	10.48	9.63	12.85	11.52	8.10	7.45	9.20
4	NO_x (µg/m^3)	80 (µg/m^3)	13.21	10.60	11.75	14.36	10.78	13.94	7.03	6.85
5	CO (µg/m^3)	2000 (µg/m^3)	510	480	500	530	550	530	500	520

Sr. No.	Parameters	NAAQ Standards, 2009 (Industrial, Residential, Rural & Other areas) for 24 hours	Location code: (AM-H1)							
			Sampling Date							
			19-08-2025	20-08-2025	25-08-2025	28-08-2025	01-09-2025	02-09-2025	08-09-2025	09-09-2025
1	PM_{10} (µg/m^3)	100 (µg/m^3)	60.33	43.30	49.40	69.50	68.86	64.79	94.08	54.81
2	$PM_{2.5}$ (µg/m^3)	60 (µg/m^3)	7.45	<5	28.96	24.80	10.16	13.20	18.20	19.98
3	SO_2 (µg/m^3)	80 (µg/m^3)	10.34	9.54	12.39	11.40	8.41	7.39	<5	<5
4	NO_x (µg/m^3)	80 (µg/m^3)	6.15	6.19	8.30	12.99	8.53	<6	46.62	50.82
5	CO (µg/m^3)	2000 (µg/m^3)	530	510	520	530	500	540	490	510

Sr. No.	Parameters	NAAQ Standards, 2009 (Industrial, Residential, Rural& Other areas) for 24 hours	Location code: (AM-H2)							
			Sampling Date							
			19-08-2025	20-08-2025	25-08-2025	28-08-2025	01-09-2025	02-09-2025	08-09-2025	09-09-2025
1	PM_{10} ($\mu g/m^3$)	100 ($\mu g/m^3$)	57.10	40.50	45.10	64.45	65.74	62.45	89.02	57.01
2	$PM_{2.5}$ ($\mu g/m^3$)	60 ($\mu g/m^3$)	8.00	<5	30.62	21.20	10.00	12.04	15.30	16.07
3	SO_2 ($\mu g/m^3$)	80 ($\mu g/m^3$)	9.50	8.95	11.79	12.22	7.00	8.10	<5	<5
4	NO_x ($\mu g/m^3$)	80 ($\mu g/m^3$)	5.55	6.40	7.60	11.90	7.96	<6	40.60	46.33
5	CO ($\mu g/m^3$)	2000 ($\mu g/m^3$)	560	520	550	500	520	580	510	530

Sr. No.	Parameters	NAAQ Standards,2009 (Industrial, Residential, Rural& Other areas) for 24 hours	Location code: (AM-G)							
			Sampling Date							
			19-08-2025	20-08-2025	25-08-2025	28-08-2025	01-09-2025	02-09-2025	08-09-2025	09-09-2025
1	PM_{10} ($\mu g/m^3$)	100 ($\mu g/m^3$)	14.91	16.56	19.29	27.09	26.31	33.45	21.66	16.33
2	$PM_{2.5}$ ($\mu g/m^3$)	60 ($\mu g/m^3$)	6.22	8.40	16.16	16.69	17.67	23.32	13.86	5.47
3	SO_2 ($\mu g/m^3$)	80 ($\mu g/m^3$)	10.07	9.36	11.51	10.54	7.99	11.03	<5	<5
4	NO_x ($\mu g/m^3$)	80 ($\mu g/m^3$)	<6	8.40	<6	7.64	<6	9.65	37.14	49.68
5	CO ($\mu g/m^3$)	2000 ($\mu g/m^3$)	470	520	530	490	480	450	520	500

Sr. No.	Parameters	NAAQ Standards, 2009 (Industrial, Residential, Rural & Other Areas) for 24 hours	Location Code: (AM-D)	Location Code: (AM-H1)	Location Code: (AM-H2)	Location Code: (AM-G)
			Sampling Date			
			20-08-2025	25-08-2025	28-08-2025	04-09-2025
1	**Benzene ($\mu g/m^3$)**	**5 ($\mu g/m^3$)**	<4.0	<4.0	<4.0	<4.0
2	**Hydrocarbons ($\mu g/m^3$)**	**-**	<4.0	<4.0	<4.0	<4.0
3	**Non-methane VOC ($\mu g/m^3$)**	**-**	<4.0	<4.0	<4.0	<4.0
4	**VOC ($\mu g/m^3$)**	**-**	<4.0	<4.0	<4.0	<4.0

Observations:

- The results of ambient air quality were compared with the National Ambient Air Quality Standards (NAAQS), 2009, specified by the Central Pollution Control Board (CPCB).
- Dahej:
  - The concentration of $PM_{2.5}$, SO_2, NO_x, CO, Benzene, Hydrocarbons, Non-methane VOC, and VOC were within the standard limit in all the samples.
  - PM_{10} was higher than the standard limit of 100 $\mu g/m^3$ only once.
- Hazira and Ghogha:
  - The concentration of $PM_{2.5}$, PM_{10} SO_2, NO_x, CO, Benzene, Hydrocarbons, Non-methane VOC, and VOC were within the standard limit in all the samples.
- The high concentration of PM10 could be attributed to vehicular movement in the port area and surrounding road dust, causing the dispersion of emitted particulate matter in the ambient air.

Preventive measures:

- Water sprinkling on roads, end-to-end pavement of roads, and tree plantations can considerably reduce dust suspension and its emission during vehicular movement.
- Practice should be initiated by using a mask as a preventative measure to avoid the health risk associated with the inhalation of dust particles to the person working in the port area.

2.2 Drinking water monitoring

Drinking water sampling was carried out once a month at three locations, i.e., 1 at Dahej, 1 at Hazira, and 1 at Ghogha. The analysis results were compared with the stipulated standards as per IS 10500:2012 and mentioned in **Table 6** below.

Table 6: Results of drinking water quality monitoring

Sr. No.	Parameters	Unit	Acceptable limit	Permissible limit	Location Code and Sampling Date		
			Standards IS 10500:2012		DW-D 20-08-2025	DW-H 20-08-2025	DW-G 29-08-2025
1	pH	-	6.5-8.5	No Relaxation	7.52	7.98	7.12
2	EC	µS/cm	-	-	216	48.4	331
3	TDS	mg/L	500	2000	116	26	176
4	Chloride	mg/L	250	1000	18.32	12.05	29.89
5	Total Hardness	mg/L	200	600	88	5	146
6	Calcium as Ca	mg/L	75	200	59	3	72
7	Magnesium as Mg	mg/L	30	100	29	2	74
8	Turbidity	NTU	1.00	5.00	1.45	BQL● (QL=0.5)	0.63
9	Fluoride as F	mg/L	1	1.5	0.44	QL● (QL=0.3)	0.51
10	SO_4	mg/L	200	400	BQL● (QL=10)	BQL● (QL=10)	29.94
11	Na	mg/L	-	-	14.99	8.03	50.96
12	K	mg/L	-	-	1.83	BQL● (QL=1)	2.55
13	NO_3	mg/L	45	No relaxation	2.95	2.53	5.01
14	NO_2	mg/L	-	-	BQL● (QL=0.1)	BQL● (QL=0.1)	BQL● (QL=0.1)
15	Odour	TON	Agreeable	Agreeable	1	1	1
16	Hg	mg/L	0.001	No relaxation	BQL● (QL=0.003)	BQL● (QL=0.003)	BQL● (QL=0.003)
17	Salinity	PSU	-	-	0.10	0.03	0.16

Sr. No.	Parameters	Unit	Acceptable limit	Permissible limit	Location Code and Sampling Date		
			Standards IS 10500:2012		DW-D 20-08-2025	DW-H 20-08-2025	DW-G 29-08-2025
18	Free Residual Cl^-	mg/L	0.2	1	BQL● (QL=2)	BQL● (QL=2)	BQL● (QL=2)
19	Pb	mg/L	0.01	No relaxation	BQL● (QL=0.002)	BQL● (QL=0.002)	BQL● (QL=0.002)
20	Cd	mg/L	0.003	No relaxation	BQL● (QL=0.002)	BQL● (QL=0.002)	BQL● (QL=0.002)
21	Fe	mg/L	0.3	No relaxation	BQL● (QL=0.1)	BQL● (QL=0.1)	BQL● (QL=0.1)
22	Total Cr	mg/L	0.05	No relaxation	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)
23	Hexavalent Cr	mg/L	-	-	BQL● (QL=0.01)	BQL● (QL=0.01)	BQL● (QL=0.01)
24	Cu	mg/L	0.05	1.5	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)
25	Zn	mg/L	5.00	15.00	BQL● (QL=0.5)	BQL● (QL=0.5)	BQL● (QL=0.5)
26	As	mg/L	0.01	0.05	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)
27	Color	Hazen	5.00	15.00	1	1	1
28	TSS	mg/L	-	-	4	BQL●(QL=2)	BQL●(QL=2)
29	Microbiological (MPN) (Total Coliforms)	CFU/ 100 ml	Shall not be detectable in any 100 ml sample		5	BQL● (QL=1)	120
30	Mn	mg/L	0.1	0.3	BQL● (QL =0.04)	BQL● (QL =0.04)	BQL● (QL =0.04)

BQL – Below Quantification Limit, QL– Quantification Limit

Observations:

- The samples were collected from the respective drinking water sources at the monitored locations. The following were observed from the analysis of drinking water samples.
- At all three locations, Dahej, Hazira, and Ghogha, all parameters were within the standard acceptable limit, except the following.
- At Ghogha, the concentration of Mg (74mg/L) exceeded the acceptable limit of 30 mg/L but not exceeded the permissible limit of 100 mg/L.
- At Dahej, the concentration of Turbidity (1.45 NTU) exceeded the acceptable limit of 1 NTU but not exceeded the permissible limit of 1.5 NTU.
- The concentration of Total coliform content at Dahej, Hazira, and Ghogha was detected as 5, BQL, and 120 CFU/100 ml, respectively.

Preventive measures:

- The presence of the Total Coliforms in all samples indicates microbiological contamination. Therefore, regular cleaning and maintenance of the RO system/water storage tank is recommended. It is required to ensure an efficient operation of the disinfection system to prevent the contamination of water from coliform.

2.3 Noise level monitoring

Noise monitoring was conducted at all four locations, i.e., 1 at Dahej, 2 at Hazira, and 1 at Ghogha. The monitoring was conducted once a month at all the locations for 24 hours. The results of the noise monitoring are mentioned in **Table 7**. The results were compared with the prescribed limit of noise level as per the noise standards of Environment Protection Rules,2000, as given in **Table 8**.

Table 7: Results of noise monitoring

Sr. No.	Location Code	Date of Monitoring	Day Time			Night Time		
			Max.	Min.	Leq.	Max.	Min.	Leq.
1	N-D	14-August-25	57.8	51.6	53.8	48.8	41.1	44.9
2	N-H1	20-August-25	62.9	53.7	58.0	53.5	43.1	46.7
3	N-H2	30-August-25	59.4	52.9	56.7	59.4	44.2	48.1
4	N-G	28- August-25	71.3	56.2	60.6	62.5	40.7	47.2

Table 8: Ambient air quality norms with respect to noise

Area Code	Type of area	Noise dB(A) Leq	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silent zone	50	40

Observations:

- Average Leq noise levels, for Day-time and Night-time at all locations, Dahej, Hazira, and Ghogha, were found below the maximum permissible limits defined for "Industrial area".

2.4 Soil quality monitoring

Soil quality monitoring was carried out at all three locations, 1 at Dahej, 1 at Hazira, and 1 at Ghogha, once a month. **Table 9** shows the analysis results of soil quality.

Table 9: Results of soil quality monitoring

Sr. No.	Parameters		Unit	Location Code & Date of Sampling		
				S-D	S-H	S-G
				20-08-2025	20-08-2025	29-08-2025
1	Organic Carbon		%	0.35	0.39	0.68
2	Total Organic Matter		%	0.61	0.67	1.17
3	Inorganic Phosphate (Av. Phosphorous)		kg/Ha	0.81	0.83	0.71
4	Particle size distribution & silt content	Sand %	-	43.73	25.69	38.98
5		Silt %	-	23.98	31.99	42.40
6		Clay %	-	32.29	42.31	18.31
7	Texture	Type of soil	-	Clay loam	Clay	Loam
8	pH		-	9.41	9.8	8.51
9	Conductivity		dS/m	2.18	0.54	0.59
10	SAR		meq/L	6.32	1.82	0.15
11	Water Holding Capacity		%	54.38	69.97	59.95
12	Al		mg/kg	10513.99	13419.32	26587.56
13	Cr		mg/kg	92.19	103.86	108.41
14	Ni		mg/kg	33.67	38.93	40.72
15	Cu		mg/kg	48.27	60.77	67.26
16	Zn		mg/kg	50.75	57.17	66.88
17	Cd		mg/kg	BQL● (QL=1)	BQL● (QL=1)	BQL● (QL=1)
18	Pb		mg/kg	3.13	2.7	6.71
19	As		mg/kg	3.18	3.14	2.8
20	Hg		mg/kg	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)

BQL – Below Quantification Limit QL- Quantification Limit

To classify the soil quality, the soil quality standards- “Soil fertility class by Soil Health card 2015” & “Standard limit EU 2002” were adopted and shown in **Table 10** below.

Table 10: Soil quality standard

Soil fertility class by Soil Health Card (SHC 2015)				
Sr. No.	Parameter	Range & Interpretation of Result		
1	pH	Acidic <6.5	Normal 6.5-8.2	Alkaline >8.2
2	Electrical Conductivity (dS/m)	Normal <1	Medium 1-3	Harmful >3
3	Available Phosphorus (kg/Ha)	Low < 28	Medium 28-56	High >56
4	Organic Carbon (%)	Low < 0.5	Medium 0.5-0.75	High > 0.75
5	Zinc (mg/kg)	Low < 0.5	Medium 0.5-1.0	High >1.0
6	Copper (mg/kg)	Low < 0.2	Medium 0.2-0.4	High >0.4

Standard limit EU 2002		
7	**Chromium (mg/kg)**	150
8	**Lead (mg/kg)**	300
9	**Cadmium (mg/kg)**	3.0
10	**Nickel (mg/kg)**	75

Observations:

- The soil texture was identified as 'Clay loam' type at Dahej, 'Clay' at Hazira and 'Loam' type at Ghogha.
- The pH value in soil was found to be 'Alkaline' at all three locations.
- Electrical Conductivity at Dahej was found in the 'Medium' Category, and Hazira and Ghogha were found to be in the 'Normal' category.
- Available phosphorus falls under the 'Low fertility' quality class at all three locations.
- The Organic carbon content in the soil was found in the 'Low fertility' class at Dahej and Hazira and 'Medium fertility' at Ghogha locations.
- The values of Zn and Cu were found in the 'High fertility' class at all three locations.
- The heavy metals, including Cr, Pb, Cd, and Ni, were detected within permissible limits at all three locations.
- The overall quality of the soil at all three locations was found to have low essential nutrients, hence less suitable for plant growth.

2.5 Marine Water, Sediment & Ecology Monitoring

Marine water, sediment, and ecology monitoring was carried out at five locations: 1 at Dahej, 2 at Hazira, and 2 at Ghogha. The results and observations are mentioned below.

2.5.1 Marine Water Quality Monitoring

The analysis results of the marine water are presented in **Table 11** below. The results of marine water quality were compared with the water quality criteria for the designated best use for the coastal water stipulated by the 'Environment (Protection) Act, 1986', shown in **Table 12.**

Table 11: Result of marine water quality monitoring

Sr. No.	Parameters	Unit	Location code & date of sampling				
			MA-D	MA-H1	MA-H2	MA-G1	MA-G2
			20-08-2025	20-08-2025	20-08-2025	29-08-2025	29-08-2025
1	EC	µS/cm	29,780	27,366	30,457	37,100	37,300
2	DO	mg/L	6.7	5.84	6.19	5.3	6.5
3	pH	-	7.75	7.39	7.34	7.49	7.61
4	Color	Hazen	5	5	10	5	5
5	Odor	TON	1	1	1	1	1
6	Turbidity	NTU	>500 (QL=500)	432	>500 (QL=500)	215	72.7
7	TDS	mg/L	19,357	17,788	19,797	25,720	25,812
8	TSS	mg/L	430	372	467	278	188
9	Particulate Organic Carbon	mg/L	7.73	3.05	8.28	1.93	1.06
10	COD	mg/L	47.32	44.4	37.63	35.8	29.1
11	BOD	mg/L	4.9	BQL● (QL=3)	5.07	BQL● (QL=3)	BQL● (QL=3)
12	Silica	mg/L	>5 (QL=5)	>5 (QL=5)	>5 (QL=5)	7.52	6.89
13	PO_4	mg/L	3.07	0.63	2.34	BQL● (QL=0.5)	BQL● (QL=0.5)
14	SO_4	mg/L	1351.91	1208	1385.53	1709.85	1655.05
15	NO_3	mg/L	5.28	7.09	6.35	5.10	5.17
16	NO_2	mg/L	BQL● (QL=0.1)	0.29	0.23	BQL● (QL=0.1)	BQL● (QL=0.1)
17	Na	mg/L	5768.80	4214	5135.18	>10,000 (QL=10,000)	>10,000 (QL=10,000)
18	K	mg/L	218.40	88.80	185.25	1390	1188
19	Mn	mg/L	1.19	0.34	3.03	0.10	BQL● (QL=0.04)

Sr. No.	Parameters	Unit	Location code & date of sampling				
			MA-D	MA-H1	MA-H2	MA-G1	MA-G2
			20-08-2025	20-08-2025	20-08-2025	29-08-2025	29-08-2025
20	Fe	mg/L	8.99	3.7	8.98	1.43	0.33
21	Total Cr	mg/L	0.02	0.01	0.02	BQL● (QL=0.005)	BQL● (QL=0.005)
22	Hexavalent Cr	mg/L	BQL● (QL=0.01)	BQL● (QL=0.01)	BQL● (QL=0.01)	BQL● (QL=0.01)	BQL● (QL=0.01)
23	Cu	mg/L	0.06	0.02	0.11	0.01	BQL● (QL=0.005)
24	Cd	mg/L	BQL● (QL=0.002)	BQL● (QL=0.002)	BQL● (QL=0.002)	BQL● (QL=0.002)	BQL● (QL=0.002)
25	As	mg/L	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)
26	Pb	mg/L	0.01	0.002	0.02	BQL● (QL=0.002)	BQL● (QL=0.002)
27	Zn	mg/L	BQL● (QL=0.5)	BQL● (QL=0.5)	BQL● (QL=0.5)	BQL● (QL=0.5)	BQL● (QL=0.5)
28	Hg	mg/L	BQL● (QL=0.003)	BQL● (QL=0.003)	BQL● (QL=0.003)	BQL● (QL=0.003)	BQL● (QL=0.003)
29	Oil & grease	mg/L	BQL● (QL=1)	BQL● (QL=1)	BQL● (QL=1)	BQL● (QL=1)	BQL● (QL=1)
30	Microbiological (MPN) (Total Coliforms)	MPN/ 100 ml	23	23	23	BQL● (QL=1)	BQL● (QL=1)
31	Density	kg/m^3	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)
32	Microbiological (MPN) (Fecal Coliforms)	MPN/ 100 ml	2	13	8	BQL● (QL=1)	BQL● (QL=1)
33	Floating material (Scum, Petroleum products)	-	ND	ND	ND	ND	ND

BQL – Below Quantification Limit, QL- Quantification Limit, ND- Not detected

Table 12: Water quality criteria: Primary water quality criteria for designated best uses for coastal waters [As per "The Environment (Protection) Act, 1986]

Parameters	SW-I	SW-II	SW-III	SW-IV	SW-V
pH	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.0 – 9.0	6.0 – 9.0
Dissolved oxygen (as O_2), mg/l, min	5 or 60% of saturation value, whichever is higher	4 or 50% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher
Color & Odour	No noticeable color or offensive odour	No noticeable color or offensive odour	No noticeable color or offensive odour	No noticeable color or offensive odour	None in such concentrations that would impair any usages specifically assigned to this class
Floating matters	No visible, obnoxious floating debris, oil slick, scum	Nothing obnoxious or detrimental for use purpose	No visible, obnoxious floating debris, oil slick, scum	10 mg/l max. (including Oil & grease & scum / petroleum products)	-
Oil & grease, mg/L max. (including petroleum products)	0.1	-	-		-
Suspended solids	None from sewage & industrial origin	-	-	-	-
Heavy metals • Mercury, mg/L (as Hg) • Lead, mg/L (as Pb) • Cadmium, mg/L (as Cd)	 • 0.001 • 0.001 • 0.01	-	-	-	-
Turbidity, NTUmax.	-	30	30	-	-

Parameters	SW-I	SW-II	SW-III	SW-IV	SW-V
Fecal coliforms, MPN/100ml,max	-	100	500	500	500
BOD, mg/L, 3 days at 27°C, max	-	3	-	5	-
Dissolved iron,mg/L max (as Fe)	-	-	0.5	-	-
Dissolved manganese, mg/L max (as Mn)	-	-	0.5	-	-
Sludge deposits,solid refuse, floating solids, oil & grease,scum	-	-	-	-	None except for such a small amount that may result from discharge of appropriately treated sewage & or industrial waste
SW-I: Salt pans, shell fishing, mariculture, and ecologically sensitive zone SW-II: Bathing, contact water sports, and commercial fishing SW-III: Industrial cooling, recreation (non-contact), and aesthetics SW-IV: Harbor waters SW-V: Navigation and controlled waste disposal					

Observations:

Analysis results of the pH, DO, BOD, floating materials and Fecal coliforms showed the suitability of marine water for Harbour Waters. There were no oil slicks or floating trash at the sampling locations.

2.5.2 Marine sediment quality monitoring

The quality of the marine sediment samples collected from Dahej, Hazira & Ghogha from 13th August to 12th September 25 has been summarized in **Table 13**.

Table 13: Result of Marine Sediment Quality Monitoring

Sr. No.	Parameters	Unit	Location code and sampling date				
			MA-D	MA-H1	MA-H2	MA-G1	MA-G2
			20-08-2025	20-08-2025	20-08-2025	29-08-2025	29-08-2025
1	Texture	-	Clay loam	Clay loam	Clay loam	Loam	Silt loam
2	Organic matter	%	1.04	1.41	0.67	1.47	1.14
3	Inorganic phosphate (Av. phosphorus)	kg/Ha	1.84	2.71	1.34	0.69	0.9
4	Silica	g/kg	407.82	388.84	473.59	455.69	455.8
5	Phosphate (Total phosphorous)	mg/kg	511.5	413.1	373.8	266.27	225
6	Sulphate	mg/kg	37.2	33.26	38.29	75	80
7	NO_2	mg/kg	1.07	1.26	1.01	1.13	1.26
8	NO_3	mg/kg	7.29	6.84	6.53	7.09	6.96
9	Ca	mg/kg	3507	3206.4	2905.8	3707.4	3406.8
10	Mg	mg/kg	2369.74	2755.84	2187.45	3281.18	2855.84
11	Na	mg/kg	3974	4274	3607	3252	5854
12	K	mg/kg	3370	3417	2618	2344	2406
13	Al	mg/kg	14617.55	14853.99	11987.45	26041.7	28701.22
14	Cr	mg/kg	122.11	115.71	102.14	107.26	114.38
15	Ni	mg/kg	39.35	41.02	36.1	53.61	43.5
16	Zn	mg/kg	79.36	69.46	66.77	76.23	73.93
17	Cd	mg/kg	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
18	Pb	mg/kg	6.52	2.88	3.46	12.02	7.58
19	As	mg/kg	3.71	3.29	2.9	4.16	2.38
20	Hg	mg/kg	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)	BQL● (QL=0.005)
21	Cu	mg/kg	62.96	58	56.58	90.04	72.21

BQL – Below Quantification Limit QL- Quantification Limit

Observations:

The marine sediment quality at Dahej, Hazira, and Ghogha was compared based on the obtained results, and the following were observed.

- Organic matter in sediment consists of carbon and nutrients in the form of carbohydrates, proteins, fats, and nucleic acids. Sediment organic matter is derived from plant and animal detritus, bacteria, or plankton formed in situ, or derived from natural and anthropogenic sources in catchments. Organic matter was found to be 1.04% at Dahej, 0.67 to 1.41% at

Hazira and 1.14 to 1.47% at Ghogha.

- Inorganic phosphate was found to be 1.84 kg/Ha at Dahej, 1.34 to 2.71 kg/Ha at Hazira and 0.69 to 0.9 kg/Ha at Ghogha. The capacity of sediment to retain or release phosphorus is one of the important factors that influence the concentration of inorganic/organic phosphorus in the overlying waters (Saravanakumar, Rajkumar, Serebiah, & Thivakaran, 2008).
- The texture of the sediments was found to be ‘Clay loam’ at Dahej and Hazira, and ‘Loam’ to ‘Silt loam’ at Ghogha location.
- The concentration of Sulphate was found to be 37.2 mg/kg at Dahej, 33.26 to 38.29 mg/kg at Hazira and 75 to 80 mg/kg at Ghogha. The sulphate concentrations in marine sediment can vary naturally based on geological and hydrological factors.
- Nitrite concentration was found 1.07 mg/kg at Dahej, 1.01 to 1.26 mg/kg at Hazira, and 1.13 to 1.26 mg/kg at Ghogha.
- Nitrate concentration was found to be 7.29 mg/kg at Dahej, 6.53 to 6.84 mg/kg at Hazira, and 6.96 to 7.09 mg/kg at Ghogha.
- Ca was found to be 3507 mg/kg at Dahej, 2905.8 to 3206.4 mg/kg at Hazira, and 3406.8 to 3707.4 mg/kg at Ghogha. The source of Ca accumulation in marine sediment may be due to its naturally occurring element, and its concentration can vary widely from local geological, hydrological conditions and environmental factors. It depends on various factors, including the composition of the underlying rocks and the presence of calcareous organisms such as coral reefs.
- Mg was observed to be 2369.74 mg/kg at Dahej, 2187.45 to 2755.84 mg/kg at Hazira and 2855.84 to 3281.18 mg/kg at Ghogha. Magnesium is an essential component of marine sediments and plays a significant role in marine ecosystem dynamics. The concentration of magnesium in marine sediments can depend on various factors, including the composition of the underlying rocks, sediment type, and local hydrological conditions.
- The values for Sodium in marine sediment were found to be 3974 mg/kg at Dahej, 3607 to 4274 mg/kg at Hazira and 3252 to 5854 mg/kg at Ghogha. Sodium concentrations in marine sediments are often correlated with salinity levels. It is an essential component of marine ecosystems.
- The value for Potassium was found to be 3370 mg/kg at Dahej, 2618 to 3417 mg/kg at Hazira, and 2344 to 2406 mg/kg at Ghogha. Potassium is an essential nutrient for plants and the composition of parent materials, sediment types, weathering processes, and local hydrological conditions.
- The Silica in marine sediment was found to be 407.82 g/kg at Dahej, 388.84 to 473.59 g/kg

at Hazira and 455.69 to 455.8 g/kg at Ghogha. Its presence in marine sediments can be attributed to both natural geological processes and biological contributions, such as mineral weathering, biogenic silica, aquatic plants, and oceanographic processes.

- The Total phosphorus concentration was found to be 511.5 mg/kg at Dahej, 373.8 to 413.1 mg/kg at Hazira and 225 to 266.27 mg/kg at Ghogha. Phosphorus is an essential nutrient for marine ecosystems, playing a crucial role in biological processes. Its presence in marine sediments can have significant implications for nutrient cycling and ecosystem health. It can accumulate on the seafloor due to land runoff, natural weathering, decomposition of organic matter, local geology, etc.
- The sediment quality for the trace metals concentration was compared to the sediment quality guidelines (US Environmental Protection Agency, 1977; Augustynowicz, et al., 2013; Bi, Liu, Guo, & Lu, 2018; Saravanakumar, Rajkumar, Serebiah, & Thivakaran, 2008; Tanmay , Anilava , & Subrata , 2017; Tokatli, 2017; Perin, Bonardi, & Scotto, 1997; Onjefua, et al., 2020; Pazi, 2011), as shown in **Table 14**.

Table 14: Sediment Quality Guidelines (SQG) of the US Environmental Protection Agency (EPA) 1977

Metals	Sediment quality (mg/kg)		
	Not Polluted	Moderately Polluted	Heavily Polluted
As	<3	3-8	>8
Cu	<25	25-50	>50
Cr	<25	25-75	>75
Ni	<20	20-50	>50
Pb	<40	40-60	>60
Zn	<90	90-200	>200
Al	ND	ND	ND
Cd	-	<6	>6
ND- Not detected			

- As per the comparison of the metals to this guideline, a variation in the concentration of the metals was found. The concentration of Pb and Zn was in the ‘Not polluted’ quality class at all three locations. Ni concentration was in ‘Moderately polluted’ quality class at Dahej, Hazira & MA-G2 locations whereas it was found in and ‘Heavily polluted’ quality class at MA-G1. Cd concentrations were in the ‘Moderately polluted’ quality class at all three locations. Arsenic levels at all locations fell in the ‘Not pollute’ to ‘Moderately polluted’ class. The concentrations of Cu fell in ‘Heavily Polluted’ quality class in all three locations. Cr concentrations were ‘Heavily polluted’ quality class in all three locations. Sediments are highly dynamic, constantly being deposited and carried away by water currents (Labenua, et al., 2023).The possible reasons for the higher concentration of some heavy metals may be attributed to the high sedimentation rate and to various natural and anthropogenic factors.

2.5.3 Marine ecological monitoring

The various parameters monitored for Marine ecological monitoring are mentioned in **Table 15** and **Table 16** as follows:

Table 15: Results of marine ecological monitoring for Biomass, NPP, GPP, Pheophytin, Chlorophyll-a, Secchi depth & Particulate oxidizable organic carbon

Location code	Sampling date	Biomass	Net Primary Productivity (NPP)	Gross Primary Productivity (GPP)	Pheophytin	Chlorophyll-a	Secchi Depth	Particulate oxidizable organic carbon
		mg/L	mg/L/hr.	mg/L/hr.	mg/m^3	mg/m^3	meter	mg/L
MA-D	20-08-25	504	BQL	0.01	BQL	4.06	0.06	7.73
MA-H1	20-08-25	460	BQL	0.01	BQL	3.07	0.07	3.05
MA-H2	20-08-25	368	BQL	0.05	BQL	5.02	0.06	8.28
MA-G1	29-08-25	216	BQL	BQL	BQL	8.54	0.11	1.93
MA-G2	29-08-25	126	BQL	0.01	BQL	0.72	0.23	1.06

BQL – Below Quantification Limit

Table 16: Results of marine ecological monitoring for Benthic macroinvertebrates, Phytoplankton, and Zooplankton

Location code	Sampling date	Benthic macroinvertebrates (Counts/L)		Phytoplankton (Counts/L)		Zooplankton (Counts/L)	
		Observation	Individual count	Genera	Individual count	Observation	Individual count
MA-D	20-08-25	-	-	Nitzschia	33333	Nil	Nil
MA-H1	20-08-25	-	-	Nitzschia	66667	Nil	Nil
MA-H2	20-08-25	-	-	Skeletonema	33333	Nil	Nil
MA-G1	29-08-25	Mollusca Hydrobiidae	5.00	Nil	Nil	Nil	Nil
MA-G2	29-08-25	-	-	Nil	Nil	Nil	Nil

Observations and Interpretation:

- The essential nutrients that stimulate phytoplankton growth i.e. nitrate, phosphorus along with silica show variable concentrations influenced by monsoon.
- The nitrate concentrations observed are moderate, ranging between 5.10 mg/L and 7.09 mg/L. Silica levels were observed to exceed the quantifiable limits at all monitoring locations. Neither MA-G1 nor MA-G2 exhibited Phosphorus concentrations, which corresponded to absence of phytoplankton. Whereas, phosphorus was detected at MA-D, MA-H1 and MA-H2 which is a reflection for the presence of certain phytoplankton populations of *Nitzschia* and *Skeletonema* with complete absence of zooplankton at all sites. This evidently implies high levels of biomass particularly at MA-D, MA-H1 & MA-H2.
- The season lack the availability of limited or no light. Therefore, though primary producers are there, there is no activity of primary productivity confirming practically absent photosynthetic activity (Natiq Faris, Talib Abedali, & Buhlool AL-Ghizzi, 2022)
- The rainfall is likely to promote the addition of sediments and other compounds to the water body; subsequently, they settle down and result in turbid water. Hence, the Secchi depth values recorded are also very low (0.06 – 0.23m) (Tailor, 2019). The Chlorophyll-a levels were also very low (0.723–8.543 mg/m^3) across the sites. Phaeophytin levels are below quantifiable limits across all locations.
- Benthic macroinvertebrate community shows the presence of only one group, Mollusca: Hydrobiidae, recorded at MA-G1, with 5 individuals. Other locations showed no benthic organisms at the monitoring locations.

2.6 Meteorological monitoring

To determine the prevailing micro-meteorological conditions at the project site the Automatic Weather Monitoring Stations (AWS) have been installed at the sites of Dahej, Hazira, and Ghogha at 10 m above the ground.

The summary of hourly meteorological observations recorded at the observatory, Dahej, Hazira, and Ghogha for 13th August to 12th September 25 for the significant parameters has been mentioned in **Table 17.**

Table 17: Results of meteorological monitoring

Sr. No.	Location	Month	Wind direction	Wind speed (m/s)			Rain (mm/hr.)	Relative humidity (%)			Temperature (°C)			Solar radiation (W/m^2)
				Mean	Max	Min	(Avg.)	Mean	Max	Min	Mean	Max	Min	(Avg.)
1	M-D	August to September 25	South-South-West	2.05	8.39	0.33	0.23	89.46	92.49	86.73	28.96	29.57	28.36	66.29
2	M-H		South-West	17.39	38.67	6.71	0.25	93.98	96.11	91.95	30.24	30.80	29.65	59.16
3	M-G		West-South-West (WSW)	5.47	18.04	1.14	0.19	82.87	85.24	80.49	28.52	29.38	27.70	59.08

Observations:

The monthly average of maximum and minimum daily observed values, summarized in **Table 17,** has been discussed as follows.

• Temperature

Dahej: The ambient temperature varied from 28.36-29.57°C, with an average temperature of 28.96°C.

Hazira: The ambient temperature varied from 29.65-30.80°C, with an average temperature of 30.24°C.

Ghogha: The ambient temperature varied from 27.70-29.38°C, with an average temperature of 28.52°C.

• Relative humidity

Dahej: The Relative Humidity varied from 86.73-92.49%, with an average humidity of 89.46%.

Hazira: The Relative Humidity varied from 91.95-96.11%, with an average humidity of 93.98%.

Ghogha: The relative humidity varied from 80.49-85.24%, with an average humidity of 82.87%.

• Rainfall

Dahej: The average Rainfall was recorded as 0.23 mm/hr.

Hazira: The average Rainfall was recorded as 0.25 mm/hr.

Ghogha: The average Rainfall was recorded as 0.19 mm/hr.

• Wind speed

Wind speed and direction play a significant role in transporting the pollutants and thus determine the air quality.

Dahej: The wind speed was recorded in the range of 0.33-8.39 m/s, with an average of 2.05m/s.

Hazira: The wind speed was recorded in the range of 6.71-38.67 m/s, with an average of 17.39m/s.

Ghogha: The wind speed was recorded in the range of 1.14-18.04 m/s, with an average of 5.47m/s.

• Solar radiation

The average solar radiation at Dahej, Hazira, and Ghogha was 66.29, 59.16 and 59.08 $W/m^{2,}$ respectively.

• **Wind rose diagram**

The wind-rose diagram has been drawn based on hourly wind speed and direction data. This wind rose reveals that the prevailing winds predominantly blow from a South-South-West (SSW) direction at Dahej, South-West (SW) at Hazira, and West-South-West (WSW) direction at Ghogha.

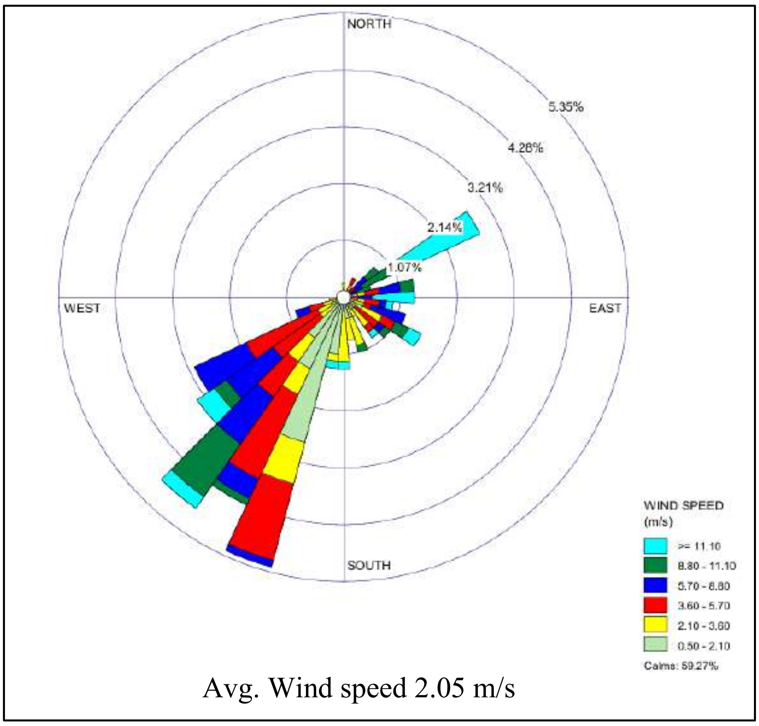
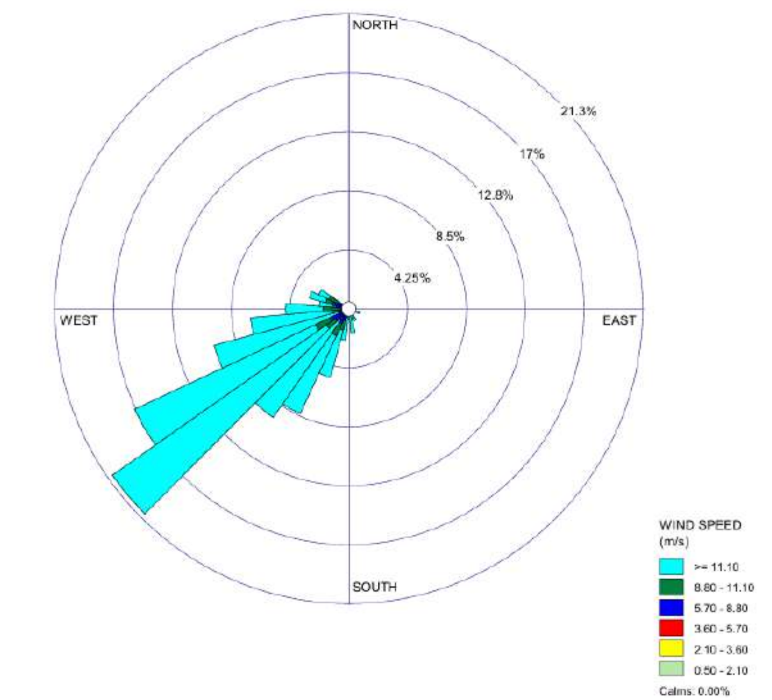


Fig. 5: Windrose diagram of Dahej



Avg. Wind speed 17.39 m/s

Fig. 6: Windrose diagram of Hazira

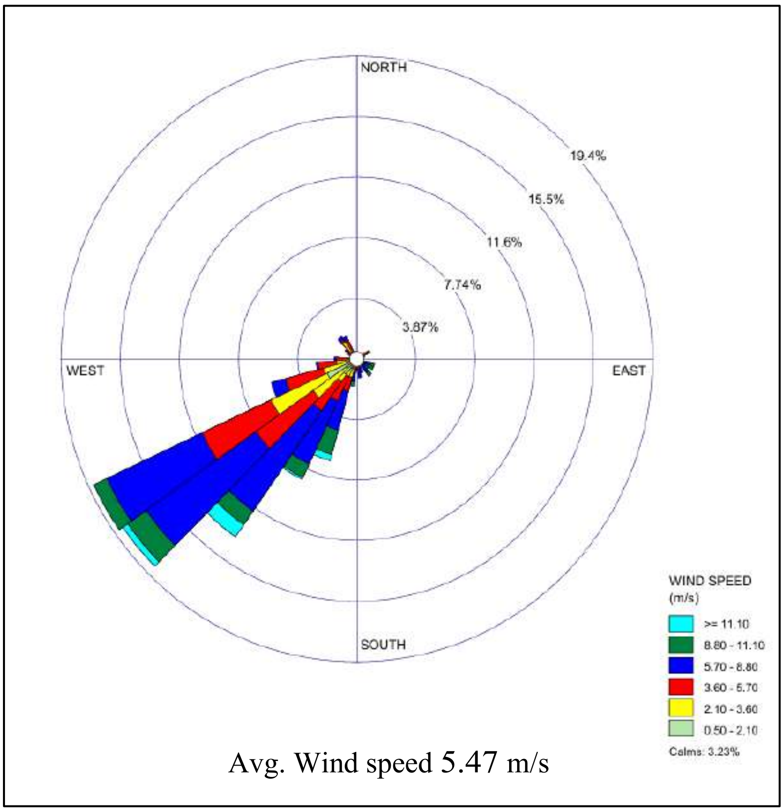


Fig. 7: Windrose diagram of Ghogha

2.7 Monitoring of DG stack emissions

DG sets at the Deendayal Port Authority (DPA) are generally utilized as a secondary power source. The sampling and monitoring of the DG stack emissions were carried out at Dahej, Hazira and Ghogha. The monitoring cycle was once a month. Sampling details of the locations are mentioned in **Table 18**.

Table 18: Result of DG stack emissions

Sr. No.	Parameters	Unit	DG sets standards	Location Code (DG-D)	Location Code (DG-H)	Location Code (DG-G)
				Sampling Date		
				26-08-2025	18-08-2025	04-09-2025
1.	Suspended Particulate Matter (SPM)	mg/Nm^3	150	102	104	105
2.	SO_2	PPM	100	N.D.	N.D.	N.D.
3.	NOx	PPM	50	31	44	28
4.	CO	%	-	0.0035	0.0065	0.0017
5.	CO_2	%	-	1.19	1.22	1.27

N.D. – Not detected

Observations:

The results of DG stack emissions for Hazira, Dahej, and Ghogha are compared with the DG set standards and found within the prescribed limit for SPM, SO_2, and NOx.

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ANNEXURE-I: Meteorological monitoring data

Dahej Meteorological Data

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
13-08-2025	00:00:00	29.5	29.1	28.8	87.7	86.4	85.1	1.4	1004.5	229.6	20.6	7	1.9	0
13-08-2025	01:00:00	29.2	28.9	28.7	88.4	86.1	82.6	1.4	1004.2	230.8	17.9	7	1.9	0
13-08-2025	02:00:00	29.2	28.8	28.5	85	82.8	80.6	1.3	1003.6	234.1	19.9	8.1	3.3	0
13-08-2025	03:00:00	28.8	28.4	28.2	87.1	84.8	82.9	1.4	1003	236.9	17.9	7.4	2.6	0
13-08-2025	04:00:00	28.5	28.1	27.8	89	87.6	86.2	1.5	1002.2	222.7	13.9	4.7	1.3	0
13-08-2025	05:00:00	28.5	28.1	27.8	89.6	88.5	87.4	1.5	1002.1	238.5	12.6	4.9	1.3	0
13-08-2025	06:00:00	28.7	28.3	28.1	88.5	86.7	85.6	1.5	1002.8	237.1	14.6	4.6	1.3	0
13-08-2025	07:00:00	28.6	28.2	27.9	88.9	87.5	86.1	3.9	1003.3	232.8	15.2	4.2	0	0
13-08-2025	08:00:00	29.2	28.7	28.1	88	84.7	82.6	28.1	1004	234.9	11.9	4.6	0.6	0
13-08-2025	09:00:00	30.2	29.4	28.9	83.7	81.3	78.8	79.6	1004.4	238.6	16.6	5.9	0.6	0
13-08-2025	10:00:00	31.6	30.6	29.9	80.9	77.3	73.7	188.3	1004.9	243	17.9	6.8	1.9	0
13-08-2025	11:00:00	32.4	31.8	30.8	74.5	69.5	66.1	227	1005.2	245.5	19.9	6.2	0.6	0
13-08-2025	12:00:00	33.5	32.2	30.5	75.1	66.7	58.8	268.6	1005	240.8	15.9	5.1	0	0
13-08-2025	13:00:00	33.7	32.4	31.3	69.4	64.3	57.3	214	1004.3	248.4	17.9	6.6	0.6	0
13-08-2025	14:00:00	34.7	33.4	31.3	69.9	62.4	57.4	227	1004.1	164.7	11.3	2.6	0	0
13-08-2025	15:00:00	33.7	33.1	32.3	70.4	64.7	60.2	166.6	1003	164.8	11.3	2.7	0	0
13-08-2025	16:00:00	32.5	32	31.4	73.9	71.5	69.2	121.6	1002	164.2	13.3	2.2	0	0
13-08-2025	17:00:00	31.6	31.3	30.9	76.8	74.4	72.7	84.3	1001.1	145.2	21.2	3.4	0	0
13-08-2025	18:00:00	31	30.5	30.1	84.6	79.2	76.1	32.8	1000.9	176.8	22.6	2.6	1.3	0
13-08-2025	19:00:00	30.4	29.7	29.4	88.7	87	84	3.4	1001.5	135.9	19.2	2.7	1.9	0
13-08-2025	20:00:00	29.9	29.5	29.2	89.9	87	81	1.3	1002	180.9	17.2	3.1	1.3	0
13-08-2025	21:00:00	30	29.6	29.5	84.2	81.8	80.2	1.2	1002.5	179.2	15.2	3.2	1.3	0
13-08-2025	22:00:00	29.9	29.6	29.4	85	82.6	80.7	1.2	1003.1	200.9	17.2	3.9	0.6	0
13-08-2025	23:00:00	29.9	29.5	29.3	85.2	83.8	82.6	1.3	1003.6	204.3	15.2	4.6	1.3	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
14-08-2025	00:00:00	29.7	29.4	29.2	86.8	85.3	84.2	1.4	1002.9	210.7	17.2	5.3	1.3	0
14-08-2025	01:00:00	29.7	29.2	29	87	85.7	84.8	1.4	1002.4	218	18.6	7.4	2.6	0
14-08-2025	02:00:00	29.4	29	28.7	87.3	86	84.8	1.4	1001.9	220	15.9	6.3	1.9	0
14-08-2025	03:00:00	29.1	28.7	28.3	90	87.7	86.2	1.5	1001.8	220.7	14.6	6.1	1.3	0
14-08-2025	04:00:00	28.6	28.1	27.7	94.4	91.5	89.1	1.7	1001.7	225.9	17.2	7.3	1.9	0
14-08-2025	05:00:00	28.2	27.9	27.7	95.2	94.5	93.7	1.9	1002	226.3	10.6	4.8	1.9	0
14-08-2025	06:00:00	28.2	27.9	27.7	95.6	94.7	94.2	1.9	1002.3	217.1	8.6	1.6	0	0
14-08-2025	07:00:00	28.2	27.9	27.6	95.6	93.9	90.7	3.1	1002.7	208.9	3.3	0	0	0
14-08-2025	08:00:00	29	28.4	27.8	92.5	90.7	88	33.9	1004	86.6	13.9	3.4	0	0
14-08-2025	09:00:00	30.5	29	28.5	92.4	90.3	86.6	83.3	1004.7	78.5	12.6	4.5	0	0
14-08-2025	10:00:00	32.1	30.9	30	87.2	82.1	76.5	187	1005.4	80.1	15.9	5.6	0.6	0
14-08-2025	11:00:00	33.4	32.1	31.4	79.3	74.8	68.7	219.5	1005.4	97.7	13.9	3.8	0	0
14-08-2025	12:00:00	33.6	33.2	32.9	70.7	68.4	66.8	273.2	1005.4	95.6	14.6	3.6	0	0
14-08-2025	13:00:00	34.2	33.7	33	69.2	64.7	61.6	316.1	1005.1	143.7	13.9	3.2	0	0
14-08-2025	14:00:00	35.1	34.3	33.7	65.7	62.7	58.7	394.3	1004.8	140.8	16.6	3.4	0.6	0
14-08-2025	15:00:00	34.6	33.5	32.5	67.9	64.8	62.2	249.9	1003.8	130.1	16.6	4	1.3	0
14-08-2025	16:00:00	34.7	34.1	33.1	68	62.9	58.7	300.6	1003.2	149.5	19.2	3.1	0.6	0
14-08-2025	17:00:00	33.2	31.9	31.1	76.8	72.9	67.3	90.6	1001.3	178.5	12.6	2.9	0	0
14-08-2025	18:00:00	31.8	31.4	31	78.6	76.3	74.5	74.9	1001.1	129.7	19.9	3.4	0	0
14-08-2025	19:00:00	31.2	30.7	30	82	78.8	76.7	33.4	1001.4	190.2	17.2	3.3	0.6	0
14-08-2025	20:00:00	30.3	29.7	29.4	84.2	82.2	80.9	1	1001.8	211.7	17.9	5.2	1.3	0
14-08-2025	21:00:00	29.8	29.5	29.3	86.4	83.8	82.2	1.1	1002.4	213.7	18.6	4.8	0	0
14-08-2025	22:00:00	29.8	29.4	29.2	88	86.7	85.5	1.3	1002.8	167.4	13.9	3.1	0.6	0
14-08-2025	23:00:00	29.7	29.4	29.1	88.9	87.3	86.2	1.3	1003.4	116.8	13.3	3.6	0	0
15-08-2025	00:00:00	29.7	29.3	29.1	89.2	88.2	87.4	1.4	1003.2	108.9	13.9	3.4	0.6	0
15-08-2025	01:00:00	29.8	29.4	29.2	89.5	88.5	87.7	1.4	1002.9	115	15.9	3.3	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
15-08-2025	02:00:00	29.6	29.3	29	91.2	89.4	87.8	1.5	1002.3	113.7	10.6	2.5	0	0
15-08-2025	03:00:00	29.5	29.2	29	91	89.4	88.5	1.5	1001.4	104.4	7.3	0.6	0	0
15-08-2025	04:00:00	29.6	29	28.6	94.6	91.7	88.7	1.5	1000.9	87.5	11.3	3.6	0	0
15-08-2025	05:00:00	29.1	28.8	28.6	95.8	94.3	91.3	1.6	1001	78.3	11.3	3.1	0	0
15-08-2025	06:00:00	29.3	28.9	28.7	92	89.8	88.4	1.7	1001.1	104.2	7.9	1.1	0	0
15-08-2025	07:00:00	29.4	28.9	28.5	91.6	90.2	88.4	1.7	1001.8	208.8	11.3	3.7	0	0
15-08-2025	08:00:00	29.5	29	28.6	91.5	89.6	88	23.4	1003	217.2	10.6	3.5	0	0
15-08-2025	09:00:00	30.3	29.7	29.1	88.7	84.9	80.5	75.6	1003.7	217.8	9.9	4.2	0	0
15-08-2025	10:00:00	30.6	30.1	29.8	84.1	81.7	79.4	76.3	1004	227.3	11.3	5.1	0	0
15-08-2025	11:00:00	30.7	30.3	30	84	81.4	79.5	105.1	1004.1	223.3	12.6	6	1.9	0
15-08-2025	12:00:00	31.4	30.8	30.1	82.5	78.6	75.7	141.7	1004.3	231.1	13.9	5.5	1.3	0
15-08-2025	13:00:00	33	32.1	31.2	77.3	73.4	69	219	1004.2	201.7	12.6	3.8	0	0
15-08-2025	14:00:00	34.7	33.5	32.5	71.3	67	61.6	293.7	1003.7	144.5	17.9	3.6	0	0
15-08-2025	15:00:00	34.1	33.5	33	68.3	65.3	60.4	287.1	1002.6	124	14.6	3.3	1.3	0
15-08-2025	16:00:00	34.1	33	32.2	66	62.7	58.2	213	1001.5	195.8	14.6	3.7	0	0
15-08-2025	17:00:00	33.5	32.9	32.1	73	68.5	63.6	188.1	1000.5	146.4	19.2	3.4	0	0
15-08-2025	18:00:00	32.3	31.4	30.8	81.1	76.1	71.9	92.1	999.7	200	21.2	4.7	0.6	0
15-08-2025	19:00:00	30.9	30.2	29.7	86.1	83.9	80.9	15.9	1000.1	198.4	17.9	4.5	1.3	0
15-08-2025	20:00:00	30.1	29.8	29.6	88.4	86.5	85.3	1.2	1000.9	214.1	15.2	5.4	0.6	0
15-08-2025	21:00:00	30.1	29.8	29.6	87.9	86.3	84.4	1.3	1001.8	207.2	12.6	4.5	0.6	0
15-08-2025	22:00:00	30.1	29.8	29.6	88.2	86.7	85.9	1.3	1002.1	154.8	14.6	3.2	0	0
15-08-2025	23:00:00	30.1	29.8	29.6	90.6	88.4	86.4	1.4	1002.2	179.3	14.6	3.4	0	0
16-08-2025	00:00:00	30.1	29.6	29.2	92.1	87.8	84.8	1.5	1001.9	219.4	24.6	9	1.9	0
16-08-2025	01:00:00	29.6	29.2	28.9	87.3	83.8	82	1.3	1001	225.6	20.6	9	3.3	0
16-08-2025	02:00:00	29.3	28.9	28.6	87.4	85.2	84	1.4	1000.6	214.5	14.6	5.6	0.6	0
16-08-2025	03:00:00	29	28.7	28.5	89.2	87.4	86	1.5	1000.3	197.8	6.6	2.1	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
16-08-2025	04:00:00	28.9	28.4	28.1	90.8	89.6	88.5	1.5	999.7	206.3	6.6	1.3	0	0
16-08-2025	05:00:00	28.6	28.2	28	90.9	89.7	88.1	1.6	999.6	214.3	8.6	2.8	0	0
16-08-2025	06:00:00	28.6	28.3	28	89.4	88	87.3	1.6	1000	220.5	11.3	4.1	1.3	0
16-08-2025	07:00:00	28.5	27.9	27.6	94.4	92	88	2.1	1000.4	216.3	8.6	3.6	0	0
16-08-2025	08:00:00	28.7	28.1	27.6	94.4	92.9	91.6	18.3	1000.8	228.4	10.6	4.3	1.9	0
16-08-2025	09:00:00	29.5	28.8	28.3	92.3	90.1	87.6	49.8	1001.6	232.2	11.9	4.7	1.3	0
16-08-2025	10:00:00	30.5	29.7	29.1	88.5	85.9	83.9	85.8	1002.2	243.9	10.6	4.3	0.6	0
16-08-2025	11:00:00	30.9	30.3	29.8	85.3	83.3	81.3	104.5	1002.1	235.9	13.9	6.2	1.3	0
16-08-2025	12:00:00	31.7	30.8	30.1	85	81	76.1	153	1001.8	242.7	15.9	6.9	1.3	0
16-08-2025	13:00:00	31.5	30.6	29.2	92.4	82.3	77	123.7	1000.9	240	15.9	6.6	0.6	1.5
16-08-2025	14:00:00	30.4	29.9	29.3	92.9	89.3	86.2	93	1000.4	253.8	9.9	3.2	0	0
16-08-2025	15:00:00	34.2	32.4	30.1	87.1	74.2	63.3	218.4	1000.4	259.6	6.6	1.7	0	0
16-08-2025	16:00:00	34.1	33.1	32.4	72.2	69.4	64.6	165	999	143.5	14.6	1.7	0	0
16-08-2025	17:00:00	33.7	33	32.6	73.7	68.2	63.8	169.2	999	128	13.3	3	0	0
16-08-2025	18:00:00	32.7	31.6	31.2	79	76.4	72.1	83.6	998.4	204.5	14.6	3	0.6	0
16-08-2025	19:00:00	31.4	30	29	91.2	85.9	78.8	14.9	999	217.7	18.6	6	1.3	0
16-08-2025	20:00:00	29.4	28.8	28.4	92.9	91	89.6	1.9	999.7	216.1	19.9	6.4	1.3	0
16-08-2025	21:00:00	29.4	29	28.7	91.4	90.2	88.9	1.8	1000.3	224.7	23.2	8.2	1.9	0
16-08-2025	22:00:00	29.2	28.6	27.8	95.3	90.7	87.5	1.8	1000.7	223.5	12.6	5.2	1.3	0.5
16-08-2025	23:00:00	28.1	27.5	26.7	100.6	97.3	94.5	2.2	1000.8	228.3	11.9	5.7	0	2.5
17-08-2025	00:00:00	27.8	27.3	26.4	107.8	103.1	98.9	2.2	1000	231.6	11.9	4.3	0	1
17-08-2025	01:00:00	27.6	27.2	26.4	108	107.2	106.8	2.2	999.9	234.4	5.9	0	0	0
17-08-2025	02:00:00	27.8	27.2	26.3	108	107.3	106.8	2.2	999.6	243.7	0.6	0	0	0
17-08-2025	03:00:00	27.4	27	26.2	107.9	107.2	105.7	2.2	998.6	0	0	0	0	0
17-08-2025	04:00:00	27.4	27.1	26.2	107.9	107.2	106.8	2.2	998.5	0	0	0	0	0
17-08-2025	05:00:00	27.8	27.2	26.2	107.9	107.3	106.9	2.2	998.5	229.4	0.6	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
17-08-2025	06:00:00	28	27.6	26.7	108	107.2	106.4	2.2	999.3	0	0	0	0	0
17-08-2025	07:00:00	28.3	27.7	26.7	107.7	104.5	99.9	2.2	999.4	0	0	0	0	0
17-08-2025	08:00:00	28.2	27.8	26.8	108	107.2	106.6	3.5	999.6	0	0	0	0	0.5
17-08-2025	09:00:00	29	28.2	27	107.9	103	96.8	30.7	1000.3	226.1	5.3	0	0	0.5
17-08-2025	10:00:00	29.2	28.8	27.9	100.2	97.5	95.8	57.3	1000.9	48.2	11.9	4	0	0
17-08-2025	11:00:00	30.3	29.5	28.7	96.7	92.9	89.1	116.8	1001.2	26.1	11.9	3.1	0	0
17-08-2025	12:00:00	31.4	30.1	29.1	94.9	89	82.9	90.3	1001.2	25.4	11.9	3.3	0	0.5
17-08-2025	13:00:00	30.8	30.1	29.4	94.6	90.5	86.9	140.4	1000.7	62.6	11.9	2.1	0	0
17-08-2025	14:00:00	30.5	29.6	29.2	93.1	91.3	88.5	64.5	999.9	118.9	18.6	5.4	0	0
17-08-2025	15:00:00	32.3	31.4	29.6	91.7	83	79.1	243.6	999.2	129.3	18.6	4.3	0	0
17-08-2025	16:00:00	32.5	31.5	30.3	83.8	79.1	75.7	142.5	998.6	129.6	15.2	3.9	0	0
17-08-2025	17:00:00	30.8	30.2	29.2	89.4	86	83.6	78.7	998	125.7	29.2	6	0	0
17-08-2025	18:00:00	29.7	28.8	28.1	94.8	92.3	88.9	74	997.4	131.5	31.2	5.6	1.9	0
17-08-2025	19:00:00	29.5	29	28.7	94	92.2	89.7	15.1	998.4	161.1	19.2	3.5	0.6	0
17-08-2025	20:00:00	29.2	28.8	28.5	94.6	92.6	91.3	1.6	999.1	205.4	15.2	4.4	0.6	0
17-08-2025	21:00:00	29	28.7	28.5	94.6	93.2	92	1.7	999.9	160	17.2	3.5	0	0
17-08-2025	22:00:00	29	28.7	28.5	93.5	90.9	89	1.7	1000.1	179.9	17.9	3.3	1.3	0
17-08-2025	23:00:00	29.2	28.8	28.5	91.5	90.2	89.1	1.6	1000.8	176.9	21.2	2.7	0.6	0
18-08-2025	00:00:00	29.2	28.8	28.7	91.2	89.6	87.8	1.6	1001	196.6	17.2	3.5	1.3	0
18-08-2025	01:00:00	29.4	29	28.8	90.4	88.9	87.8	1.6	1001	197.8	15.9	3.8	0	0
18-08-2025	02:00:00	29.2	28.7	28.2	93.3	90.2	87.9	1.6	1000.5	211.4	17.2	4.9	0.6	0
18-08-2025	03:00:00	29	28.6	28.3	93.6	92.6	91.7	1.7	1000.2	199.6	7.9	2.5	0	0
18-08-2025	04:00:00	29	27.8	26.7	107.5	98	91.8	1.9	1000.1	206.1	15.9	2.6	0	0.5
18-08-2025	05:00:00	28.2	27.7	26.7	107.9	107.1	105.5	2	999.9	194.7	7.3	0.9	0	0
18-08-2025	06:00:00	28.3	27.8	27.1	107.8	103.5	99.3	2.1	1000.3	97.1	15.2	2.1	0	0
18-08-2025	07:00:00	28.5	27.7	26.7	107.9	104.3	99.5	9.5	1000.2	79.7	14.6	1.9	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
18-08-2025	08:00:00	28.6	27.9	26.7	107.9	101.9	98.6	39.5	1001.1	61.7	24.6	9	0	1
18-08-2025	09:00:00	29.5	28.5	27.1	107.9	99.4	94.4	150.6	1001.9	61.4	22.6	9.7	1.3	0
18-08-2025	10:00:00	31.4	30.4	29.2	95.1	88.5	83.5	197.8	1002.9	63.9	20.6	8.1	1.3	0
18-08-2025	11:00:00	32.9	31.1	29.8	89.9	83.9	75.9	237.1	1002.8	81.9	20.6	6.5	0	0
18-08-2025	12:00:00	34.1	32.9	31.9	80.4	75.1	68.6	288.4	1002.9	108.3	17.2	5.2	0.6	0
18-08-2025	13:00:00	34.1	32.9	32	77.2	73.5	69.5	253	1002.8	93.4	17.9	5.7	0.6	0
18-08-2025	14:00:00	34.5	32.8	31.1	82.8	73.1	65.7	231.3	1001.8	78.8	18.6	6.5	0.6	0
18-08-2025	15:00:00	32.4	31.8	30.9	83	78.9	74.9	188.9	1000	93.7	17.2	6.3	0	0
18-08-2025	16:00:00	32.8	32.3	31.4	79.5	76.5	74.1	189.4	999.7	97.5	18.6	6.1	0	0
18-08-2025	17:00:00	31.7	31.4	31.1	83.3	81.1	78.9	112.2	998.9	108.9	16.6	5.8	0	0
18-08-2025	18:00:00	31.4	31	30.5	84.1	82.9	81.8	63.2	998.6	110.4	17.2	6.6	1.3	0
18-08-2025	19:00:00	30.9	29.9	29	90.1	86.3	83	12.4	999	112.8	23.9	8.5	1.3	0
18-08-2025	20:00:00	29.4	28.9	28.6	94	91.5	89.5	1.4	999.6	83.9	26.6	7.5	1.3	0
18-08-2025	21:00:00	29	28.5	28.3	94.1	93.1	92.3	1.7	1000.2	76.5	35.2	10.9	1.9	0
18-08-2025	22:00:00	28.7	28.3	28	95.1	94	93.2	1.8	1000.8	62.8	31.2	12.7	3.3	0
18-08-2025	23:00:00	28.5	28.1	27.8	96	95	94.2	1.9	1001	58.5	31.2	13.6	4.6	0
19-08-2025	00:00:00	28.4	28	27.3	100.6	97.9	95.1	2	1000.8	55.1	29.9	11.4	1.9	0
19-08-2025	01:00:00	28.8	28.2	27.6	106.1	101	96.9	2.1	1000.4	71.4	23.2	8.3	1.3	0
19-08-2025	02:00:00	28.8	28	26.9	108	102.4	96.3	2.2	999.7	68.9	31.2	9.6	1.3	0
19-08-2025	03:00:00	28.1	27.6	26.7	108	105.1	99.4	2.2	998.7	63.3	33.2	11.4	1.3	0
19-08-2025	04:00:00	28.1	27.5	26.7	107.7	102.5	99.3	2.2	998.2	58.8	33.2	13.5	2.6	0
19-08-2025	05:00:00	27.7	27.3	26.5	108	107.1	105.5	2.2	998.1	58.2	31.9	12.4	3.9	0
19-08-2025	06:00:00	27.5	27.2	26.3	107.9	106.8	105.7	2.2	997.8	55.9	30.5	12.1	2.6	0
19-08-2025	07:00:00	27.3	27	26.3	107.6	106.7	105.9	3	998.5	53.6	28.5	10.6	2.6	0
19-08-2025	08:00:00	27.7	27.2	26.3	108	107	105.6	22	999.6	55.8	27.2	11.4	3.3	0
19-08-2025	09:00:00	28.7	27.8	26.5	107.8	101.8	95	64.9	999.9	59.3	30.5	11.8	3.9	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
19-08-2025	10:00:00	31.2	29.7	28.5	95.9	89.7	83.8	208.5	1000.5	59.1	30.5	11.8	3.3	0
19-08-2025	11:00:00	32.3	31.4	30.9	84.2	80.3	76.7	270.7	1001	57.2	22.6	9.8	3.3	0
19-08-2025	12:00:00	33.2	32.7	32.2	77.1	73	69.9	328.2	1000.4	58.7	23.9	10.8	3.3	0
19-08-2025	13:00:00	33.2	32.7	32.1	73.8	71.5	68.9	278.7	999.8	60.3	27.9	10.9	3.3	0
19-08-2025	14:00:00	34.7	33.8	32.8	71.5	66.6	62.2	381.6	999.9	56.7	25.2	10.1	1.9	0
19-08-2025	15:00:00	35.1	34.6	34.1	64.3	61.3	59.2	323.6	999.2	51.9	20.6	8.5	1.9	0
19-08-2025	16:00:00	35.1	34.6	33.3	71.3	61.2	57.4	235.7	997.9	63.6	20.6	8.1	1.3	0
19-08-2025	17:00:00	33.6	32.8	31.7	80.4	75.1	70.6	109.1	996.8	115.1	15.2	2.5	0	0
19-08-2025	18:00:00	32.8	31.5	30.1	83.9	79.2	73.3	40.9	996.6	69	46.5	9	0	0
19-08-2025	19:00:00	30.5	29.7	29	89.6	85.3	83	17.4	996.6	61.4	40.5	13.5	3.9	0
19-08-2025	20:00:00	29.4	28.9	28.6	92.7	90.7	88.4	1.6	997	56.3	32.5	12.2	2.6	0
19-08-2025	21:00:00	29	28.6	28.3	94.1	92.7	91.9	1.7	997.7	52.4	26.6	9.1	1.3	0
19-08-2025	22:00:00	28.8	28.3	28	93.9	92.9	92.2	1.7	998.4	49.2	23.9	7.7	1.3	0
19-08-2025	23:00:00	28.4	27.9	27.7	94.7	93.6	92.6	1.7	998.4	31.2	16.6	5.4	0	0
20-08-2025	00:00:00	28.1	27.7	27.4	96.7	94.9	93.6	1.7	998	47.1	13.3	4.4	0	0
20-08-2025	01:00:00	28	27.6	27.1	99.4	96.3	95.2	1.8	997.6	66.6	9.9	1.9	0	0
20-08-2025	02:00:00	28	27.7	27.2	99	96.2	95.7	1.8	997.1	343.3	10.6	1.2	0	0
20-08-2025	03:00:00	28	27.6	26.9	99.5	97.1	95.9	1.9	996.7	249.5	13.9	4.3	0	0
20-08-2025	04:00:00	28	27.5	26.8	100.9	98.8	96.4	2	996.3	257.4	12.6	3.2	0	0
20-08-2025	05:00:00	28.1	27.5	26.4	107.9	101.9	98.6	2	996.4	240.3	28.5	5.5	0	1
20-08-2025	06:00:00	27.4	27	26.4	107.8	106.8	105.7	2.2	996.7	237.6	24.6	8.5	0	3.5
20-08-2025	07:00:00	27.6	27.1	26.5	107.7	106.5	105.6	2.2	997.5	225.4	6.6	0.3	0	4.5
20-08-2025	08:00:00	27.5	27	26.5	107.3	106	105.3	4.4	998	0	0	0	0	5.5
20-08-2025	09:00:00	28	27.4	26.7	107.8	106.4	105.4	33.4	998.9	222.5	22.6	6.1	0	0
20-08-2025	10:00:00	27.8	26.8	26	107.8	106.7	105.7	19.1	999.3	228.8	21.2	0	0	0.5
20-08-2025	11:00:00	27.2	26.8	26.2	107.6	106.5	105.5	36	999.5	0	0	0	0	0.5

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
20-08-2025	12:00:00	27.3	26.8	26.2	107.8	106.6	105.5	38.3	999.6	224.9	29.9	5.3	0	0
20-08-2025	13:00:00	27.1	26.6	25.8	107.6	106.3	105.4	17.3	999.4	226.8	30.5	12.5	2.6	4
20-08-2025	14:00:00	26.7	26.1	25.4	107.6	106.2	105.3	37.4	999.1	229.5	28.5	11.7	0	6
20-08-2025	15:00:00	27.8	26.7	25.7	107.8	106.8	105.8	88.4	998.8	219.7	27.9	11.1	0	5
20-08-2025	16:00:00	28.6	27.8	26.8	107.9	104.7	96.5	75.4	998.5	217.1	25.2	9.8	0	0
20-08-2025	17:00:00	29.6	28.8	27.7	100.1	95.3	92.3	122.2	998.5	217.3	31.2	8.9	0	0
20-08-2025	18:00:00	29.2	28.7	28.4	95.5	94.5	93.4	32.2	998.7	218.3	25.9	9.3	1.9	0
20-08-2025	19:00:00	28.9	28.4	28	96.8	94.6	93.1	5.4	999.1	219.4	28.5	10.4	1.9	0
20-08-2025	20:00:00	28.6	28.3	28.1	95.4	93.9	92.8	1.9	999.9	220	31.2	11.2	2.6	0
20-08-2025	21:00:00	28.6	28.2	27.8	95.8	93.7	91.4	1.8	1000.6	225.7	33.9	13	3.3	0
20-08-2025	22:00:00	28.5	28.1	27.8	95.9	94.6	93.5	1.9	1001.3	212.9	30.5	10.9	3.3	0
20-08-2025	23:00:00	28.5	28.2	28	94.4	93.6	92.8	1.8	1002.2	155.2	29.2	11	3.9	0
21-08-2025	00:00:00	28.6	28.2	28	94	93.2	92.6	1.7	1002.3	142.1	28.5	12	3.9	0
21-08-2025	01:00:00	28.6	28.3	28.1	93.8	92.8	92.4	1.7	1002.1	119.3	30.5	12.3	3.9	0
21-08-2025	02:00:00	28.7	28.3	28.1	93.1	91.6	90.7	1.7	1001.6	100.4	38.5	14	4.6	0
21-08-2025	03:00:00	28.6	28.3	28.1	93.3	92.2	91.4	1.7	1001.5	87.7	27.2	12.7	3.3	0
21-08-2025	04:00:00	28.5	28.1	27.8	94.9	93.2	91.4	1.7	1001.9	88.7	29.2	12.4	1.9	0
21-08-2025	05:00:00	28.3	27.9	27.7	95.8	94.5	93.5	1.8	1001.3	89.5	29.2	12.1	3.3	0
21-08-2025	06:00:00	28.3	27.9	27.7	96	95.1	94.4	1.9	1001.5	82.9	26.6	11	3.3	0
21-08-2025	07:00:00	28.8	28.1	27.8	95.4	94.1	92.2	7.1	1001.9	106.4	29.2	7.7	3.3	0
21-08-2025	08:00:00	29.9	28.8	28.3	92.8	90.7	87.5	79.7	1003.2	90.9	32.5	13.4	2.6	0
21-08-2025	09:00:00	30	29.5	29.3	88.5	86.9	85.6	126.5	1004.3	93.4	33.9	13.4	3.3	0
21-08-2025	10:00:00	30	29.6	29.3	88.3	86.6	85.5	112.1	1004.9	90.8	31.9	13.4	4.6	0
21-08-2025	11:00:00	31	30.3	29.5	86.9	83.4	80.3	202.9	1005.1	121.3	33.9	9.1	4.6	0
21-08-2025	12:00:00	31.8	31.2	30.6	84.2	80.6	76.1	259.6	1005.1	132.3	27.9	9.5	2.6	0
21-08-2025	13:00:00	31.7	31.1	30.7	84.1	82.2	80.1	250.8	1004.6	117.6	33.9	9.2	2.6	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
21-08-2025	14:00:00	31	29.3	26.5	100.6	88.1	82.2	115.1	1004.1	123.9	41.8	12.3	3.9	0.5
21-08-2025	15:00:00	29.2	28.2	26.9	100.7	96	91.8	108.8	1003.2	108.5	27.9	8	1.3	0
21-08-2025	16:00:00	30	29.2	28.6	95.2	92.7	90.8	92.1	1002.7	175.4	33.2	12.9	2.6	0
21-08-2025	17:00:00	30.1	29.5	29.1	92.8	90.8	88.7	65.7	1002.6	186.3	31.2	12.2	2.6	0
21-08-2025	18:00:00	29.9	28.2	26.8	107.8	99.4	89.2	36.7	1002.5	197.2	42.5	4.6	0	2
21-08-2025	19:00:00	28.7	28.1	27.2	107.7	98.4	95.1	5.6	1003.6	0	0	0	0	0
21-08-2025	20:00:00	28.8	28.4	27.8	99.7	96.4	95	2.1	1004.7	0	0	0	0	0
21-08-2025	21:00:00	28.9	28.6	28.3	96.7	95.8	95.1	2	1005.7	0	0	0	0	0
21-08-2025	22:00:00	28.9	28.5	28.3	96.4	94.9	94	1.9	1005.8	0	0	0	0	0
21-08-2025	23:00:00	28.7	28.3	28.1	95.1	93.8	93.2	1.8	1005.9	0	0	0	0	0
22-08-2025	00:00:00	28.7	28.2	27.9	95.2	94.1	93.2	1.8	1005.8	0	0	0	0	0
22-08-2025	01:00:00	28.4	28.1	27.8	94.6	93.6	92.7	1.8	1005.6	0	0	0	0	0
22-08-2025	02:00:00	28.4	28	27.8	95.3	94.1	93	1.8	1004.5	0	0	0	0	0
22-08-2025	03:00:00	28.4	28.1	27.9	95.4	93.6	91.9	1.7	1004.3	0	0	0	0	0
22-08-2025	04:00:00	28.3	27.9	27.7	94.6	93.5	92.8	1.7	1003.7	0	0	0	0	0
22-08-2025	05:00:00	28.1	27.8	27.6	94.9	93.7	93	1.7	1003.8	0	0	0	0	0
22-08-2025	06:00:00	28.2	27.8	27.6	94.2	93.1	92.2	1.7	1004.1	0	0	0	0	0
22-08-2025	07:00:00	28.3	27.9	27.7	93.7	92.5	91.6	2.7	1004.6	0	0	0	0	0
22-08-2025	08:00:00	28.7	28.2	27.8	92.6	91.4	90.1	42.8	1005.3	0	0	0	0	0
22-08-2025	09:00:00	29.1	28.6	28.3	91.8	89.6	88.4	86	1006.1	0	0	0	0	0
22-08-2025	10:00:00	30.1	29.2	28.7	90.2	87.7	84.5	125	1006.7	0	0	0	0	0
22-08-2025	11:00:00	31.1	30.3	29.6	85.9	81.7	78.1	209.6	1006.6	0	0	0	0	0
22-08-2025	12:00:00	32.4	31.1	29.9	85	78.8	73.3	280	1006.3	0	0	0	0	0
22-08-2025	13:00:00	32.3	32	31.5	81.6	75.8	72.7	377.1	1005.8	0	0	0	0	0
22-08-2025	14:00:00	32.1	31.4	30.4	82.2	78.8	75.8	386.2	1004.7	0	0	0	0	0
22-08-2025	15:00:00	31.5	30.9	30.4	82.2	79.7	76.7	366.1	1003.8	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
22-08-2025	16:00:00	31.5	29.4	28.3	93.7	86.2	77.4	74.3	1002.9	0	0	0	0	0
22-08-2025	17:00:00	28.9	28	27	102.5	95.9	88.6	53.9	1002.5	0	0	0	0	0.5
22-08-2025	18:00:00	28.4	27.5	26.5	107.6	100.8	96.4	14.8	1002.8	196.5	0.6	0	0	0.5
22-08-2025	19:00:00	28.4	28	27.6	97	95.2	93.1	1.9	1003.6	0	0	0	0	0
22-08-2025	20:00:00	28.7	28.3	27.9	95.1	92.2	89.4	1.7	1004	0	0	0	0	0
22-08-2025	21:00:00	28.7	28.4	28.1	92.3	90.6	89.1	1.5	1004.5	0	0	0	0	0
22-08-2025	22:00:00	28.5	28	27.8	92.8	91.1	90.2	1.6	1005.3	0	0	0	0	0
22-08-2025	23:00:00	28.3	28	27.8	92.6	91.7	91	1.6	1005.6	0	0	0	0	0
23-08-2025	00:00:00	28.3	27.9	27.6	93.3	92	91	1.6	1004.9	0	0	0	0	0
23-08-2025	01:00:00	28.1	27.7	27.5	92.1	90.3	89.4	1.5	1004.1	0	0	0	0	0
23-08-2025	02:00:00	27.9	27.6	27.4	92.6	91.2	90.3	1.6	1004	0	0	0	0	0
23-08-2025	03:00:00	27.9	27.6	27.4	94	92.6	91.7	1.7	1003.6	0	0	0	0	0
23-08-2025	04:00:00	27.9	27.6	27.4	93.8	92.3	91.7	1.6	1003.1	0	0	0	0	0
23-08-2025	05:00:00	27.9	27.6	27.4	93	91.7	90.7	1.6	1002.7	0	0	0	0	0
23-08-2025	06:00:00	27.9	27.5	27.4	94	92.6	91.4	1.7	1002.3	0	0	0	0	0
23-08-2025	07:00:00	27.8	27.5	27.3	94.2	93.2	92.2	2.8	1002.6	0	0	0	0	0
23-08-2025	08:00:00	28.3	27.8	27.4	93.5	92	90.7	30.5	1003.6	0	0	0	0	0
23-08-2025	09:00:00	28.9	28.2	27.8	92.4	90.9	88	71.5	1004.3	0	0	0	0	0
23-08-2025	10:00:00	29.9	29	28.5	89.2	87.1	84.8	123.6	1005	0	0	0	0	0
23-08-2025	11:00:00	30	28.8	26.7	100.7	89.4	84.1	89.1	1004.7	227.5	0.6	0	0	0.5
23-08-2025	12:00:00	28	27.1	26	107.9	102.2	96.5	67.1	1004.7	0	0	0	0	0.5
23-08-2025	13:00:00	28.9	28.1	26.5	107.9	97.7	90.7	124.5	1004.7	224.6	0.6	0	0	1
23-08-2025	14:00:00	28.6	27.5	26.2	101.6	97.6	91.9	142.2	1004.2	0	0	0	0	1.5
23-08-2025	15:00:00	29	28	27	100.2	94.7	90.1	88.5	1003.4	226.2	0.6	0	0	1
23-08-2025	16:00:00	28.9	28.2	27.6	96.4	93.2	90.4	98.5	1002.5	0	0	0	0	0
23-08-2025	17:00:00	29	27.9	26.8	101.6	96.5	89.9	54.2	1002.3	0	0	0	0	0.5

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
23-08-2025	18:00:00	28.7	28	27.1	100	93.7	91	24.7	1002	0	0	0	0	0.5
23-08-2025	19:00:00	28.5	28	27.4	100	93.4	89.8	7.4	1002.7	0	0	0	0	0
23-08-2025	20:00:00	28.6	27.3	25.6	107.8	96.3	87.5	1.6	1003.5	203.5	0.6	0	0	5
23-08-2025	21:00:00	27.6	26.8	26	107.9	104.6	95.7	2	1004.3	0	0	0	0	0
23-08-2025	22:00:00	28.1	27.5	26.9	96.4	93	89.9	1.6	1004.4	0	0	0	0	0
23-08-2025	23:00:00	28.3	27.9	27.6	92.1	89.7	87.8	1.2	1004.8	0	0	0	0	0
24-08-2025	00:00:00	28.3	27.9	27.7	90.8	88.9	87.7	1.1	1004.5	0	0	0	0	0
24-08-2025	01:00:00	28.3	27.9	27.7	90.9	88.9	87.6	1.1	1004.1	0	0	0	0	0
24-08-2025	02:00:00	28.2	27.9	27.7	90.8	89.2	87.6	1.1	1003.5	0	0	0	0	0
24-08-2025	03:00:00	28.1	27.7	27.5	91.5	89.9	89.1	1.2	1002.9	0	0	0	0	0
24-08-2025	04:00:00	28	27.6	27.4	92.6	91.1	90.1	1.3	1002.9	0	0	0	0	0
24-08-2025	05:00:00	28.1	27.7	27.5	92.7	91.6	90.6	1.3	1002.8	0	0	0	0	0
24-08-2025	06:00:00	28.1	27.8	27.6	92.2	90.8	89.8	1.3	1003.1	0	0	0	0	0
24-08-2025	07:00:00	28.2	27.4	26.9	96.7	94.1	90.3	1.8	1003.2	0	0	0	0	0
24-08-2025	08:00:00	28.6	27.7	27.4	95.5	93.7	91.8	46.5	1003.6	0	0	0	0	0
24-08-2025	09:00:00	29.2	28.3	28	92.4	91	88.6	97.7	1004.2	0	0	0	0	0
24-08-2025	10:00:00	29.1	28.4	28.1	92.7	90.7	88.4	79.5	1004.9	0	0	0	0	0
24-08-2025	11:00:00	30	29.1	28.3	91.4	87.2	83	164.2	1005.1	0	0	0	0	0
24-08-2025	12:00:00	29.8	28.9	28.1	93	88.7	84.3	121.5	1005	0	0	0	0	0
24-08-2025	13:00:00	30.2	29.3	28.6	91.1	86.9	82.9	176.1	1004.7	0	0	0	0	0
24-08-2025	14:00:00	30.3	29.6	28.9	89.4	85.9	83	153.5	1004.3	0	0	0	0	0
24-08-2025	15:00:00	29.9	28.7	26.7	100.5	89.5	83	115.5	1003.8	193.2	0.6	0	0	2
24-08-2025	16:00:00	28.9	28.2	27.3	98.9	94.8	92.6	90.2	1003.4	0	0	0	0	0
24-08-2025	17:00:00	29.3	28.8	28.3	93.4	90.7	88.4	73.2	1003.1	0	0	0	0	0
24-08-2025	18:00:00	28.7	27.3	25.8	107.8	99.4	90.9	14.1	1003.2	236.3	0.6	0	0	5
24-08-2025	19:00:00	27.3	26.9	25.9	108	107.2	105.8	4.4	1003.7	0	0	0	0	0.5

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
24-08-2025	20:00:00	27.6	26.9	26.2	107.9	106.1	99.3	2	1003.9	0	0	0	0	0
24-08-2025	21:00:00	27.8	27.4	26.6	101.1	96.2	94.6	1.8	1004.4	0	0	0	0	0
24-08-2025	22:00:00	27.8	27.5	27.2	95.9	94.7	93.7	1.5	1005	0	0	0	0	0
24-08-2025	23:00:00	27.6	27	25.9	107.8	98.4	94.9	1.7	1005.5	0	0	0	0	0.5
25-08-2025	00:00:00	27.1	26.6	25.8	107.8	106.7	105.5	2	1005.3	0	0	0	0	1.5
25-08-2025	01:00:00	27.3	26.9	26.1	107.9	107.2	105.5	2	1004.8	0	0	0	0	0
25-08-2025	02:00:00	27.6	27.1	26.3	107.7	99.1	96.2	1.8	1004.3	0	0	0	0	0
25-08-2025	03:00:00	27.5	27.1	26.6	99.9	97.7	96.4	1.7	1003.7	0	0	0	0	0
25-08-2025	04:00:00	27.5	27.1	26.5	99.9	97.9	96.4	1.7	1003.1	0	0	0	0	0
25-08-2025	05:00:00	27.5	27.1	26.5	99.8	97.9	96.4	1.6	1003.2	0	0	0	0	0
25-08-2025	06:00:00	27.6	27.1	26.6	99.9	97.6	96.3	1.6	1003.4	0	0	0	0	0
25-08-2025	07:00:00	27.6	27.2	26.9	97.1	95.8	95.2	1.5	1003.6	0	0	0	0	0
25-08-2025	08:00:00	27.9	27.4	27	96.2	94.7	92.9	12.9	1004	0	0	0	0	0
25-08-2025	09:00:00	28.3	27.7	27.5	93.6	92.5	91.6	31.1	1004.6	0	0	0	0	0
25-08-2025	10:00:00	28.8	28.5	28.1	92.4	89.4	88.2	83.3	1004.7	0	0	0	0	0
25-08-2025	11:00:00	30.5	29.6	28.5	89	84.4	80.7	221.5	1005.4	0	0	0	0	0
25-08-2025	12:00:00	30.4	29	28	93	88.5	83.2	124.5	1004.9	197.9	0.6	0	0	0
25-08-2025	13:00:00	30.6	29.4	28.3	93.6	88.2	81.8	77.2	1004.5	180.3	1.3	0	0	0
25-08-2025	14:00:00	29.3	28.5	27.8	98.4	94.3	91.4	88.2	1003.8	0	0	0	0	1.5
25-08-2025	15:00:00	31.3	29.4	28	97.3	92.9	85.3	144	1003.3	353.9	0.6	0	0	0
25-08-2025	16:00:00	30.8	28.9	27.2	100	92.8	85.7	60.5	1001.7	0	0	0	0	0
25-08-2025	17:00:00	29.4	28.8	27.8	96.9	92.8	90.5	62	1001.3	0	0	0	0	0
25-08-2025	18:00:00	29.5	29.1	28.7	92	89.8	87.6	25.1	1001	0	0	0	0	0
25-08-2025	19:00:00	29.4	28.6	27.8	93.5	90.3	86.6	1.1	1001.5	0	0	0	0	0
25-08-2025	20:00:00	29	28.6	28	94.8	90.8	87.7	1.2	1002.5	0	0	0	0	0
25-08-2025	21:00:00	29.1	28.7	28.5	93.1	90.4	88.5	1.2	1003.6	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
25-08-2025	22:00:00	29	28.6	28.2	92.8	89.7	88.2	1.1	1004.1	0	0	0	0	0
25-08-2025	23:00:00	28.6	28.1	27.8	94.9	92.8	91.7	1.4	1004.4	0	0	0	0	0
26-08-2025	00:00:00	28.3	27.9	27.7	94.9	93.6	92.8	1.4	1004.5	0	0	0	0	0
26-08-2025	01:00:00	28.3	27.9	27.7	93.4	92.2	91.7	1.3	1004	0	0	0	0	0
26-08-2025	02:00:00	28.2	27.7	27.4	94.7	93	92.2	1.3	1003.4	0	0	0	0	0
26-08-2025	03:00:00	27.8	27.4	27.1	96.1	95.1	94.1	1.4	1002.5	0	0	0	0	0
26-08-2025	04:00:00	27.8	27.4	27.2	96	95.2	94.6	1.5	1002.6	0	0	0	0	0
26-08-2025	05:00:00	27.9	27.6	27.4	95.5	94.3	93.7	1.4	1003.4	0	0	0	0	0
26-08-2025	06:00:00	27.8	27.4	26.9	97.2	95.4	94.3	1.5	1003.9	0	0	0	0	0
26-08-2025	07:00:00	27.7	27.3	26.8	99.6	96.1	95.6	1.7	1004	0	0	0	0	0
26-08-2025	08:00:00	28.5	27.7	27.2	96.5	94.7	93.4	33.1	1004.6	0	0	0	0	0
26-08-2025	09:00:00	29.9	29.1	28.1	94	89.4	86.7	158.2	1005.9	0	0	0	0	0
26-08-2025	10:00:00	30.6	30.1	29.6	88	84.3	81.3	239.5	1006.8	0	0	0	0	0
26-08-2025	11:00:00	31.4	30.6	29.9	84.6	81.3	78	267	1006.9	0	0	0	0	0
26-08-2025	12:00:00	32.6	32	31.3	80.9	75.7	72.6	297.1	1007.1	0	0	0	0	0
26-08-2025	13:00:00	33.5	32.3	30.8	82.3	74.6	69	263.2	1006.5	0	0	0	0	0
26-08-2025	14:00:00	32.3	31.2	29.9	87.8	80.9	75	182.1	1005.4	0	0	0	0	0
26-08-2025	15:00:00	34.1	32.7	31.5	82.5	75.7	67.8	278.9	1005.1	0	0	0	0	0
26-08-2025	16:00:00	34.2	32.4	29.8	91.7	75.2	65.5	157.3	1004.2	0	0	0	0	0
26-08-2025	17:00:00	30.6	30.1	29.8	91.8	89.7	87.8	54.4	1003	0	0	0	0	0
26-08-2025	18:00:00	30.9	30.3	30	90.9	88.7	87.2	74.2	1003.1	0	0	0	0	0
26-08-2025	19:00:00	30.4	29.6	29.2	94.9	92.3	88.9	12.6	1003.4	0	0	0	0	0
26-08-2025	20:00:00	29.9	29.5	29.2	95.8	94.6	91.8	1.6	1004.3	0	0	0	0	0
26-08-2025	21:00:00	30	29.5	29.1	92.4	90.6	86.8	1.5	1004.8	0	0	0	0	0
26-08-2025	22:00:00	29.6	29.1	28.9	90.8	88.5	86.8	1.1	1005	0	0	0	0	0
26-08-2025	23:00:00	29.3	28.8	28.5	92.2	90.1	88.7	1.1	1005.2	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
27-08-2025	00:00:00	28.9	28.5	28.3	93	91.9	91.2	1.3	1005.5	0	0	0	0	0
27-08-2025	01:00:00	28.7	28.2	27.8	94	92.5	91.9	1.3	1004.8	0	0	0	0	0
27-08-2025	02:00:00	28.2	27.9	27.6	94.2	93	92.2	1.4	1004.1	0	0	0	0	0
27-08-2025	03:00:00	28.1	27.7	27.5	94.2	93.2	92.7	1.3	1003.5	0	0	0	0	0
27-08-2025	04:00:00	27.9	27.5	27.1	95.2	94.2	93.6	1.4	1003	0	0	0	0	0
27-08-2025	05:00:00	27.7	27.2	26.7	96.6	95	94.1	1.4	1002.8	0	0	0	0	0
27-08-2025	06:00:00	27.6	27.1	26.7	99.2	96.5	95.8	1.5	1003.3	0	0	0	0	0
27-08-2025	07:00:00	27.6	27.1	26.5	99.8	97.6	96.3	1.5	1004	204.1	0.6	0	0	0
27-08-2025	08:00:00	28	27.5	26.8	100	96.9	95.1	7.3	1004.9	204.2	0.6	0	0	0
27-08-2025	09:00:00	29	28.2	27.4	96.4	93.6	90	69.8	1005.3	0	0	0	0	0
27-08-2025	10:00:00	29.6	29.2	28.7	90.8	88.2	86	123	1005.8	0	0	0	0	0
27-08-2025	11:00:00	30.7	29.7	28.6	90.8	86.6	81.6	195.6	1005.7	0	0	0	0	0
27-08-2025	12:00:00	32.4	31.1	30.2	85.1	78.9	71.2	288.4	1005.8	0	0	0	0	0
27-08-2025	13:00:00	33.6	32.4	31.3	76.9	71.5	64.6	340.6	1005.6	0	0	0	0	0
27-08-2025	14:00:00	34.3	33.8	33.3	68.3	61.4	58.1	385.9	1005.1	0	0	0	0	0
27-08-2025	15:00:00	35	34.4	33.8	63	58.4	53.7	298.1	1004.6	204.2	0.6	0	0	0
27-08-2025	16:00:00	35	34.3	33.4	68.3	63.1	59.1	272.7	1003.7	0	0	0	0	0
27-08-2025	17:00:00	34	32.1	30.6	82.5	73.9	65.2	123.6	1002.1	0	0	0	0	0
27-08-2025	18:00:00	30.8	30.3	29.8	87.5	84.3	82.3	49.9	1001.7	0	0	0	0	0
27-08-2025	19:00:00	30.1	29.7	29.4	90.5	88.5	86.7	10.9	1002.3	0	0	0	0	0
27-08-2025	20:00:00	29.8	29.4	29.2	92.9	91.3	89.8	1.4	1003.2	0	0	0	0	0
27-08-2025	21:00:00	29.7	29.3	29.2	94	92.7	91.7	1.6	1003.3	0	0	0	0	0
27-08-2025	22:00:00	29.9	29.5	29.2	95.2	93.5	92.3	1.6	1004.6	193.7	0.6	0	0	0
27-08-2025	23:00:00	29.7	29.3	28.9	96.9	95.5	94.4	1.7	1004.7	173.7	10.6	0.8	0	0
28-08-2025	00:00:00	29.4	29	28.7	97	95.5	94.6	1.8	1004.4	199.4	15.2	4.7	0	0
28-08-2025	01:00:00	29.5	29.1	28.4	99.9	96.9	95.2	1.9	1004.2	201.8	16.6	6.7	1.9	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
28-08-2025	02:00:00	29.2	28.8	28.6	97.2	93.6	91.4	1.7	1003.1	220.1	25.2	10.2	2.6	0
28-08-2025	03:00:00	29	28.3	27.1	107.6	95.9	91.4	1.7	1002.1	229	28.5	7.6	0	1.5
28-08-2025	04:00:00	28.1	27.8	26.9	107.9	107	106.1	2	1002	0	0	0	0	0
28-08-2025	05:00:00	28	27.6	26.7	107.9	106.8	104.8	2.1	1002.6	267.1	1.3	0	0	0
28-08-2025	06:00:00	28	27.6	26.7	107.7	106.5	101.5	2.1	1003.2	0	0	0	0	0
28-08-2025	07:00:00	28.1	27.4	26.5	107.9	105.7	100.6	2	1003.6	258.2	0.6	0	0	0.5
28-08-2025	08:00:00	27.8	27.3	26.5	107.9	106.9	101.1	14	1004	0	0	0	0	0
28-08-2025	09:00:00	28.8	28	26.9	102.9	98.6	94.7	58.3	1004.7	246.5	1.9	0	0	0
28-08-2025	10:00:00	28.7	28.2	27.5	99.8	96.1	95	23.4	1004.6	0	0	0	0	0
28-08-2025	11:00:00	29	27.9	26.8	107.8	102.5	96.8	62.5	1004.8	241.1	0.6	0	0	0.5
28-08-2025	12:00:00	29.6	29	28.6	98.9	94.4	92.8	134.9	1004.7	0	0	0	0	0
28-08-2025	13:00:00	30.6	29.8	28.8	94.7	90.1	86.8	198.2	1004.3	0	0	0	0	0
28-08-2025	14:00:00	30.8	30.2	29.5	90.4	87.3	84.8	150	1003.2	0	0	0	0	0
28-08-2025	15:00:00	29.7	28.7	27.8	101.6	96.8	90.2	58	1001.6	209	1.3	0	0	3.5
28-08-2025	16:00:00	29.2	28.7	28	102.3	100	97.1	28.8	1000.9	203.8	0.6	0	0	0
28-08-2025	17:00:00	29.4	28.8	28.1	102.7	100.7	99.4	26.5	1000.9	203.9	3.3	0	0	0
28-08-2025	18:00:00	29.8	29.2	28.5	101.2	99.1	96.9	25.1	1001.3	200	1.3	0	0	0
28-08-2025	19:00:00	29.3	28.8	28.1	100.3	98.8	96.7	2.8	1001.5	149.8	0.6	0	0	0
28-08-2025	20:00:00	29.2	28.7	28	100.2	98.2	96.7	1.8	1002.5	156.6	1.3	0	0	0
28-08-2025	21:00:00	29.2	28.7	28	101.6	100.2	97.4	1.8	1003.6	164.9	0.6	0	0	0
28-08-2025	22:00:00	29.3	28.8	28.2	102.7	100.1	97.9	1.8	1004.1	154.4	6.6	0	0	0
28-08-2025	23:00:00	29.2	28.7	28.1	102.6	100.4	97	1.8	1004	198.7	2.6	0	0	0
29-08-2025	00:00:00	29.2	28	26.2	100	96	92.2	1.7	1003.1	187.5	6.6	0	0	0
29-08-2025	01:00:00	27	26	24.9	107.8	103.9	97.1	1.6	1001.4	187.7	5.9	0.2	0	0
29-08-2025	02:00:00	26.4	26	25.3	107.8	106.8	105.5	1.6	1000.6	193	1.3	0	0	0
29-08-2025	03:00:00	27.3	26.5	25.5	107.8	103.3	98.8	1.7	1000.5	193.7	6.6	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
29-08-2025	04:00:00	27.5	26.9	26.1	100.7	99.1	96.5	1.7	1000.4	194	1.9	0	0	0
29-08-2025	05:00:00	28	27.3	26.6	102.1	100	98.5	1.7	1001.1	194.1	3.9	0	0	0
29-08-2025	06:00:00	28.1	27.6	26.9	102.3	100.2	99.3	1.7	1001.7	194.1	2.6	0	0	0
29-08-2025	07:00:00	28.1	27.7	26.8	108	106.2	100.2	1.7	1002.2	193.4	1.9	0	0	0
29-08-2025	08:00:00	28.3	27.9	27.1	108	106.9	105.7	8.6	1002.8	193.5	2.6	0	0	0
29-08-2025	09:00:00	29	28.2	27.4	108	106.7	100.7	39.7	1004	238.5	1.9	0	0	0.5
29-08-2025	10:00:00	29.4	28.7	27.9	102.7	99.5	95.6	72.6	1004.9	0	0	0	0	0
29-08-2025	11:00:00	30.4	29.5	29	96.2	91.3	88.2	131.6	1004.5	0	0	0	0	0
29-08-2025	12:00:00	31.3	30.5	29.4	90.1	83.8	79	241.4	1004.6	0	0	0	0	0
29-08-2025	13:00:00	32	31.1	30.4	83	77	71.2	229.4	1004.2	0	0	0	0	0
29-08-2025	14:00:00	31.7	30.8	30.1	83	79.1	74.2	98.9	1003.3	217.3	1.3	0	0	0
29-08-2025	15:00:00	30.2	29.4	28.7	95.4	90.9	82.5	23.9	1001.9	174.1	3.3	0	0	0
29-08-2025	16:00:00	29	28.6	27.5	107.8	99.2	94.9	19.2	1000.7	127.9	2.6	0	0	0.5
29-08-2025	17:00:00	29.2	28.5	27.6	108	106.2	99.7	51.7	1001.1	193	2.6	0	0	0
29-08-2025	18:00:00	29.4	28.9	28.3	102.7	98.6	96	54.4	1001.8	192	4.6	0	0	0
29-08-2025	19:00:00	29.1	28.5	27.8	100.1	98.2	96.4	14.1	1002.4	184.5	1.3	0	0	0
29-08-2025	20:00:00	28.7	28.2	27.8	100.1	97.2	95.8	1.5	1003	169.3	3.9	0	0	0
29-08-2025	21:00:00	28.7	28.3	28	99.8	96.5	95.3	1.5	1003.3	176.9	0.6	0	0	0
29-08-2025	22:00:00	28.8	28.4	28.1	99.3	95.9	94.6	1.5	1003.9	0	0	0	0	0
29-08-2025	23:00:00	29	28.7	28.4	99.3	96.4	95.7	1.5	1004.4	0	0	0	0	0
30-08-2025	00:00:00	29	28.7	28.5	97	96.2	95.9	1.6	1004.7	0	0	0	0	0
30-08-2025	01:00:00	29.1	28.7	28.2	99.9	97.1	96.2	1.5	1004.5	0	0	0	0	0
30-08-2025	02:00:00	29	28.6	27.8	100.8	99.1	96.8	1.7	1004.3	0	0	0	0	0
30-08-2025	03:00:00	28.7	28	27.2	102.5	99.2	96.5	1.7	1003.6	0	0	0	0	0
30-08-2025	04:00:00	28.3	27.9	27.5	99.9	96.5	95.6	1.6	1002.5	0	0	0	0	0
30-08-2025	05:00:00	28.3	27.7	26.7	106.8	99.8	96.3	1.7	1002.9	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
30-08-2025	06:00:00	27.9	27.4	26.5	107.7	104.2	99.5	1.8	1003.3	0	0	0	0	0
30-08-2025	07:00:00	28.1	27.7	27	101.6	97.8	95.2	1.7	1004.3	0	0	0	0	0
30-08-2025	08:00:00	28.3	27.9	27.6	95.9	94.5	93.8	4.1	1004.8	0	0	0	0	0
30-08-2025	09:00:00	28.8	28.1	27.8	96.7	95.2	93.8	29.9	1005.3	0	0	0	0	0
30-08-2025	10:00:00	29.5	28.9	28.5	94.5	92.1	89.9	67	1005.7	0	0	0	0	0
30-08-2025	11:00:00	29.9	29.3	29	92.2	90.6	88.4	88.4	1006.2	0	0	0	0	0
30-08-2025	12:00:00	30.5	30.1	29.6	89.4	87.7	85.9	140.2	1006.4	0	0	0	0	0.5
30-08-2025	13:00:00	30.8	30.3	29.9	91.2	89.1	86.6	137.4	1006.2	203.9	7.9	0.1	0	0
30-08-2025	14:00:00	30.5	30.1	29.8	90.6	89	88	97.7	1005.5	186.5	6.6	0.3	0	0
30-08-2025	15:00:00	30.1	29.6	29.1	92.7	90.6	88.5	74.4	1004.4	184.7	1.9	0	0	0
30-08-2025	16:00:00	29.4	28.6	28	99.6	95.3	91.5	76.3	1003.8	0	0	0	0	0
30-08-2025	17:00:00	29	28.5	28	97.1	95.2	94.2	44.7	1004	192.1	6.6	0	0	0
30-08-2025	18:00:00	29.3	28.6	27.9	101.6	99.7	96.5	18.8	1004.1	190	6.6	0.3	0	0
30-08-2025	19:00:00	29.1	28.5	27.9	102.6	100.7	98.9	2.1	1004.9	184.8	2.6	0	0	0
30-08-2025	20:00:00	28.8	28.2	27.4	107.7	103.6	99.7	1.6	1005.2	173.2	5.3	0	0	0
30-08-2025	21:00:00	28.8	28.2	27.6	102.5	100.7	99.5	1.6	1005.5	0	0	0	0	0
30-08-2025	22:00:00	28.9	28.4	27.8	101.6	98.4	96.4	1.6	1005.7	0	0	0	0	0
30-08-2025	23:00:00	28.8	28.4	28.1	97.5	96.1	95.1	1.5	1005.9	0	0	0	0	0
31-08-2025	00:00:00	29	28.5	27.9	100.8	98.6	96.1	1.6	1005.9	0	0	0	0	0
31-08-2025	01:00:00	29	28.6	28	100	97.7	96	1.6	1006	0	0	0	0	0
31-08-2025	02:00:00	28.8	28.4	28.1	96.7	95.8	94.6	1.4	1005.2	0	0	0	0	0
31-08-2025	03:00:00	28.6	28.2	28	96.1	95.2	94.4	1.4	1004.7	0	0	0	0	0
31-08-2025	04:00:00	28.5	28.1	27.8	96.4	95.3	94.6	1.4	1004.6	0	0	0	0	0
31-08-2025	05:00:00	28.3	28	27.6	99	96.5	95.7	1.4	1004.4	0	0	0	0	0
31-08-2025	06:00:00	28.3	27.9	27.6	99.2	96.6	96	1.5	1004.5	0	0	0	0	0
31-08-2025	07:00:00	28.2	27.8	27.4	99.2	96.5	96	1.4	1005.1	196.6	5.9	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
31-08-2025	08:00:00	28.4	28	27.6	99.5	96.7	96.2	11.4	1005.8	0	0	0	0	0
31-08-2025	09:00:00	29.4	28.6	27.8	97.1	93.4	90.2	79.7	1006.8	219.7	1.3	0	0	0
31-08-2025	10:00:00	31.3	30.3	29	91.4	84.6	79.2	266	1007.8	0	0	0	0	0
31-08-2025	11:00:00	31.6	31.1	30.5	81.5	78.8	76.1	248.4	1007.8	0	0	0	0	0
31-08-2025	12:00:00	31.3	30.8	30.4	82.6	79.6	77.1	191.5	1007.3	199	5.9	0	0	0
31-08-2025	13:00:00	32.5	31.4	30.9	79.7	77.6	73.4	225.7	1007	184.2	3.9	0	0	0
31-08-2025	14:00:00	33.5	32.6	31.9	76.9	73.1	69.8	304.6	1006.6	184.6	7.9	0	0	0
31-08-2025	15:00:00	33.7	32.3	31.5	78.8	74.8	68.4	189	1005.6	165.6	4.6	0	0	0
31-08-2025	16:00:00	31.9	31	29.9	85.3	79.4	75.5	153.8	1004.3	0	0	0	0	0
31-08-2025	17:00:00	30.3	29.5	28.8	90.1	87.9	84	59.3	1003.1	0	0	0	0	0
31-08-2025	18:00:00	29.1	28.4	27.2	100.6	93.9	89	16.5	1002.9	0	0	0	0	0
31-08-2025	19:00:00	28.8	28.3	27.4	100.7	98.3	95.7	6.1	1003.1	195.6	1.3	0	0	0
31-08-2025	20:00:00	28.6	28.2	27.7	100.4	96.1	93.7	1.6	1003.6	0	0	0	0	0
31-08-2025	21:00:00	29.1	28.5	27.5	102.2	97.3	94.2	1.6	1004.2	0	0	0	0	0.5
31-08-2025	22:00:00	28.5	28	27.2	108	106.8	100.3	2.1	1004.8	0	0	0	0	0
31-08-2025	23:00:00	28.4	28	27.1	107.9	104.1	98.1	2.1	1005	0	0	0	0	0
01-09-2025	00:00:00	28.5	28	27.4	100.2	97.2	95.7	1.9	1005	0	0	0	0	0
01-09-2025	01:00:00	28.2	27.7	27.2	100	97.6	96.4	1.9	1004.1	0	0	0	0	0
01-09-2025	02:00:00	28.2	27.8	27.5	99.9	96.3	94.6	1.8	1003.7	0	0	0	0	0
01-09-2025	03:00:00	28	27.7	27.4	95.2	94.2	93.3	1.6	1002.8	0	0	0	0	0
01-09-2025	04:00:00	28	27.6	27.3	95.7	93.9	93	1.6	1002.5	0	0	0	0	0
01-09-2025	05:00:00	27.8	27.5	27.2	95.7	94.4	93.2	1.6	1002.1	0	0	0	0	0
01-09-2025	06:00:00	27.8	27.4	27.2	95.1	94.1	93.3	1.6	1002	0	0	0	0	0
01-09-2025	07:00:00	27.8	27.5	27.2	94.8	93.5	92.9	3.2	1002.5	0	0	0	0	0
01-09-2025	08:00:00	28.3	27.8	27.4	94.4	92.9	91.4	37.2	1003	0	0	0	0	0
01-09-2025	09:00:00	29.5	28.8	28	92.4	88.5	84.8	126.6	1004.1	0	0	0	0	0

Dahej station														
DATE	**TIME**	**AT_Max**	**AT_Avg**	**AT_Min**	**RH_Max**	**RH_Avg**	**RH_Min**	**SOLAR**	**BP**	**WD**	**WS_Max**	**WS_Avg**	**WS_Min**	**RAIN**
DD/MM/YY	**HH:MM:SS**	**DegC**	**DegC**	**DegC**	**%**	**%**	**%**	**W/m2**	**mbar**	**Deg**	**m/s**	**m/s**	**m/s**	**MM**
01-09-2025	10:00:00	30.1	29.6	29.2	86.8	84.4	81.9	171.5	1004.6	0	0	0	0	0
01-09-2025	11:00:00	31.5	30.8	29.7	83.2	79	74.9	263.7	1005	0	0	0	0	0
01-09-2025	12:00:00	31.6	30.8	29.6	84.1	78.5	73.8	139	1004.4	0	0	0	0	0
01-09-2025	13:00:00	32.7	31.6	30.3	81.5	76	70.8	208.7	1004.1	164.4	1.9	0	0	0
01-09-2025	14:00:00	33.5	32.9	31.3	77.7	70.4	66.6	352.9	1003.7	119.8	9.3	0	0	0
01-09-2025	15:00:00	33.5	32.7	31.7	77.4	72.9	68.9	253.1	1002.6	0	0	0	0	0
01-09-2025	16:00:00	31.9	30.7	30	88.9	84	77.3	88.4	1000.9	0	0	0	0	0
01-09-2025	17:00:00	31.9	30.9	29.9	89.8	86.2	82	124	1000.8	0	0	0	0	0
01-09-2025	18:00:00	30.8	30	29.5	90.1	88.9	85	21.6	999.9	0	0	0	0	0
01-09-2025	19:00:00	29.9	29.5	29.3	93.1	91.3	89.2	2.6	1000.3	0	0	0	0	0
01-09-2025	20:00:00	29.7	29.2	28.9	94.6	93	91	1.3	1001	0	0	0	0	0
01-09-2025	21:00:00	29.5	29	28.7	94.9	93.8	93.1	1.4	1001.5	0	0	0	0	0
01-09-2025	22:00:00	29.2	28.8	28.6	94.9	92.2	89.4	1.2	1002.1	0	0	0	0	0
01-09-2025	23:00:00	29	28.6	28.4	90.5	89.2	88.5	1	1003.1	0	0	0	0	0
02-09-2025	00:00:00	28.8	28.4	28.2	89.9	87.2	85.9	0.9	1003.1	0	0	0	0	0
02-09-2025	01:00:00	28.6	28.2	28	90.8	88.5	86.2	1	1003.3	0	0	0	0	0
02-09-2025	02:00:00	28.4	28	27.8	92.8	90.7	89.6	1.2	1002.7	0	0	0	0	0
02-09-2025	03:00:00	28.3	27.9	27.6	93.7	92.8	92.1	1.3	1002.1	0	0	0	0	0
02-09-2025	04:00:00	28	27.6	27.3	95.3	94	92.8	1.3	1001.5	0	0	0	0	0
02-09-2025	05:00:00	27.8	27.4	27.2	95.8	94.8	94.1	1.4	1001.1	0	0	0	0	0
02-09-2025	06:00:00	27.9	27.5	27.4	94.9	93.9	93.5	1.3	1001.9	0	0	0	0	0
02-09-2025	07:00:00	27.8	27.4	27.2	95	94.3	93.9	3	1002.3	0	0	0	0	0
02-09-2025	08:00:00	28.6	28	27.4	94.8	93.1	91	31.6	1003.6	194.7	9.3	0.8	0	0
02-09-2025	09:00:00	29.3	28.8	28.2	91.9	88.8	86.8	93.1	1004.2	204.2	1.3	0	0	0
02-09-2025	10:00:00	30.5	29.9	29.2	88	84.1	80.6	175.7	1005.2	0	0	0	0	0
02-09-2025	11:00:00	32.2	31.1	30.2	82.9	78.4	73.3	243.5	1005.8	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
02-09-2025	12:00:00	32.8	32.3	31.5	75.4	70.9	68	229.4	1005.8	268.9	2.6	0	0	0
02-09-2025	13:00:00	32.8	32.4	31.6	74.1	68.5	64.9	304.9	1005	264.4	1.9	0	0	0
02-09-2025	14:00:00	34.4	33.4	32.4	68.2	63.3	58.5	357.3	1004.6	197.1	11.3	0.1	0	0
02-09-2025	15:00:00	35.2	34.3	33.2	65.3	59.8	55.6	261.9	1003.6	138	8.6	0.1	0	0
02-09-2025	16:00:00	33.4	32.2	31.6	76.9	72.9	65	135.1	1002.1	0	0	0	0	0
02-09-2025	17:00:00	32.9	32.4	31.5	76.5	73	69.6	142.6	1001.7	115.1	1.3	0	0	0
02-09-2025	18:00:00	31.6	31	30.4	84.1	82	76.5	50.5	1001	129.4	1.3	0	0	0
02-09-2025	19:00:00	30.6	30	29.6	90	87.6	83.9	5.5	1001.2	148.2	5.9	0	0	0
02-09-2025	20:00:00	29.9	29.6	29.4	93.2	91.6	89.8	0.6	1001.9	188.4	8.6	0.1	0	0
02-09-2025	21:00:00	29.9	29.5	29.3	94.3	93.2	92.2	1.3	1003.4	184.3	3.3	0	0	0
02-09-2025	22:00:00	29.9	29.5	29.3	94.5	92.4	89.9	1.3	1004	203.4	2.6	0	0	0
02-09-2025	23:00:00	29.7	29.3	29	90.5	89	87.5	1.1	1004.5	0	0	0	0	0
03-09-2025	00:00:00	29.5	29.1	28.8	88.4	84.8	82.2	0.7	1004.1	0	0	0	0	0
03-09-2025	01:00:00	29	28.7	28.4	85.8	83.7	82	0.6	1003.6	0	0	0	0	0
03-09-2025	02:00:00	28.7	28.3	28.1	88.8	87.1	85	1	1003.2	0	0	0	0	0
03-09-2025	03:00:00	28.5	28.1	27.8	89.2	88	87.4	1	1003	0	0	0	0	0
03-09-2025	04:00:00	28.1	27.8	27.6	90.2	88.9	88.2	1.1	1002.4	0	0	0	0	0
03-09-2025	05:00:00	28.1	27.6	27.4	91.8	90.3	89.4	1.2	1002.8	0	0	0	0	0
03-09-2025	06:00:00	27.8	27.5	27.3	92.3	91.3	90.8	1.3	1003.4	0	0	0	0	0
03-09-2025	07:00:00	27.8	27.4	27.1	93.1	91.4	90.8	1.2	1003.9	232.2	5.9	0	0	0
03-09-2025	08:00:00	28.2	27.6	27.2	93.5	92.5	91.5	13.9	1004.8	0	0	0	0	0
03-09-2025	09:00:00	29	28.3	27.7	92.4	90.1	87.2	77.8	1005.2	0	0	0	0	0
03-09-2025	10:00:00	30.5	29.3	28.6	87.6	83.8	76.2	173.8	1005.7	0	0	0	0	0
03-09-2025	11:00:00	31.4	30.7	30.1	78.3	75.3	72.5	235.9	1006.6	0	0	0	0	0
03-09-2025	12:00:00	33.2	31.8	30.7	74.2	68.9	63.5	292	1006.7	235.5	1.3	0	0	0
03-09-2025	13:00:00	33.7	32.7	31.7	69	64.3	60.2	360.8	1006.2	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
03-09-2025	14:00:00	35	34.1	32.8	63.2	57.6	52.8	352.3	1005.7	214.5	7.3	0	0	0
03-09-2025	15:00:00	35.3	34.2	33.4	60.2	55.6	52.1	321.6	1004.9	284.5	3.9	0	0	0
03-09-2025	16:00:00	34.2	33.5	33	64.1	60.8	56	257.8	1003.7	211.4	3.3	0	0	0
03-09-2025	17:00:00	33.8	32.4	31.5	71.5	66.4	59.3	168.6	1002.6	0	0	0	0	0
03-09-2025	18:00:00	31.7	30.9	30.2	78.7	76.3	71.2	63.2	1002.1	0	0	0	0	0
03-09-2025	19:00:00	30.5	30	29.5	85	81.4	77.2	14.3	1001.8	194.9	0.6	0	0	0
03-09-2025	20:00:00	29.7	29.5	29.4	87.4	84.7	81.5	0.4	1002.5	0	0	0	0	0
03-09-2025	21:00:00	30	29.6	29.4	89	87.4	86.2	0.7	1003.3	188.8	0.6	0	0	0
03-09-2025	22:00:00	30.1	29.7	29.5	90.2	89	87.1	1.1	1004.6	0	0	0	0	0
03-09-2025	23:00:00	30	29.6	29.3	89.2	86.8	85.7	1	1004.4	0	0	0	0	0
04-09-2025	00:00:00	29.6	29.3	29.1	89.2	85.5	83.3	0.8	1003.8	0	0	0	0	0
04-09-2025	01:00:00	29.4	28.1	25.1	100	88.2	81.4	1	1003.6	221.7	0.6	0	0	7
04-09-2025	02:00:00	26	25.5	24.7	107.8	105.4	98.9	1.4	1002.7	263	11.3	0.2	0	4.5
04-09-2025	03:00:00	26.3	25.7	25	107.7	106.7	105.9	1.9	1002.1	5	13.3	0.8	0	2
04-09-2025	04:00:00	26.5	26	25.4	107.7	106.8	106.1	1.5	1001.9	2.7	7.3	0.3	0	1
04-09-2025	05:00:00	26.6	26.1	25.4	107.7	106.7	106.1	1.6	1002	2.7	5.9	0.9	0	0
04-09-2025	06:00:00	26.7	26.4	25.7	107.8	106.8	106.1	1.7	1002.6	2.6	10.6	3.1	0	0
04-09-2025	07:00:00	27	26.6	25.8	107.9	106.8	105.5	2.3	1003.7	355.3	3.3	0	0	0
04-09-2025	08:00:00	27.8	26.9	26	107.8	103.6	99.3	23.8	1004.3	238.8	1.9	0	0	0
04-09-2025	09:00:00	28.2	27.6	26.9	100.7	96	94.2	48.8	1005	0	0	0	0	0
04-09-2025	10:00:00	28.3	27.9	27.7	95.3	94.4	93.5	45.3	1005.4	0	0	0	0	0
04-09-2025	11:00:00	28.9	28.3	27.7	95.4	92.7	90.3	69.2	1005	225.5	1.9	0	0	0
04-09-2025	12:00:00	30.7	29.2	27.8	95.7	89.3	83	209.3	1004.8	0	0	0	0	0
04-09-2025	13:00:00	30.5	29.5	28.2	95.1	87.1	82.3	109.3	1004.1	226.9	4.6	0.1	0	1
04-09-2025	14:00:00	28.6	27.2	26.2	107.9	104.7	94.9	36.6	1002.5	205.7	5.9	0	0	9.5
04-09-2025	15:00:00	27.4	27	26.1	107.8	106.7	105.7	36.9	1002.2	0	0	0	0	1

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
04-09-2025	16:00:00	27.1	26.5	25.8	107.8	106.1	105.2	3.8	1001.9	220.5	1.9	0	0	18
04-09-2025	17:00:00	27.2	26.7	26.3	106.5	105.6	105.2	2.7	1001.4	220.7	0.6	0	0	11
04-09-2025	18:00:00	27.3	26.9	26.5	106.6	105.7	105.1	2.2	1001	211.1	0.6	0	0	3.5
04-09-2025	19:00:00	27.2	26.8	26.4	106.6	105.7	105.2	2.3	1001.3	205	0.6	0	0	3.5
04-09-2025	20:00:00	27.3	26.9	26.5	107	105.8	105.2	2.4	1001.6	213.2	0.6	0	0	1.5
04-09-2025	21:00:00	27.6	27.1	26.5	107.8	106.7	105.5	2.4	1002.6	0	0	0	0	0
04-09-2025	22:00:00	27.6	27.3	26.5	108	106.8	105.7	2.4	1003.5	218.9	0.6	0	0	0.5
04-09-2025	23:00:00	27.6	27.2	26.5	107.9	106.7	105.5	2.3	1003.6	0	0	0	0	0
05-09-2025	00:00:00	28	27.3	26.5	107.9	103.2	96.7	2.3	1003.7	226.6	12.6	0	0	0
05-09-2025	01:00:00	27.4	26.8	26.4	99.7	96.3	95.3	2.2	1002.8	240.7	18.6	1.7	0	0
05-09-2025	02:00:00	27.1	26.7	26.3	97	96	95.5	2.2	1002.1	252.2	17.2	1.3	0	0
05-09-2025	03:00:00	27	26.3	25.1	107.8	100.8	95	2.2	1001.6	253	11.9	0.3	0	1
05-09-2025	04:00:00	26	25.6	24.8	107.7	106.6	105.5	2.1	1001.5	253.7	12.6	0.1	0	0
05-09-2025	05:00:00	25.8	25.3	24.7	107.7	98.4	95.6	2.2	1002.1	255.9	14.6	0.4	0	0.5
05-09-2025	06:00:00	25.8	25.4	24.8	100.2	96.7	95.3	2.2	1002.6	253.5	16.6	0.4	0	0
05-09-2025	07:00:00	25.8	25.2	24.4	107.8	103.8	98.5	2.2	1003.7	237.9	7.9	0	0	0.5
05-09-2025	08:00:00	25.8	25.3	24.5	107.8	105.7	99	5.7	1004.3	246.8	9.9	0.1	0	0
05-09-2025	09:00:00	25.9	25.4	24.6	107.8	102.7	99	16	1005	235.3	8.6	0	0	1
05-09-2025	10:00:00	26.2	25.6	24.8	107.8	106.6	105.5	34.1	1005.5	231	9.9	0.2	0	2
05-09-2025	11:00:00	27	26.3	25.3	107.9	106.9	105.5	47.6	1005.8	222.9	14.6	1.7	0	0
05-09-2025	12:00:00	28.4	27.4	26.1	107.9	103.4	96.2	94.3	1005.8	226.5	20.6	0.6	0	0
05-09-2025	13:00:00	29.3	28.6	27.9	96.9	94.1	91.4	128.5	1005.7	220.6	17.2	2.9	0	0
05-09-2025	14:00:00	29.3	29	28.7	93.6	92.3	91.4	75.9	1005	218.6	15.2	3	0	0
05-09-2025	15:00:00	30.1	29.5	28.7	93.9	91.2	88.8	108.5	1003.9	216.1	16.6	3.1	0	0
05-09-2025	16:00:00	30.1	29.6	29.4	92.2	90.3	88.8	68.1	1002.3	211.3	16.6	4.3	0	0
05-09-2025	17:00:00	30.1	29.1	24.7	92.7	90.1	88.9	62.4	1001.4	212.1	19.2	5.6	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
05-09-2025	18:00:00	29.8	29.4	29.1	95.1	93	91.8	17.8	1001.7	207.9	15.9	4.2	0	0
05-09-2025	19:00:00	29.5	29.1	28.8	96.8	95.1	94	2.1	1002.5	204.1	13.3	2.6	0	0
05-09-2025	20:00:00	29.4	29	28.5	99.7	96.6	95.8	1.8	1003.4	205	13.9	3.3	0	0
05-09-2025	21:00:00	29.2	28.8	28.3	100	96.8	95.1	1.9	1003.9	214.3	22.6	7.9	0	0
05-09-2025	22:00:00	29.1	28.8	28.5	96	94.4	93.3	1.7	1004.5	219.3	30.5	10.2	1.3	0
05-09-2025	23:00:00	28.9	28.1	27.4	99.5	95.6	93.7	1.9	1005.1	221.7	25.9	10.8	3.3	0
06-09-2025	00:00:00	28.1	25.7	24.5	107.8	103.1	93.9	1.9	1005	242	19.9	1	0	17.5
06-09-2025	01:00:00	26.3	25.5	24.7	107.1	105.6	105	2	1004.2	215.7	13.3	0.4	0	2.5
06-09-2025	02:00:00	27.1	26.5	25.6	106.8	105.7	105.2	2.1	1004.2	214.8	0.6	0	0	2
06-09-2025	03:00:00	27.2	26.8	26.3	107.1	105.8	105.2	2.2	1003.9	208	7.9	0.1	0	1
06-09-2025	04:00:00	27.3	26.9	26.3	107.8	106.7	105.5	2.3	1002.5	0	0	0	0	0
06-09-2025	05:00:00	27.5	27.1	26.3	108	106.9	105.7	2.3	1003.2	0	0	0	0	0
06-09-2025	06:00:00	27.7	27.2	26.3	107.9	106.1	99.3	2.2	1003.7	0	0	0	0	0
06-09-2025	07:00:00	27.8	27.2	26.5	101.8	100.2	99.1	2.1	1004	221.5	5.9	0	0	0
06-09-2025	08:00:00	28.1	27.4	26.7	102.1	99.7	96.5	15.5	1004.8	205.8	4.6	0.1	0	0
06-09-2025	09:00:00	29.2	28.3	27.4	99.2	95	92.9	61.5	1005.7	205.8	11.3	0.6	0	0
06-09-2025	10:00:00	30.2	29.5	28.8	93.6	89.4	86.4	156.7	1005.9	206.7	10.6	0.6	0	0
06-09-2025	11:00:00	30.6	30.1	29.6	89.2	86.8	84.2	184.9	1005.8	198.2	12.6	0.2	0	0
06-09-2025	12:00:00	31	30.3	29.6	88.4	85.3	81.8	187.7	1006.3	202.5	6.6	0	0	0
06-09-2025	13:00:00	30.9	29.5	27.5	100.7	88.9	83.2	85.4	1005.5	208.2	5.3	0	0	0.5
06-09-2025	14:00:00	29	27.7	26.4	108	105.3	99.3	41.6	1004.5	221.5	9.9	0.1	0	8.5
06-09-2025	15:00:00	29.9	29.4	28.1	107.3	95.9	93	111.1	1004.5	224.7	5.9	0.1	0	0
06-09-2025	16:00:00	29.5	28.4	28	95.5	93.4	90.7	39.5	1003.2	217	10.6	0.5	0	0
06-09-2025	17:00:00	29.1	28.7	28.4	91.4	90.1	89.4	51.5	1002.6	0	0	0	0	0
06-09-2025	18:00:00	28.8	28.3	28.1	93.2	90.9	89.5	4.4	1002.5	0	0	0	0	0
06-09-2025	19:00:00	28.5	28	27.7	93.5	91.9	91	1.4	1003.5	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
06-09-2025	20:00:00	28.2	27.9	27.6	94.7	93.2	91.2	1.6	1004	0	0	0	0	0
06-09-2025	21:00:00	28	27.7	27.5	95.3	93.6	91.4	1.6	1004.4	0	0	0	0	0
06-09-2025	22:00:00	27.9	27.6	27.2	99	96	94.4	1.7	1004.7	0	0	0	0	0
06-09-2025	23:00:00	28	27.6	27.2	99.3	96.3	95.1	1.7	1005.1	0	0	0	0	0
07-09-2025	00:00:00	28.1	27.6	27.4	96.1	95.4	95	1.6	1005.1	0	0	0	0	0
07-09-2025	01:00:00	28.1	27.7	26.9	101.1	97.6	94.9	1.8	1004.7	0	0	0	0	0
07-09-2025	02:00:00	28.1	27.6	26.9	103.5	99.9	97.5	2	1004.4	0	0	0	0	0
07-09-2025	03:00:00	28.1	27.6	26.8	104.2	99.7	96.5	1.9	1003.8	0	0	0	0	0
07-09-2025	04:00:00	27.9	27.4	26.8	101.5	100.1	98.8	1.9	1003.4	0	0	0	0	0
07-09-2025	05:00:00	27.9	27.3	26.6	100.7	99.2	96.3	1.9	1003.2	0	0	0	0	0
07-09-2025	06:00:00	27.6	27	26.2	107.6	100.5	96.4	2	1003.2	0	0	0	0	0
07-09-2025	07:00:00	27.7	27.1	26.2	107.8	103.3	96.1	2	1003.5	0	0	0	0	0
07-09-2025	08:00:00	27.7	27.4	27.1	97.2	95.9	94.7	10.5	1004.3	0	0	0	0	0
07-09-2025	09:00:00	28.3	27.7	27.2	99.4	96.3	94.6	38.3	1005.3	0	0	0	0	0
07-09-2025	10:00:00	28.5	28.1	27.9	95.3	93.3	92.6	52	1005.6	0	0	0	0	0
07-09-2025	11:00:00	28.4	27.7	27.1	99.8	95.9	93	61.7	1005.9	0	0	0	0	0
07-09-2025	12:00:00	28.7	28.2	27.6	99	94.9	93	92.8	1005.9	0	0	0	0	0
07-09-2025	13:00:00	28.9	28.3	28.1	94.7	93	91.2	133.1	1005.2	0	0	0	0	0
07-09-2025	14:00:00	28.9	28.2	27.4	99.9	94.2	90.4	125.1	1004.8	0	0	0	0	0.5
07-09-2025	15:00:00	28.1	27.5	26.9	103.1	100.3	97	58.7	1004.3	0	0	0	0	0.5
07-09-2025	16:00:00	27.8	27.3	26.6	102.3	100.1	99	57.9	1003.2	205.2	6.6	0	0	1
07-09-2025	17:00:00	28.3	27.8	26.9	106.3	98.5	94.7	47.9	1002.9	168.3	13.3	0.1	0	0
07-09-2025	18:00:00	28.4	28	27.7	95.5	92	88.4	30.8	1002.5	0	0	0	0	0
07-09-2025	19:00:00	28.6	28.2	28	93	89.6	88	4.3	1002.9	0	0	0	0	0
07-09-2025	20:00:00	28.6	28.2	28.1	93.8	92.6	92.1	1.4	1003.6	0	0	0	0	0
07-09-2025	21:00:00	28.6	28.2	28.1	94.2	92	89.6	1.5	1004.5	213.6	6.6	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
07-09-2025	22:00:00	28.6	28.2	28	91	89.5	88.6	1.3	1005.4	0	0	0	0	0
07-09-2025	23:00:00	28.5	28.1	28	91	89.9	88.9	1.3	1005.7	0	0	0	0	0
08-09-2025	00:00:00	28.4	28	27.8	93.4	91.6	89.8	1.4	1005.8	0	0	0	0	0
08-09-2025	01:00:00	28.2	27.9	27.6	94.2	92.7	91.7	1.5	1005.4	213.4	3.3	0	0	0
08-09-2025	02:00:00	28.3	28	27.8	93.5	91.6	90.3	1.4	1004.9	0	0	0	0	0
08-09-2025	03:00:00	28.4	28.1	27.7	93	89.7	88	1.3	1004.4	207.7	12.6	0	0	0
08-09-2025	04:00:00	28.2	27.8	27.6	93.8	91.9	90.9	1.4	1003.4	227.5	1.9	0	0	0
08-09-2025	05:00:00	28.2	27.9	27.7	92.6	91.5	90.6	1.4	1003.2	209.4	7.3	0	0	0
08-09-2025	06:00:00	28.4	28	27.8	92.4	90.8	89.3	1.3	1003.4	190.2	5.9	0	0	0
08-09-2025	07:00:00	28.5	28	27.7	91.8	89.8	87.9	7	1003.7	207.1	11.9	0.1	0	0
08-09-2025	08:00:00	29	28.5	28.1	90.5	87.9	85.1	60.2	1004.7	0	0	0	0	0
08-09-2025	09:00:00	30.1	29.1	28.6	87.6	83.6	79.9	120.3	1005.8	0	0	0	0	0
08-09-2025	10:00:00	30.6	30	29.4	82.8	80.5	77.4	208.4	1006.7	0	0	0	0	0
08-09-2025	11:00:00	31	30.5	29.9	81.3	78.6	75.5	205.1	1007	0	0	0	0	0
08-09-2025	12:00:00	31.4	30.9	30.4	78.5	74.8	71	287.2	1007.2	190.1	0.6	0	0	0
08-09-2025	13:00:00	32.1	31.7	31.2	73.4	69.3	66.6	387.5	1007.3	0	0	0	0	0
08-09-2025	14:00:00	32.6	32.2	31.7	71.1	66.9	64.3	373.1	1006.9	159.6	17.2	0	0	0
08-09-2025	15:00:00	32.4	31.9	31.7	70.1	68.4	66.5	310.6	1006.2	196.1	16.6	0.1	0	0
08-09-2025	16:00:00	32	31.7	31.4	71.7	69.7	68.2	248.8	1005.6	222.2	13.9	0.1	0	0
08-09-2025	17:00:00	31.9	31.3	30.8	74.7	71.8	68.9	169.7	1005.2	197.2	11.3	0	0	0
08-09-2025	18:00:00	31	30.2	29.4	79.5	76.4	73.3	76.5	1004.8	262.1	9.9	0	0	0
08-09-2025	19:00:00	29.6	29	28.6	84.4	81.8	77.8	8.3	1004.6	206.4	14.6	0.2	0	0
08-09-2025	20:00:00	28.8	28.6	28.4	86.8	85.1	83.7	0.4	1005	193.1	16.6	0.6	0	0
08-09-2025	21:00:00	28.8	28.5	28.3	87.7	85.3	84	0.5	1005.7	208.5	17.2	1	0	0
08-09-2025	22:00:00	28.7	28.3	28.2	89.1	86.9	85.2	0.8	1007.1	202.8	11.9	1.2	0	0
08-09-2025	23:00:00	28.7	28.2	28	90.3	88.4	87	1	1007.5	199.9	15.2	0.9	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
09-09-2025	00:00:00	28.4	28	27.8	91.5	89.6	87.6	1.3	1007.5	194.3	9.3	0.7	0	0
09-09-2025	01:00:00	28.4	28	27.7	91.9	89.7	87.8	1.3	1007.4	201.9	12.6	1.6	0	0
09-09-2025	02:00:00	28.1	27.8	27.6	91	89.5	88.4	1.3	1007.3	198.2	11.9	1.3	0	0
09-09-2025	03:00:00	28.1	27.7	27.5	91.4	89.6	88	1.3	1006.7	206.8	12.6	1.3	0	0
09-09-2025	04:00:00	28.3	27.8	27.5	90.7	88.8	87.7	1.3	1006.4	204.5	11.9	1.2	0	0
09-09-2025	05:00:00	28.1	27.7	27.6	91.5	89.7	88.2	1.3	1006.5	179.3	16.6	0.7	0	0
09-09-2025	06:00:00	28.3	27.9	27.7	91.7	89.1	86.9	1.2	1006.6	194.3	13.3	0.8	0	0
09-09-2025	07:00:00	28.3	27.9	27.6	90.4	88.1	86.6	1.6	1007	202.1	25.2	1.1	0	0
09-09-2025	08:00:00	28.2	27.7	27.4	96	93.3	88.6	32.5	1007.8	75.6	15.2	0.8	0	0
09-09-2025	09:00:00	28.8	27.7	27.1	98.9	94.9	91.2	63.6	1009.1	82.9	9.9	0.1	0	0
09-09-2025	10:00:00	29.4	28.9	28.3	92.6	89.3	86.9	124	1009.7	87.6	9.9	0	0	0
09-09-2025	11:00:00	29.8	28.7	27.8	96	92.5	88	126	1009.6	64.4	11.3	0.2	0	0
09-09-2025	12:00:00	31.9	30.6	29	91.4	82.6	74.7	210.6	1010.2	171.4	13.3	0.4	0	0
09-09-2025	13:00:00	32.5	31.6	30.4	78.6	71.8	65.4	329.5	1010	190.7	18.6	1	0	0
09-09-2025	14:00:00	33	32.4	31.5	70	65.5	63	317.2	1009.6	196.4	14.6	1	0	0
09-09-2025	15:00:00	33.2	32.6	31.4	70.9	65.5	62.5	296.4	1009.3	172.4	12.6	0.8	0	0
09-09-2025	16:00:00	33.4	33	32.4	64.7	62.1	60.2	275.3	1008.9	158.5	12.6	0.7	0	0
09-09-2025	17:00:00	33.1	32.4	31.9	67.9	64.5	61.4	183.6	1008.6	175.5	11.3	0.5	0	0
09-09-2025	18:00:00	32	31	30.3	74.4	68.6	62.5	82.7	1008.2	190.3	12.6	0.6	0	0
09-09-2025	19:00:00	30.5	29.4	28.7	82.7	78.9	72.9	10.6	1007.9	142.6	11.9	1.1	0	0
09-09-2025	20:00:00	29	28.7	28.5	86.6	84.9	82.1	0.4	1008	187.4	11.3	0.9	0	0
09-09-2025	21:00:00	28.7	28.5	28.3	88.2	86.9	85.8	0.5	1008.4	166.9	9.9	0.7	0	0
09-09-2025	22:00:00	28.7	28.3	28	88.7	87.3	86.4	0.8	1009.2	198.8	10.6	0.9	0	0
09-09-2025	23:00:00	28.4	28	27.8	89.4	87.9	86.9	1	1009.3	200.4	9.3	0.4	0	0
10-09-2025	00:00:00	28.2	27.8	27.5	92.1	90	88.8	1.1	1009.3	200.6	9.3	0.7	0	0
10-09-2025	01:00:00	27.9	27.4	27.2	93	91.5	90.3	1.2	1008.8	199.7	8.6	0.7	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
10-09-2025	02:00:00	27.6	27.3	27.1	92.8	90.8	89.6	1.3	1008.5	198	9.3	1.1	0	0
10-09-2025	03:00:00	27.6	27.2	26.9	92.4	90.7	89.6	1.5	1008.3	200.6	8.6	0.3	0	0
10-09-2025	04:00:00	27.4	27	26.8	92.7	91.6	89.8	1.5	1008	205.4	9.3	0.2	0	0
10-09-2025	05:00:00	27.3	26.9	26.7	95.3	93.4	91.8	1.5	1008.4	202.3	8.6	0.5	0	0
10-09-2025	06:00:00	27.2	26.8	26.5	99	95.9	94.6	1.6	1009	197.6	6.6	0.4	0	0
10-09-2025	07:00:00	27.6	27.1	26.6	97	95.1	93.8	3.8	1009.6	198.8	7.9	0.7	0	0
10-09-2025	08:00:00	29.2	27.9	27.2	94.6	89.1	80.6	48.9	1010.6	201.5	8.6	0.5	0	0
10-09-2025	09:00:00	30.5	29.3	28.4	88.6	81.4	75.3	94.2	1011.6	214.5	9.3	1.1	0	0
10-09-2025	10:00:00	29.2	28.8	28.3	89.1	86.9	83.6	91.8	1011.6	221.9	10.6	0.9	0	0
10-09-2025	11:00:00	31.4	30.4	29	84.2	77.3	71.9	155.1	1012.6	201.6	11.3	0.8	0	0
10-09-2025	12:00:00	32.4	31.8	31.3	73.5	70	65.3	373.7	1012.7	206	10.6	0.7	0	0
10-09-2025	13:00:00	33.5	32.9	32.3	68.3	62.4	57.6	392.2	1011.8	163.4	9.9	0.6	0	0
10-09-2025	14:00:00	33.7	33	32.3	65.2	60.4	54.6	380.3	1010.8	189.5	13.9	0.7	0	0
10-09-2025	15:00:00	33.8	33.5	33	60.5	57.2	54.3	340	1010.3	164.2	14.6	0.6	0	0
10-09-2025	16:00:00	34	33.3	32.1	63.4	58	53.9	254.7	1009.7	174.9	13.9	0.4	0	0
10-09-2025	17:00:00	32.8	31.6	30.8	68.5	64.6	58.8	137.8	1008.7	203.3	12.6	0.9	0	0
10-09-2025	18:00:00	31.2	30.6	29.9	72.5	69.4	66	78.3	1008.1	203.3	15.2	0.8	0	0
10-09-2025	19:00:00	30	29.1	28.6	80.6	78	72.3	7.3	1007.2	205.6	11.9	0.5	0	0
10-09-2025	20:00:00	28.8	28.6	28.5	84.6	82.8	79.9	0.5	1007.5	206.8	12.6	0.6	0	0
10-09-2025	21:00:00	28.7	28.6	28.4	84	81	77.9	0.5	1008	202	11.3	0.2	0	0
10-09-2025	22:00:00	28.8	28.5	28.3	86.2	83.7	82	0.6	1008.7	207.7	8.6	0.5	0	0
10-09-2025	23:00:00	28.7	28.4	28.2	89.3	87	85.4	0.9	1008.9	210.2	8.6	0.1	0	0
11-09-2025	00:00:00	28.6	28.2	28	89.4	87.9	86.4	1	1009	201.6	1.9	0	0	0
11-09-2025	01:00:00	28.4	27.9	27.6	91.2	89.3	87.1	1.1	1008.6	0	0	0	0	0
11-09-2025	02:00:00	27.9	27.5	27.2	92.6	91.3	90.5	1.3	1008.2	0	0	0	0	0
11-09-2025	03:00:00	27.6	27.1	26.7	95.7	93.8	91.7	1.5	1007.7	0	0	0	0	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
11-09-2025	04:00:00	27.2	26.7	26.4	96	95.2	94.8	1.5	1007.5	205.3	6.6	0	0	0
11-09-2025	05:00:00	26.9	26.5	26.2	95.9	94.7	93	1.7	1007.6	228.6	11.3	2.4	0	0
11-09-2025	06:00:00	27.1	26.6	26.3	94.4	93.2	92.5	1.6	1007.8	222.3	14.6	5.6	0	0
11-09-2025	07:00:00	26.7	26.2	25.9	95.8	94.7	93.7	3.3	1008.2	204.5	6.6	0.6	0	0
11-09-2025	08:00:00	27.8	26.9	26.3	94.9	91.6	88	39.2	1009.1	205.8	8.6	0.4	0	0
11-09-2025	09:00:00	29	28.5	27.6	88.6	82.1	77.1	148.9	1010.3	203.5	1.9	0	0	0
11-09-2025	10:00:00	31.2	30	28.9	78.7	75.1	69.9	244.9	1011.4	221.7	9.9	0.5	0	0
11-09-2025	11:00:00	32.6	31.4	30.8	71.3	67.5	63.2	203.9	1011.7	196.1	9.9	0.7	0	0
11-09-2025	12:00:00	33.5	32.6	32.1	66.2	63.2	59.8	368.4	1011.5	117.9	12.6	0.6	0	0
11-09-2025	13:00:00	33.9	33.5	33	62.3	58.8	55.6	392.3	1011.4	117.4	10.6	0.9	0	0
11-09-2025	14:00:00	34.4	34	33.7	57.6	55.2	53	379.3	1010.6	104.9	13.3	1	0	0
11-09-2025	15:00:00	34.3	34.1	33.8	57.4	55.3	52.9	333.2	1009.9	115.1	12.6	0.8	0	0
11-09-2025	16:00:00	34.2	33.7	33	62.3	58	55.3	268.6	1009.2	194.5	12.6	0.6	0	0
11-09-2025	17:00:00	33.7	32.4	31.5	68	64.6	59.8	180.1	1008.5	212.8	13.3	1	0	0
11-09-2025	18:00:00	31.7	30.7	29.9	76.3	72.2	67.4	66.9	1007.8	217.3	11.9	0.4	0	0
11-09-2025	19:00:00	30.1	29.3	28.9	81.6	79.2	75.9	7	1007.5	219.7	7.3	0	0	0
11-09-2025	20:00:00	29	28.9	28.7	82.5	80.1	77.3	0.5	1007.8	0	0	0	0	0
11-09-2025	21:00:00	29.1	28.8	28.6	88.4	84.2	80.9	0.7	1008.3	214.3	18.6	3.9	0	0
11-09-2025	22:00:00	29.1	28.7	28.6	89.8	88.2	87.3	1.1	1009	212.1	22.6	8.2	1.9	0
11-09-2025	23:00:00	29	28.6	28.3	91.7	89.7	88.2	1.2	1009.2	214.2	22.6	7.8	1.3	0
12-09-2025	00:00:00	28.7	28.3	28.1	92.1	90.5	87.8	1.4	1009.1	216.1	19.9	8.2	0	0
12-09-2025	01:00:00	28.5	28	27.7	90.8	89	86.6	1.2	1008.6	221.2	23.9	9.6	1.3	0
12-09-2025	02:00:00	28.2	27.7	27.4	87.3	85.1	83.9	0.9	1007.9	232.9	23.9	9.9	1.9	0
12-09-2025	03:00:00	27.7	27.2	26.9	89.8	88.1	86.2	1.1	1007.4	233.8	21.9	8.7	1.9	0
12-09-2025	04:00:00	27.5	26.9	26.6	92.4	90.9	89.2	1.2	1007.5	232.8	17.2	7.1	0.6	0
12-09-2025	05:00:00	27	26.6	26.4	93.3	92.2	91.6	1.4	1007.6	235.8	17.2	7.2	0.6	0

Dahej station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
12-09-2025	06:00:00	27	26.6	26.3	94.6	93.1	91.9	1.5	1007.9	235.7	12.6	5	0	0
12-09-2025	07:00:00	26.7	26.4	26.2	95.4	94.5	93.9	2.2	1008.5	224.2	12.6	1.8	0	0
12-09-2025	08:00:00	28.5	27	26.3	95.5	93.4	88.4	37.1	1009.6	236.7	5.9	0.1	0	0
12-09-2025	09:00:00	29.9	29	28.1	89.1	83.5	79.1	139.1	1011.3	248.6	13.9	2.5	0	0
12-09-2025	10:00:00	30.7	30	29.6	80.2	76.4	73.3	230.3	1011.9	244.6	17.9	5.1	0	0
12-09-2025	11:00:00	31.3	30.6	30.1	76.9	72.6	69.2	185.8	1011.9	239.3	15.9	3.9	0	0
12-09-2025	12:00:00	32.4	31.5	30.4	75.5	68.8	62	311.2	1012	236	19.9	5.2	0	0
12-09-2025	13:00:00	33.4	32.7	31.6	65.6	58.9	54.1	379	1011.8	236.7	20.6	4.7	0	0
12-09-2025	14:00:00	35.8	34.1	32.5	60.4	52	45.3	373.3	1011.3	233.2	14.6	2.3	0	0
12-09-2025	15:00:00	35.5	34.7	33.8	51.4	47.5	44.6	333.3	1010.4	232.9	14.6	3.5	0	0
12-09-2025	16:00:00	35.5	34.5	33.3	51.6	47.3	43.5	243.2	1009.4	243	16.6	4	0	0
12-09-2025	17:00:00	34.6	34	33.4	51.2	48.1	45.3	170.9	1008.5	243.9	15.2	2.5	0	0
12-09-2025	18:00:00	34	32.5	31.4	60.6	54.8	48.4	75.6	1007.9	240	11.9	2.6	0	0
12-09-2025	19:00:00	32.1	30.6	29.3	75.2	66.3	56	10.5	1007.6	219.9	9.9	1.9	0	0
12-09-2025	20:00:00	29.4	29	28.8	80	76.9	74.9	0.6	1007.5	204.6	10.6	2.6	0	0
12-09-2025	21:00:00	29.1	28.9	28.7	82.1	81.1	79.9	0.6	1008.1	202.8	11.3	2.6	0	0
12-09-2025	22:00:00	29.2	28.9	28.7	86.4	83.5	81.3	0.6	1008.5	201.9	10.6	3.6	0	0
12-09-2025	23:00:00	29.2	28.8	28.6	90.2	87.4	85.6	1	1008.9	201.8	11.3	3.6	0	0

Hazira Meteorological Data

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
13-08-2025	00:00:00	31.4	31.5	31.4	87.6	85.9	83.8	0	1005.7	217.5	46.6	22.6	7.3	0
13-08-2025	01:00:00	31.6	31.4	31.2	87.4	86	84.6	0	1004.8	218.9	45.3	22.2	9.3	0
13-08-2025	02:00:00	31.6	31.4	31.4	88.2	87.2	86	0	1004.6	216.6	47.3	23.4	10.6	0
13-08-2025	03:00:00	31.6	31.4	31.2	92.7	87.3	83.7	0	1004.5	214.9	44.6	21.3	8.6	0
13-08-2025	04:00:00	31.6	31.3	31.2	94.2	93.1	91.3	0	1004.5	221	38	16.9	6.6	0
13-08-2025	05:00:00	31.6	31.1	30.5	93.7	90.6	86.1	0	1004.5	226.2	30	14.3	5.3	0
13-08-2025	06:00:00	31.5	31.2	30.8	94.9	91.1	86.2	0	1005.5	233.3	28.6	10.1	2	0.5
13-08-2025	07:00:00	31.6	31.2	30.7	99.4	97.4	93.6	0.1	1005.9	225.9	24.6	10.9	1.3	0
13-08-2025	08:00:00	33.3	32.4	31.2	98.9	96.8	93.6	15.8	1007.2	219.2	29.3	14.8	4	0
13-08-2025	09:00:00	34.5	33.7	32.5	93.8	87.5	80.8	54.5	1009	237.1	36	14.2	5.3	0
13-08-2025	10:00:00	35.2	34.4	33.7	81.9	76.5	72.8	83.7	1010.2	264.6	35.3	10.8	3.3	0
13-08-2025	11:00:00	36	35.5	34.8	76	73.5	69.6	135.3	1009.7	230.5	40	15.7	6	0
13-08-2025	12:00:00	36.2	35.5	34.6	84.6	82.4	75.7	146.2	1009	227.2	39.3	17.8	7.3	0
13-08-2025	13:00:00	36.2	35.8	35.4	88.4	82.9	76.3	169.3	1008.1	220.5	43.3	22.2	6	0
13-08-2025	14:00:00	36.6	36.1	35.6	76.5	69.6	62.6	163.2	1007.4	221	44.6	22.2	7.3	0
13-08-2025	15:00:00	36.5	36.1	35.4	69.3	66.6	63.3	146.3	1006.3	218.9	47.3	24.9	8.6	0
13-08-2025	16:00:00	36.4	35.9	35.4	69.4	66.5	63.8	109.3	1005.7	217.4	50	26.4	8.6	0
13-08-2025	17:00:00	36.3	35.3	34.4	67.1	64.1	61.6	65.7	1004.8	218.5	50.6	27.9	12	0
13-08-2025	18:00:00	35.3	34.3	33.5	72.4	67.8	64.2	24.5	1004.1	217.6	49.3	27.7	11.3	0
13-08-2025	19:00:00	33.9	33.1	32.5	78.9	75.5	71.7	2.2	1003.4	213.9	52.6	27.2	8.6	0
13-08-2025	20:00:00	32.8	32.4	32	82.1	79.8	78	0	1003.8	216	46.6	26	10.6	0
13-08-2025	21:00:00	32.6	32.2	31.9	82.6	81.7	80.3	0	1003.8	216.7	50.6	24.4	9.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
13-08-2025	22:00:00	32.4	32	31.7	84.8	82	80.7	0	1004.4	211.2	46	25.3	6.6	0
13-08-2025	23:00:00	32.2	31.9	31.6	87.2	86.2	84.6	0	1005	214.4	52.6	24.9	10.6	0
14-08-2025	00:00:00	29	28.7	28.1	100.2	99.3	98.4	0	1002.6	231.6	28	5.3	0	0.5
14-08-2025	01:00:00	29.5	28.7	27.8	108.8	101.6	98.8	0	1002.2	236.3	26.6	4.6	0	3
14-08-2025	02:00:00	29.5	28.9	28.1	108.8	105.8	100.2	0	1001.7	226.7	20.6	4.7	1.3	1
14-08-2025	03:00:00	29.6	29.1	28.5	102	99.6	98.5	0	1001.8	231	21.3	7	2	0
14-08-2025	04:00:00	29.8	29.4	29	99.1	98	97.2	0	1001.5	219.4	14.6	6.9	3.3	0
14-08-2025	05:00:00	29.7	29.4	29	98.3	97.6	96.9	0	1001.8	213.1	20	8.5	2.6	0
14-08-2025	06:00:00	29.9	29.5	29.2	98	97.2	96.7	0	1001.9	222.6	12	2.3	0	0
14-08-2025	07:00:00	30	29.4	28.8	99.4	98.1	96.9	0	1002.4	110.8	34.6	11.4	1.3	0
14-08-2025	08:00:00	29.6	29.2	28.6	101.1	99.4	98.7	9.2	1002.8	154.9	34.6	21.9	9.3	0
14-08-2025	09:00:00	30.2	29.7	29.2	99.6	97.6	96	66.9	1003.7	164.1	32	20.2	9.3	0
14-08-2025	10:00:00	31.2	30.6	29.9	97	94.9	92.4	134.2	1004.6	170	32.6	19.9	9.3	0
14-08-2025	11:00:00	32.2	31.3	30.8	93.1	91.1	88	245.6	1005.1	164.6	34.6	21	10	0
14-08-2025	12:00:00	32.9	31.8	31.2	90.7	88.3	84.4	279.2	1004.9	164.6	36	23.2	11.3	0
14-08-2025	13:00:00	33.3	32.6	32	87.2	84.9	82.1	308	1004.6	171	41.3	22.6	10	0
14-08-2025	14:00:00	33.5	33	32.5	84.3	82	80.3	279.5	1004.2	184.3	43.3	24.6	8.6	0
14-08-2025	15:00:00	33.4	32.9	32.5	84.1	82	80.1	278.8	1003.2	195.4	42	25.5	11.3	0
14-08-2025	16:00:00	34	33.4	32.7	81.9	79.8	77.4	276.8	1002.9	204.6	40.6	22.4	8.6	0
14-08-2025	17:00:00	34.1	33.3	32.7	82.8	80.8	78.1	182.9	1002.2	207.2	39.3	20.8	8.6	0
14-08-2025	18:00:00	33.5	32.7	32.1	84.1	82	80	113.8	1002.1	209.8	36	20.7	6.6	0
14-08-2025	19:00:00	32.5	31.7	31	87.8	85.6	83.3	25.4	1002.4	209.8	31.3	17.5	6	0
14-08-2025	20:00:00	31.4	30.9	30.4	90.4	89	87	0	1002.2	210.4	32.6	15	7.3	0
14-08-2025	21:00:00	31	30.6	30.3	91.8	90.8	90	0	1002.6	200.5	28.6	14.5	5.3	0
14-08-2025	22:00:00	30.8	30.5	30.3	93.5	92.2	91.1	0	1002.9	192.2	27.3	14	5.3	0
14-08-2025	23:00:00	30.9	30.5	30.2	93.5	92.6	92.1	0	1003.3	194.9	26	12.7	4	0

Hazira station														
DATE	**TIME**	**AT_Max**	**AT_Avg**	**AT_Min**	**RH_Max**	**RH_Avg**	**RH_Min**	**SOLAR**	**BP**	**WD**	**WS_Max**	**WS_Avg**	**WS_Min**	**RAIN**
DD/MM/YY	**HH:MM:SS**	**DegC**	**DegC**	**DegC**	**%**	**%**	**%**	**W/m2**	**mbar**	**Deg**	**m/s**	**m/s**	**m/s**	**MM**
15-08-2025	00:00:00	30.9	30.6	30.3	93.6	92.8	91.3	0	1003.2	195.8	20	11	4.6	0
15-08-2025	01:00:00	30.8	30.4	30	93.9	93.4	92.8	0	1002.9	200	18	9.6	4.6	0
15-08-2025	02:00:00	30.6	30.2	29.8	95.4	94.3	93.4	0	1002.1	213.7	24	10	4	0
15-08-2025	03:00:00	30.4	30.1	29.8	94.8	93.5	92.4	0	1001.4	229.1	16	7.2	2.6	0
15-08-2025	04:00:00	30.6	30.3	30	93	92.2	91.3	0	1001.3	237.9	17.3	6.3	0.6	0
15-08-2025	05:00:00	30.8	30.4	30.2	92.3	91.6	91	0	1001.5	243.5	17.3	7.4	2.6	0
15-08-2025	06:00:00	30.8	30.5	30.2	93.2	92.4	91.5	0	1001.6	237	16.6	6.4	2	0
15-08-2025	07:00:00	30.7	30.4	30.1	93.8	93.2	92.6	0.6	1002	228.1	18.6	7.8	2.6	0
15-08-2025	08:00:00	31.9	31.1	30.4	93.3	91.2	88.7	36.8	1003	223.6	22	9.6	2	0
15-08-2025	09:00:00	33.5	32.1	31.2	89.8	87.3	82.2	117.1	1004.1	225.3	24.6	11.3	4	0
15-08-2025	10:00:00	33.6	32.6	32	86	84.1	81.8	87.2	1004.6	223.7	24.6	10.3	4	0
15-08-2025	11:00:00	32.7	32.2	31.6	88.2	85.3	83.4	88.2	1004.5	212.8	24	11.9	4.6	0
15-08-2025	12:00:00	32	30.9	29.3	93.4	89	86.6	41.6	1003.9	274.9	24.6	9	4	2.5
15-08-2025	13:00:00	29.6	28.9	28.4	98.2	96.4	92.9	20.7	1002	292	27.3	6.2	0	5
15-08-2025	14:00:00	29.4	28.7	28.1	100.1	98.7	96.6	66.4	1001.8	15.3	18.6	9.6	2.6	1
15-08-2025	15:00:00	30.3	29.1	28.3	100.2	98.7	97.2	114.2	1007	11.6	14.6	4.7	0	0.5
15-08-2025	16:00:00	32.9	31.6	30	97.8	94.2	89.2	203.7	1008.2	210.5	18.6	5.7	0	0
15-08-2025	17:00:00	32.5	31.8	31	93.4	91.4	89.4	138.9	1000.7	184.9	36	12.9	4.6	0
15-08-2025	18:00:00	32.5	31.7	31	90.9	89.5	88	79	1000.3	214.8	36.6	18.4	7.3	0
15-08-2025	19:00:00	31.2	30.9	30.2	92.6	91.7	90.6	1.1	1001	232.4	26	11.5	1.3	0
15-08-2025	20:00:00	31	30.8	30.4	94	93.2	92.1	0	1001.1	222.6	28.6	14	6	0
15-08-2025	21:00:00	31	30.7	30.4	94	93.5	93.1	0	1002.1	226.6	25.3	11.3	4.6	0
15-08-2025	22:00:00	31	30.6	30.3	93.7	92.8	92.3	0	1002.5	217	24.6	12.8	6	0
15-08-2025	23:00:00	31	30.7	30.4	94.1	93.1	92.4	0	1002.4	205.5	32	16.4	7.3	0
16-08-2025	00:00:00	31	30.6	30.3	94.2	93.5	92.3	0	1001.9	219.8	31.3	14.7	5.3	0
16-08-2025	01:00:00	31	30.7	30.3	93.4	92.8	92.3	0	1001.8	231.2	28	9.4	3.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
16-08-2025	02:00:00	30.8	30.6	30.3	94.9	94	93	0	1001.2	235.5	12	5.3	2	0
16-08-2025	03:00:00	30.6	30.3	29.8	96.1	95.2	94.2	0	1000	270.5	14	3.3	1.3	0
16-08-2025	04:00:00	30.1	28.7	27.5	103.4	98.4	95.1	0	997.8	0.3	18.6	7.9	0.6	13
16-08-2025	05:00:00	28.9	28.1	27.3	108.8	107.3	101.8	0	997.9	201.7	15.3	5	0	0.5
16-08-2025	06:00:00	29.2	28.8	28.1	108.3	107.2	106.3	0	999.9	197.7	19.3	8.7	1.3	0
16-08-2025	07:00:00	29.2	28.8	28.3	108.3	107.4	106.3	0	999.7	224.2	14.6	4.7	0	0.5
16-08-2025	08:00:00	28.9	28.4	27.7	108.4	107.6	106.3	7.9	999.6	257.2	14.6	6.4	1.3	0.5
16-08-2025	09:00:00	29.9	29.1	28.3	108.8	107.6	103.6	51	1003.7	233.2	14.6	6.3	2.6	0
16-08-2025	10:00:00	30.8	29.9	29	108.1	99.8	96.5	85.9	1008.2	248	15.3	7.2	2.6	0
16-08-2025	11:00:00	31.4	30.8	30.4	97.1	95.1	93.4	66.7	1006.2	263.7	18	7.8	2	0
16-08-2025	12:00:00	30.8	30.5	30.2	95	93.4	92.2	32.2	1001.7	286.8	13.3	3.9	0	0
16-08-2025	13:00:00	30.8	30.4	29.8	95.8	93.8	92.2	12.6	1001.2	244.1	12	4.1	0	1
16-08-2025	14:00:00	30.2	29.7	28.8	100.2	97.5	95.4	24	999.9	186.7	33.3	8.9	0	4
16-08-2025	15:00:00	30	29.3	28.7	108.2	100.3	98.9	123.8	1002.2	189.1	28.6	15.2	8	1
16-08-2025	16:00:00	31.2	30.3	29.4	99.9	97.7	95.3	163.4	1006.3	195	32	16.9	7.3	0
16-08-2025	17:00:00	31.6	31	30.5	96.2	94.9	93.5	116.2	998.9	200.8	31.3	17.6	4.6	0
16-08-2025	18:00:00	31.3	30.9	30.6	95.2	93.7	92.8	83.4	998.9	208.8	36	19.5	8	0
16-08-2025	19:00:00	30.9	30.4	30	96.1	94.8	93.1	11.6	999	215.7	36.6	19.5	8	0
16-08-2025	20:00:00	30.6	30.2	29.9	97	96.3	95.6	0	999.5	228.1	38.6	15.1	5.3	0
16-08-2025	21:00:00	30.4	30.1	29.8	97.2	96.8	96.2	0	1000.2	232.5	26.6	11.5	4.6	0
16-08-2025	22:00:00	30.3	29.9	29.4	99.2	97.5	96.5	0	1000.8	243.6	63.3	12.3	4.6	1
16-08-2025	23:00:00	29.9	29.5	29.1	100	99.4	98.7	0	1000.2	261.8	26.6	12.3	4	0.5
17-08-2025	00:00:00	29.9	29.5	28.8	100.4	99.4	98.6	0	1000.3	268.4	23.3	9.9	3.3	0
17-08-2025	01:00:00	29.7	29.3	29	99.2	98	96.6	0	999.4	261.6	22.6	10.1	3.3	0
17-08-2025	02:00:00	29.8	29.5	29.2	97.2	96.5	96.2	0	999	288.9	14.6	4.4	0.6	0
17-08-2025	03:00:00	29.9	29.5	29.2	97.6	97.1	96.6	0	998.3	291.9	14	4.9	0.6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
17-08-2025	04:00:00	29.6	29.3	29.1	97.9	97.5	97.1	0	998.3	283.4	7.3	3.2	0	0
17-08-2025	05:00:00	29.9	29.3	28.9	99.2	98.2	97.4	0	998.2	120.3	18	3	0	0
17-08-2025	06:00:00	29.8	29.4	28.9	104.3	99.9	98.8	0	998.5	105.6	18	7.5	0.6	0
17-08-2025	07:00:00	29.8	29.4	28.7	108.8	104.7	99.8	0	998.4	92.3	16.6	6.7	0	0
17-08-2025	08:00:00	29.7	29.1	28.4	108.8	107.9	105.3	11.1	998.8	98.9	28	12.2	0.6	0
17-08-2025	09:00:00	29.1	28.7	28.2	108.5	107.7	106.2	15.3	999.4	105.8	27.3	17.6	7.3	0
17-08-2025	10:00:00	29.6	29.1	28.4	108.9	107.9	103.8	108.4	1000.2	112	22.6	14.4	7.3	0
17-08-2025	11:00:00	30.2	29.5	28.9	108.8	106.2	100	111.8	1000.2	143.8	38	22.3	12.6	0
17-08-2025	12:00:00	30.6	30.1	29.4	106.5	99.6	97.4	104.3	1000.4	169.8	40.6	26.1	11.3	0
17-08-2025	13:00:00	31.3	30.6	30.1	98.5	96.7	94.5	113	1000.2	187.1	38.6	21.8	10	0
17-08-2025	14:00:00	32.2	31.7	31	95.8	92.4	90.4	218.5	999.9	180.2	42.6	22.3	11.3	0
17-08-2025	15:00:00	31.9	31.4	31.1	92.2	91.4	90.3	124.8	999.1	198.7	35.3	18.8	6.6	0
17-08-2025	16:00:00	32.2	31.4	30.6	92.7	90.5	88.7	93.3	998.8	200.5	34.6	18.1	6	0
17-08-2025	17:00:00	31	30.4	29.8	96.3	94	92.2	0.9	998.3	207.1	30.6	15.7	5.3	0
17-08-2025	18:00:00	30.2	29.8	29.1	98.5	97.1	95.6	7.6	997.8	214.4	46.6	16.8	7.3	0
17-08-2025	19:00:00	29.8	29.3	28.9	99.4	98.8	97.8	7.2	998	210.8	42	20.2	10	0
17-08-2025	20:00:00	29.8	29.2	28.7	99.3	98.2	97.2	0	998.9	214	39.3	17.4	6.6	0
17-08-2025	21:00:00	29.9	29.3	28.9	99.1	98	96.4	0	1000	213.5	40	17.3	7.3	0
17-08-2025	22:00:00	30	29.4	28.7	99.1	97.5	96.2	0	1000.4	201	36.6	19.6	8	0.5
17-08-2025	23:00:00	30.2	29.8	29.5	97.4	96.6	95.8	0	1000.9	202.2	40	20.3	8	0
18-08-2025	00:00:00	30.4	30.1	29.8	96.5	95.6	95	0	1001.5	209.4	39.3	17.9	6	0
18-08-2025	01:00:00	30.3	29.7	29.3	98.2	97	95.4	0	1000.9	220.3	34	14.9	3.3	0
18-08-2025	02:00:00	30.3	29.9	29.5	98	97	96.2	0	1000.8	212.5	33.3	14.5	6	0
18-08-2025	03:00:00	30.2	29.5	28.5	99.8	97.8	95.4	0	999.8	216.7	46	14.5	4.6	0
18-08-2025	04:00:00	29.7	28.9	27.7	108.8	102	97.4	0	999.7	218.1	40.6	12.6	3.3	1.5
18-08-2025	05:00:00	29.4	28.8	28.1	108.8	107.8	106	0	999.6	214.2	32	10.5	2.6	0.5

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
18-08-2025	06:00:00	29.2	28.8	28	108.8	107.6	105.8	0	999.9	203.9	24.6	10.6	4.6	0
18-08-2025	07:00:00	29.5	29	28.4	108.9	107.7	106	1.5	1000	191.4	21.3	10.5	5.3	0
18-08-2025	08:00:00	30.3	29.7	28.8	108.8	103.7	99.2	26.6	1000.4	185.7	26	14	6	0
18-08-2025	09:00:00	31.6	30.7	29.8	99.8	97.6	95.2	112.7	1002	194.9	34	16.2	4	0
18-08-2025	10:00:00	31.8	31.2	30.6	96.6	95.2	93.6	119.5	1002.7	194.3	28.6	16.3	6	0
18-08-2025	11:00:00	32.1	31.5	30.4	96.2	93.4	91.6	157.1	1003.2	222.8	32	15.4	2	0
18-08-2025	12:00:00	32.2	31.6	31	92.3	90.8	88.7	135.4	1003	230.7	30.6	13.3	5.3	0
18-08-2025	13:00:00	32.9	32.3	31.6	89.5	87	84.5	181	1002.9	222.5	30	13.9	6	0
18-08-2025	14:00:00	33.1	32.7	32.3	88.1	86.8	84.5	185.1	1002.1	204.6	23.3	10.8	3.3	0
18-08-2025	15:00:00	34.2	33.4	32.6	85.3	82.8	79.8	215.3	1001.3	205.5	20.6	9	2.6	0
18-08-2025	16:00:00	33.6	31.7	29.6	96.9	88.1	81.2	73.8	999.8	138	44.6	15.3	5.3	0
18-08-2025	17:00:00	30.1	29.1	28.3	108.8	101.3	96.5	32.4	998.1	157.3	42	23	12	1
18-08-2025	18:00:00	29.6	28.9	28.1	108.8	107.7	101.3	39.2	997.9	152.7	54	30.5	15.3	1
18-08-2025	19:00:00	29.8	29.3	28.3	108.5	107.6	106.1	8.6	999.2	166.4	62	32.4	12	0
18-08-2025	20:00:00	29.4	28.9	28.4	108.5	107.7	106.6	0	998.6	187.9	36.6	17.1	6	0
18-08-2025	21:00:00	29.6	29.1	28.4	108.4	107.6	106.5	0	998.9	176.9	30.6	13.5	4.6	2
18-08-2025	22:00:00	29.6	29.3	28.7	108.4	107.7	106.5	0	999.4	216.2	55.3	25.2	10.6	0
18-08-2025	23:00:00	29.6	29.1	28.4	108.4	107.7	106.6	0	999.7	213.5	54	27.4	11.3	0
19-08-2025	00:00:00	29.8	29.2	28.5	108.8	106	99.4	0	1001.1	204	54	27.5	10.6	0
19-08-2025	01:00:00	29.8	29.2	28.7	102.5	99.3	98.3	0	1000.1	191.9	42.6	24.8	10.6	0
19-08-2025	02:00:00	29.8	29.4	28.8	100.6	99	98	0	999.4	198	56	28.8	12	0
19-08-2025	03:00:00	29.6	29	28.4	99.7	98.8	97.9	0	998.3	199.5	54	26	10.6	0
19-08-2025	04:00:00	29.6	29.3	29	98.4	96.5	95.1	0	998.2	200.2	44.6	22.5	11.3	0
19-08-2025	05:00:00	30	29.6	29.2	97.8	96.7	95.4	0	997.7	210.7	41.3	19.7	8.6	0
19-08-2025	06:00:00	29.9	29.5	29.2	98.5	97.5	96.8	0	997.8	208.8	26.6	11	4	0
19-08-2025	07:00:00	30	29.7	29.4	99.2	98.5	97.8	0.9	998.1	190.8	16.6	8.2	3.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
19-08-2025	08:00:00	30.6	30	29.5	99.1	97.7	96.2	22.5	999	177.3	14.6	7.7	3.3	0
19-08-2025	09:00:00	31	30.5	29.8	97.6	96.1	94.9	54.4	999.7	150.3	32	12.1	4	0
19-08-2025	10:00:00	30.3	29.5	28.6	108.9	101.9	97	87.8	999.4	111.4	42	24.3	8	0
19-08-2025	11:00:00	30.1	29.7	28.3	108.9	102.1	99.1	217.6	1007.2	115.2	40.6	27.7	6	0
19-08-2025	12:00:00	30.6	30.2	29.5	101.1	99.2	97.8	152.6	1000.6	126.2	40	25.7	16	0
19-08-2025	13:00:00	30.6	30.2	29.7	100.8	98.7	97.3	87	998.9	148.7	46.6	33.5	20	0
19-08-2025	14:00:00	30.8	30.3	29.8	100	97.9	95.6	191.6	998.8	154.4	55.3	39.2	22.6	0
19-08-2025	15:00:00	32.3	31.5	30.6	96.5	92.7	89.1	357	998.3	151.6	40.6	26.8	14.6	0
19-08-2025	16:00:00	32.1	31.3	30.1	95.1	92.7	90.1	146.4	996.9	154.2	62.6	32.1	12.6	0
19-08-2025	17:00:00	32	31.3	30.4	95.3	92	89.9	118.4	996.3	117.4	62	38.7	18	0
19-08-2025	18:00:00	30.8	30.1	29.6	97.7	95.3	93.1	14.9	995.8	168.2	44.6	20.2	8	0
19-08-2025	19:00:00	30.1	29.7	29.2	98.3	95.8	94.2	4.1	995.6	98.4	45.3	21.6	2.6	0
19-08-2025	20:00:00	30.2	29.9	29.4	99.4	98.3	97.4	0	995.6	114.3	25.3	8.4	0.6	0
19-08-2025	21:00:00	30.3	29.8	29.3	100.8	99.5	98.2	0	996.6	29.6	18.6	3.1	0	0
19-08-2025	22:00:00	30	29.7	29.1	108.8	103.4	99.8	0	997.1	288.7	26.6	8.2	0.6	0
19-08-2025	23:00:00	30.1	29.2	28.2	108.8	106	99.5	0	998.1	245.1	61.3	26.4	8	0
20-08-2025	00:00:00	29	28.6	28	108.7	107.6	106.1	0	997.8	242.9	58	25.6	12.6	0.5
20-08-2025	01:00:00	29	28.4	27.8	108.3	107.2	106	0	997.2	243.8	62	28.8	11.3	3
20-08-2025	02:00:00	28.5	28.3	27.9	109.2	107.6	105.6	0	996.9	243	67.3	31	13.3	2.5
20-08-2025	03:00:00	28.5	28	27.7	109.2	109	108.8	0	996.2	245.8	68	33.5	16	4.5
20-08-2025	04:00:00	28.5	28.1	27.8	109.2	109	108.8	0	996	245.7	71.3	32.1	12.6	10.5
20-08-2025	05:00:00	28.4	28.1	27.8	109.2	109	108.8	0	996.1	249.5	55.3	29.2	10.6	8
20-08-2025	06:00:00	28.5	28.1	27.7	109.2	109	108.8	0	996.4	249.2	60.6	30.1	14	3.5
20-08-2025	07:00:00	29	28.3	27.8	109.3	107.7	105.6	0	997.7	251.6	66	27.9	12.6	0
20-08-2025	08:00:00	29.2	28.7	28.1	108.3	106.8	105.7	6.6	999.1	252.6	62.6	29	12	0
20-08-2025	09:00:00	29.1	28.6	28	108.6	107.6	106	16.3	998.2	254.9	65.3	32.6	12	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
20-08-2025	10:00:00	29.3	28.8	28.1	108.8	105	99.4	43.5	999.2	267	58.6	25	8.6	0
20-08-2025	11:00:00	29.9	29.5	28.4	108.5	98.3	95.8	136	1000.1	261.3	57.3	26.3	9.3	0
20-08-2025	12:00:00	30.6	30.1	29.5	96.8	94.8	93.3	134.2	1000.1	256.3	54.6	26	10.6	0
20-08-2025	13:00:00	31.2	30.6	30.1	94.3	92.1	89.9	142.7	1000.2	275.2	55.3	19.6	5.3	0
20-08-2025	14:00:00	30.8	30.2	29.4	96.1	93.2	91.3	68.6	999.8	273.5	40.6	16.6	4.6	0
20-08-2025	15:00:00	29.7	29.1	28.2	108.7	101.6	96	11.5	998.7	249.4	65.3	25.1	10.6	0
20-08-2025	16:00:00	29.6	29	28.3	108.8	107.6	101	21.7	999.2	238	68	27.9	12	0.5
20-08-2025	17:00:00	29.6	29.1	28.4	108.9	108	106	22.8	998.9	233.4	69.3	26.8	12	0.5
20-08-2025	18:00:00	30	29.4	28.7	108.7	100.7	97.2	17.4	1001	231.4	66.7	28.4	12.6	0.5
20-08-2025	19:00:00	29.8	29.1	27.7	108.8	100.3	96.2	1.4	999.3	239.4	64.6	25.4	11.3	0
20-08-2025	20:00:00	29.6	28.8	27.7	108.8	105.1	99.2	0	999.6	237.1	58	21.8	8.6	0
20-08-2025	21:00:00	29.9	29.3	28.2	108.7	101.2	97.6	0	1001.4	234.8	58.6	21.7	8	0
20-08-2025	22:00:00	30.2	29.7	29	98.9	97.4	95.6	0	1002.1	229.6	54.6	22.9	8	0
20-08-2025	23:00:00	29.8	29.3	28.8	101.4	99.2	98.3	0	1001.7	229.4	53.3	22.5	8.6	0
21-08-2025	00:00:00	29.6	29	27.7	108.8	102.6	97.7	0	1001.5	231.5	56.6	21.7	7.3	0
21-08-2025	01:00:00	30.1	29.5	28.8	100.5	99	97.5	0	1003.5	228.7	48	19.8	8.6	0
21-08-2025	02:00:00	30.3	29.7	28.6	101.8	97.5	95.2	0	1002.6	227.9	56	21.9	10	0
21-08-2025	03:00:00	29.9	29.4	28.9	101.6	99.1	97.7	0	1001.7	230.8	49.3	20.6	10	0
21-08-2025	04:00:00	29.9	29.5	29.1	99.3	98.3	96.3	0	1001.9	230.7	54.6	20.1	8.6	0
21-08-2025	05:00:00	29.8	29.3	28.3	100.9	98.9	97.3	0	1002	234	52.6	20.7	8	0
21-08-2025	06:00:00	29.3	28.6	27.8	108.8	106.9	98.8	0	1002.9	245.2	56.6	20.6	7.3	0
21-08-2025	07:00:00	29.9	29.2	28.3	108.7	101.4	97	0	1004.6	231	57.3	23.2	10.6	0
21-08-2025	08:00:00	30.7	29.9	29.3	99.2	97	95.1	21.1	1003.4	226.1	52.6	23.2	10	0
21-08-2025	09:00:00	31.6	30.7	30.1	95.4	93.4	90.3	95.1	1004.4	218.6	54.6	29.4	13.3	0
21-08-2025	10:00:00	32.5	31.7	31.2	90.7	89.2	86.7	192.9	1005.7	220.7	58.6	29.1	14	0
21-08-2025	11:00:00	32.7	32.3	31.6	91.2	86.2	85.7	315.5	1006.5	224.3	54	27.8	13.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
21-08-2025	12:00:00	33.3	32.4	31.3	91.8	87.6	83.5	327.7	1006.1	221.6	58	28.3	13.3	0
21-08-2025	13:00:00	33.5	32.9	32.2	88.3	85.9	83.3	365	1005.5	222.3	57.3	27.7	11.3	0
21-08-2025	14:00:00	33.5	31.4	29.3	100.3	91.5	83.1	187.2	1004.5	231	59.3	22.4	7.3	2
21-08-2025	15:00:00	31.4	30.5	29.1	107.2	98.2	93.8	174.9	1003.6	228.1	58.6	24.3	8	1.5
21-08-2025	16:00:00	31.7	30.6	28.7	101.2	96.7	92.7	183.5	1009.4	227.7	52.6	24	10.6	0
21-08-2025	17:00:00	32.1	31.5	31.2	93.5	91.3	89.8	123.1	1003.7	231.1	60.6	24.7	9.3	0
21-08-2025	18:00:00	31.8	31.1	30.6	93.5	91.5	89.3	46.4	1003.2	233.1	56.6	23.5	8.6	0
21-08-2025	19:00:00	31.1	30.6	30.2	95.1	94	91.8	12.6	1003.6	232.5	52	22.2	9.3	0
21-08-2025	20:00:00	30.8	30.4	30.2	94.1	93.3	92.5	0	1004.6	235.1	49.3	22.1	8	0
21-08-2025	21:00:00	30.8	30.3	30	95.2	93.6	92.3	0	1005.5	236.3	52	21.6	8.6	0
21-08-2025	22:00:00	30.4	29.9	29.3	98.3	95.7	94	0	1005.7	239.6	46.6	20.1	7.3	0
21-08-2025	23:00:00	30.2	29.4	28.5	99.6	98.2	96.4	0	1005.9	233.5	50.6	20.3	7.3	0
22-08-2025	00:00:00	30.2	29.7	29.3	98.9	97.9	96.6	0	1006	232.3	54	21.9	10.6	0
22-08-2025	01:00:00	30.2	29.5	28.3	101.4	98.2	95.2	0	1005.8	229.4	52	22.2	9.3	0.5
22-08-2025	02:00:00	29.9	29.4	28.8	99.6	98.9	98	0	1005.2	230.9	58	24.7	9.3	0
22-08-2025	03:00:00	30	29.7	29.3	98.3	97.3	96.2	0	1004	231.7	64	24.1	10.6	0
22-08-2025	04:00:00	30.1	29.8	29.6	97.2	96	94.7	0	1003.6	230.5	66.7	24.3	9.3	0
22-08-2025	05:00:00	30.2	29.8	29.5	95.7	94.3	93.2	0	1003.7	235.4	62	24.4	10.6	0
22-08-2025	06:00:00	30.3	30	29.7	93.8	92.5	91.6	0	1004.1	234.6	58.6	24.3	10.6	0
22-08-2025	07:00:00	30.2	29.6	29.1	96.3	94.9	92.7	0.1	1004.6	234.8	51.3	22.6	9.3	0
22-08-2025	08:00:00	30	28.9	27.7	99.6	97	93.1	12.1	1005.2	236.5	64	23.4	9.3	0
22-08-2025	09:00:00	30.7	29.2	27.8	100.6	97.7	94	61.4	1010.6	228.2	62.6	22.9	10	0
22-08-2025	10:00:00	32.2	31.5	30.3	94.3	88.6	85.1	198.2	1011.9	232.4	58	25.6	11.3	0
22-08-2025	11:00:00	32.9	32.6	31.3	89.2	85.7	84.3	281.6	1007.9	221.7	52.6	26.6	3.3	0
22-08-2025	12:00:00	32.9	32.2	31.6	88.8	86.6	83.8	310.2	1007.4	227.2	66	30.3	12.6	0
22-08-2025	13:00:00	32.7	32.1	31.2	90.5	86.6	84	305.9	1006.6	222	64	32.7	16	0

Hazira station														
DATE	**TIME**	**AT_Max**	**AT_Avg**	**AT_Min**	**RH_Max**	**RH_Avg**	**RH_Min**	**SOLAR**	**BP**	**WD**	**WS_Max**	**WS_Avg**	**WS_Min**	**RAIN**
DD/MM/YY	**HH:MM:SS**	**DegC**	**DegC**	**DegC**	**%**	**%**	**%**	**W/m2**	**mbar**	**Deg**	**m/s**	**m/s**	**m/s**	**MM**
22-08-2025	14:00:00	33.1	32.4	31.8	87.8	84.8	82.2	293.4	1006.2	225.3	66.7	31.3	12.6	0
22-08-2025	15:00:00	33.1	32.6	32.1	84.7	82.8	81.1	283.5	1005.2	227.8	70.7	31.6	12.6	0
22-08-2025	16:00:00	32.5	31.6	29.6	93.6	86.2	82.5	235.5	1004.3	228.4	67.3	30.1	14	0
22-08-2025	17:00:00	32.5	31.2	28.5	96.3	87.7	83.6	139.1	1003.4	231.2	73.3	31.9	14	0.5
22-08-2025	18:00:00	31.2	28.7	27.3	108.8	99.8	95.3	22.3	1002.4	231.6	79.3	28.6	12	1.5
22-08-2025	19:00:00	30.6	30.2	29.6	96.1	92.5	90.3	2.3	1005.6	229.1	66.7	27.6	10.6	0
22-08-2025	20:00:00	30.6	30.2	30	92.1	91.1	90.3	0	1004.4	229	57.3	25.9	10	0
22-08-2025	21:00:00	30.6	30	29.4	95.1	92.2	90.4	0	1005	231.2	61.3	24.2	10.6	0
22-08-2025	22:00:00	30.6	30.2	29.9	92	90.9	89.6	0	1005.7	232.7	61.3	23.1	8.6	0
22-08-2025	23:00:00	30.4	30.2	29.8	91.8	90.6	88	0	1005.5	236.3	50.6	21.5	10	0
23-08-2025	00:00:00	30.4	30	29.7	93.1	92.3	91	0	1005.2	234.4	52	21.2	9.3	0
23-08-2025	01:00:00	30.3	30	29.7	92.2	91.4	90.6	0	1004.3	234.1	51.3	22	10.6	0
23-08-2025	02:00:00	30.3	30	29.7	92	91	90.2	0	1003.9	235.3	53.3	22.9	10.6	0
23-08-2025	03:00:00	30.2	29.9	29.6	92.7	91.3	90.2	0	1003.3	239	55.3	22.4	6.6	0
23-08-2025	04:00:00	30.2	29.9	29.5	93.5	92.2	91	0	1002.9	242.3	50.6	22.4	8.6	0
23-08-2025	05:00:00	30.1	29.3	28.7	96.9	94.9	91.8	0	1002.4	241.3	57.3	23.9	10	0.5
23-08-2025	06:00:00	29.7	29.2	28.7	96.7	95.8	94.8	0	1003.1	243.2	52	22.5	8.6	0
23-08-2025	07:00:00	30	29.5	29	95.2	93.9	92.8	4.8	1003.3	248.4	49.3	25.3	11.3	0
23-08-2025	08:00:00	30.1	29.7	29	97.4	94.5	93.5	19.3	1003.9	251.4	56	25.5	9.3	0.5
23-08-2025	09:00:00	30.1	29.3	28.5	96.5	94	91.5	24.7	1001.2	242.2	52	30.5	9	0.5
23-08-2025	10:00:00	28.3	27.8	27.2	108.7	107.3	100.5	31.1	1002.3	256.4	68.7	31.7	12.6	5
23-08-2025	11:00:00	29	28	27.1	108.8	107.6	106	44.1	1004.3	236.7	71.3	29.9	12.6	4.5
23-08-2025	12:00:00	29	28	27.1	94.3	92.1	90	118.3	1005	235.1	62	27	10.6	0
23-08-2025	13:00:00	31	30.6	29.5	94.5	90.5	88.2	125.2	1012	231.5	68	29.5	12	0
23-08-2025	14:00:00	31.4	31	30.3	88.9	87.2	86.2	124	1005	227	65.3	31.2	15.3	0
23-08-2025	15:00:00	32.1	31.2	30.4	87.7	85.6	82.8	172.7	1004.6	231.4	74.7	31.8	8	0

Hazira station														
DATE	**TIME**	**AT_Max**	**AT_Avg**	**AT_Min**	**RH_Max**	**RH_Avg**	**RH_Min**	**SOLAR**	**BP**	**WD**	**WS_Max**	**WS_Avg**	**WS_Min**	**RAIN**
DD/MM/YY	**HH:MM:SS**	**DegC**	**DegC**	**DegC**	**%**	**%**	**%**	**W/m2**	**mbar**	**Deg**	**m/s**	**m/s**	**m/s**	**MM**
23-08-2025	16:00:00	32.2	31.5	30.9	87.8	85.6	82.9	149.2	1003.8	228.2	73.3	31.9	13.3	0
23-08-2025	17:00:00	31.2	30.3	29.4	94	90.1	86.3	44	1002.8	228.4	78	33.1	13.3	0
23-08-2025	18:00:00	30.6	30.3	29.9	91.2	89.4	87.7	14	1003	228.7	66	31.7	13.3	0
23-08-2025	19:00:00	30.6	30.3	30	90.5	89.4	88.3	1.4	1003.6	227.7	66	31.2	14.6	0
23-08-2025	20:00:00	30.6	30.3	30	89.8	88.7	87.8	0	1004.2	228.8	72	30.7	14	0
23-08-2025	21:00:00	30.6	30.2	30	90	89	87.8	0	1004.7	229.4	64.6	27.8	11.3	0
23-08-2025	22:00:00	32.8	30.2	29.9	89.7	88.6	87.1	0	1005.5	230.1	62	27	10.6	0
23-08-2025	23:00:00	30.6	30.2	29.8	90	88.6	87.7	0	1005.5	227.7	64.6	28.6	10	0
24-08-2025	00:00:00	30.5	29.7	28.9	95.3	91.8	88.9	0	1005.1	228.6	62	26	11.3	0
24-08-2025	01:00:00	30	29	27.8	99.4	95.5	92.7	0	1003.9	227.4	66	26.7	10	0.5
24-08-2025	02:00:00	30.2	30.8	31.5	105	99.1	93.2	0	1010.1	228.4	74	32.1	14	1
24-08-2025	03:00:00	29	28.3	26.9	102	99.2	97.2	0	1002.9	228.1	62.6	24.9	10.6	0
24-08-2025	04:00:00	29.7	29.1	28.4	98.5	96.9	95.2	0	1004.3	226.9	74.7	27.9	12.6	0
24-08-2025	05:00:00	29.6	29	28.5	98.4	96.5	94.6	0	1002.9	227.4	70.7	27.3	11.3	0
24-08-2025	06:00:00	29.9	29.4	28.9	97.4	94.6	91.3	0	1003.6	229.3	64.6	27.5	10.6	0
24-08-2025	07:00:00	29.8	29	28.3	96.3	94.4	91.7	0.7	1003.3	229.2	63.3	25.8	9.3	0
24-08-2025	08:00:00	29.9	29.2	28.7	97.2	96.1	95.1	24.9	1004.1	228	60.6	24.3	9.3	0
24-08-2025	09:00:00	29.8	28.8	27.2	108.3	98.1	94.7	14.6	1004.2	256	71.3	25.3	10	7
24-08-2025	10:00:00	28.7	27.9	27.1	108.7	107.5	106	19.5	1004.7	255	64	26	10	8.5
24-08-2025	11:00:00	30.4	29.3	28	108.9	102.6	97	78.4	1010.1	233.4	63.3	28.1	12	0.5
24-08-2025	12:00:00	31.5	30.5	29.2	99.4	94	88.5	143.1	1010.5	230.6	70.7	30.4	13.3	0
24-08-2025	13:00:00	32.2	31.4	30.8	89.3	87.4	82.4	202.4	1006	229.8	74	32.1	14	0
24-08-2025	14:00:00	32.7	32.3	31.7	86.1	83.7	81.4	314.8	1006	228.5	74.7	33.4	14.6	0
24-08-2025	15:00:00	32.7	32.2	31.6	85.3	83.2	82	252.7	1005.4	228.6	72	33.2	15.3	0
24-08-2025	16:00:00	32.7	32.1	31.6	85	82.6	81	214.7	1004.6	224.9	73.3	35.1	15.3	0
24-08-2025	17:00:00	32.8	32	31.3	84.6	83.2	81.2	152.9	1004.5	227.9	68.7	31.8	14.6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
24-08-2025	18:00:00	32.1	31.3	30.6	87.2	85.5	83.1	65.4	1004.3	228.4	64.6	30.2	13.3	0
24-08-2025	19:00:00	31	30.6	30.2	88.9	87.7	86.3	4.3	1004.1	228.1	66	28.8	13.3	0
24-08-2025	20:00:00	30.8	30.3	30	90.6	89.5	88.2	0	1004.4	225.4	62	28.3	14.6	0
24-08-2025	21:00:00	30.6	30.1	29.3	92.7	91	88.9	0	1004.6	225.6	63.3	29	10.6	0
24-08-2025	22:00:00	29.6	27.9	26.7	108.7	101.2	92.3	0	1004.4	252.4	63.3	28.5	10	18
24-08-2025	23:00:00	28.2	27.4	26.7	108.3	107.5	106.2	0	1004.7	236	67.3	25.6	11.3	0
25-08-2025	00:00:00	29.1	28.8	28.3	108.5	102.4	100.1	0	1008.2	229.7	62	33.4	20.6	0
25-08-2025	01:00:00	30	29.4	28.5	100.7	97	93.6	0	1007.3	237.6	65.3	26.6	12	0
25-08-2025	02:00:00	30	29.7	29.4	94.8	93.8	92.8	0	1004.4	239.1	58.6	27.4	12.6	0
25-08-2025	03:00:00	29.7	28.1	27.3	108.3	100.6	92.8	0	1003.5	253.1	62	28.3	12	2.5
25-08-2025	04:00:00	28.7	28.1	27.3	108.7	107.4	100.2	0	1004	254.6	52.6	23.3	7.3	0.5
25-08-2025	05:00:00	28.8	28.3	27.4	108.8	107.6	100.4	0	1003.9	243.2	57.3	24.5	10.6	1
25-08-2025	06:00:00	29.3	28.7	28.1	108.8	107.1	100	0	1004.7	240.1	58.6	23.2	10	0
25-08-2025	07:00:00	30.8	28.1	27.4	108.6	107.5	106	0	1002.7	254.1	58	24.8	8.6	7.5
25-08-2025	08:00:00	29	28.3	27.5	108.7	107.5	106.1	1.2	1004.3	248	54.6	24.5	10	0
25-08-2025	09:00:00	30.1	29.4	28.5	108.5	99.5	94.8	50.5	1008.4	250	53.3	25.5	10.6	0
25-08-2025	10:00:00	30.2	29.7	29.1	97.4	95.6	92.3	48.4	1005.3	255.6	53.3	24.2	10.6	0
25-08-2025	11:00:00	29.5	28.7	28	108.6	101.8	97.1	55.2	1005.6	245	45.3	20.4	8.6	1
25-08-2025	12:00:00	30.8	30.1	28.5	102.1	97	92.9	177.7	1008.2	243.8	50	21.8	4	0
25-08-2025	13:00:00	31.4	30.9	30.2	92	90.3	89.1	169.4	1005.6	248.7	50.6	25.4	10.6	0
25-08-2025	14:00:00	31	30.7	30.4	91.8	90.4	89	123.4	1004.4	248.1	50	24	8	0
25-08-2025	15:00:00	31.2	30.8	30.4	92.2	90.6	89.7	137.9	1003.6	245.4	59.3	27.9	11.3	0
25-08-2025	16:00:00	31.4	30.8	30.4	92.4	90.7	88.8	149.1	1003	243.5	54.6	26.5	10	0
25-08-2025	17:00:00	31.3	30.9	30.4	91.2	89.8	88.2	92.8	1002.7	240.8	58.6	24.9	12	0
25-08-2025	18:00:00	30.1	29.7	29.4	97.6	94.5	91.4	14.2	1003.2	253.1	58	24	8	0
25-08-2025	19:00:00	30.4	30.1	29.7	94.4	92.8	91.6	2.4	1003	240.4	48.6	23.2	9.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
25-08-2025	20:00:00	30.2	29.9	29.6	95.1	94.2	93.4	0	1002.9	243.4	50	21.6	8.6	0
25-08-2025	21:00:00	30.1	29.8	29.6	94.5	94	93.6	0	1003.7	242.6	48	20.8	10	0
25-08-2025	22:00:00	30.2	29.9	29.6	94.9	94.2	93.6	0	1004.6	244.5	40.6	18.4	6.6	0
25-08-2025	23:00:00	30.2	29.8	29.5	95.7	94.4	93.6	0	1004.6	248	38.6	17.9	6	0
26-08-2025	00:00:00	30.2	29.8	29.4	95.6	94.7	93.7	0	1004.6	248.9	36	17.2	7.3	0
26-08-2025	01:00:00	30	29.6	29.1	96.7	95.6	94.7	0	1004.2	259.5	36	15.7	5.3	0
26-08-2025	02:00:00	29.9	29.5	29.3	97.8	96	95.4	0	1003.7	260.2	34	17.1	7.3	0
26-08-2025	03:00:00	29.8	29.4	29.2	97.2	96.6	96	0	1003	258.2	31.3	14.6	4	0
26-08-2025	04:00:00	29.7	29.4	29.1	96.7	96.2	95.6	0	1002.7	248.7	34	15.8	6	0
26-08-2025	05:00:00	29.6	29.3	29	97	96.4	94.9	0	1003	244.7	37.3	17.2	6.6	0
26-08-2025	06:00:00	29.8	29.5	29.2	96.9	95.9	95.1	0	1003.6	250	35.3	17.3	6.6	0
26-08-2025	07:00:00	29.8	29	28	101	97.1	94.9	0	1003.9	261.3	34	14.4	4	2
26-08-2025	08:00:00	29.3	28.7	27.9	103.8	100.3	98.6	8.6	1004.4	265.8	30	12.3	4.6	0.5
26-08-2025	09:00:00	30.6	29.5	28.5	99.2	96.4	92.3	79.6	1005.8	265.8	28	13.4	5.3	0
26-08-2025	10:00:00	31	30.2	29.6	95.1	92.9	90.6	145	1006.6	260.8	37.3	15.6	6	0
26-08-2025	11:00:00	31.9	31.3	30.6	91.5	89.8	88.6	182.8	1007.2	255.8	37.3	16.4	5.3	0
26-08-2025	12:00:00	32.4	31.8	30.4	92.3	88.3	86.1	313.3	1007.5	249.1	38.6	18.7	4	0
26-08-2025	13:00:00	32.9	32.2	31.3	87.2	85.2	82.9	353.9	1006.9	256.2	40.6	18.5	7.3	0
26-08-2025	14:00:00	32.9	32.5	32.1	86.2	83.8	81.8	344.6	1006.2	251.3	39.3	18.7	7.3	0
26-08-2025	15:00:00	33.3	32.8	32.2	85.1	82.8	80.6	278.9	1005.4	238.2	46	20	9.3	0
26-08-2025	16:00:00	33.1	32.4	32	88	85.3	83.4	243.5	1004.7	238.9	47.3	21.7	9.3	0
26-08-2025	17:00:00	32.1	31.6	31.1	88.8	87.5	86.5	68	1004.2	237.4	41.3	21.9	10	0
26-08-2025	18:00:00	31.5	31	30.3	92.2	90.1	88	40.5	1003.6	240.5	49.3	21.5	9.3	0
26-08-2025	19:00:00	30.8	30.4	30.1	94.4	92.9	91.4	0.6	1003.8	240.8	44	19	8.6	0
26-08-2025	20:00:00	30.4	30.2	30	95	94.3	93.4	0	1004.3	239.7	42.6	19	8	0
26-08-2025	21:00:00	30.5	30.2	30	95.6	95.1	94.2	0	1004.7	243.9	40	17.4	8	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
26-08-2025	22:00:00	30.4	30.2	29.9	95.8	95.3	94.8	0	1005	245.1	36	16.8	7.3	0
26-08-2025	23:00:00	30.4	30	29.8	96.3	95.8	95.4	0	1005.5	249.7	31.3	15.1	6.6	0
27-08-2025	00:00:00	30.3	30	29.7	96.6	96	95.5	0	1005.5	252.9	30.6	14.9	6.6	0
27-08-2025	01:00:00	30.2	29.9	29.5	96.4	95.8	95.4	0	1005	256	52	18	7.3	0
27-08-2025	02:00:00	30	29.7	29.3	96	95.5	95.1	0	1004	260.6	37.3	17.9	6	0
27-08-2025	03:00:00	29.8	29.5	29.1	96.9	95.8	95.1	0	1003.2	264	35.3	14	4.6	0
27-08-2025	04:00:00	29.6	29.3	29	96.9	96.5	95.9	0	1003.2	260.8	24.6	11.5	4.6	0
27-08-2025	05:00:00	29.7	29.4	29.1	97	96.2	95.6	0	1002.8	253.2	23.3	11.2	4	0
27-08-2025	06:00:00	29.7	29.3	29	97.2	96.7	96.4	0	1003.2	263.9	20.6	9.1	3.3	0
27-08-2025	07:00:00	29.7	29.3	29.1	97.2	96.8	96.3	0	1003.7	282.5	17.3	7.8	2	0
27-08-2025	08:00:00	29.9	29.5	29.3	96.9	95.6	94.6	11.2	1004.4	294.1	20.6	10	2	0
27-08-2025	09:00:00	30.4	29.9	29.4	95.1	93.7	92	43.5	1005.2	296.7	25.3	10.7	2	0
27-08-2025	10:00:00	31.3	30.4	29.8	92.8	91.4	89.1	109.8	1005.9	293.6	26	12.1	4	0
27-08-2025	11:00:00	31.8	31.4	30.8	89.5	86.9	84.5	194.4	1006.5	294.2	25.3	12.4	4	0
27-08-2025	12:00:00	33.1	32.2	31.4	86.2	83.5	80	330.9	1006.8	281.2	24	11.1	3.3	0
27-08-2025	13:00:00	33.4	32.8	32.2	83.1	81.1	79.1	337.4	1006.1	263.6	26	10.6	3.3	0
27-08-2025	14:00:00	34.4	33.4	32.5	82.6	78.4	74.2	371.4	1005.2	265.2	25.3	11.3	2.6	0
27-08-2025	15:00:00	35	34.5	33.9	77.4	75.4	72.9	325.4	1004.8	236.6	26	10.8	3.3	0
27-08-2025	16:00:00	34.8	34	33.1	80.5	78.2	75.4	231.1	1003.8	215.9	30	15.9	6	0
27-08-2025	17:00:00	34.8	33.6	32.3	84.3	79.1	74.6	134.6	1003.3	222.4	31.3	15.3	6.6	0
27-08-2025	18:00:00	32.6	32	31.4	88.6	86.2	83.5	23.5	1002.7	226.3	30.6	13.7	6	0
27-08-2025	19:00:00	31.9	31.3	30.9	90.8	89.3	87.7	2	1002.8	225.7	36	14.7	6	0
27-08-2025	20:00:00	31.4	30.9	30.6	93.6	92.1	90.4	0	1003.2	228.9	30.6	13.8	6	0
27-08-2025	21:00:00	31	30.7	30.5	93.9	93.3	92.7	0	1003.3	228.7	38	15.4	5.3	0
27-08-2025	22:00:00	31	30.6	30.3	95	94.3	93.4	0	1004.2	230.1	31.3	13.4	4.6	0
27-08-2025	23:00:00	30.8	30.5	30.3	95.6	95.1	94.5	0	1004.6	235.5	28.6	12.4	6	0

Hazira station														
DATE	**TIME**	**AT_Max**	**AT_Avg**	**AT_Min**	**RH_Max**	**RH_Avg**	**RH_Min**	**SOLAR**	**BP**	**WD**	**WS_Max**	**WS_Avg**	**WS_Min**	**RAIN**
DD/MM/YY	**HH:MM:SS**	**DegC**	**DegC**	**DegC**	**%**	**%**	**%**	**W/m2**	**mbar**	**Deg**	**m/s**	**m/s**	**m/s**	**MM**
28-08-2025	00:00:00	30.8	30.4	30	95.8	95.3	95	0	1004.3	232.2	30	13.5	6	0
28-08-2025	01:00:00	30.6	30.4	30	97.1	96.3	95.2	0	1003.4	240.7	34	15.3	7.3	0
28-08-2025	02:00:00	30.7	30.4	30.1	97.6	96.9	96.3	0	1002.9	253.4	32	16.7	6.6	0
28-08-2025	03:00:00	30.6	29.6	29	99.2	97.5	96.2	0	1002.3	265.6	32.6	15.1	4	0
28-08-2025	04:00:00	30.1	29.7	29.2	99.2	97.4	96.5	0	1002	268	22.6	9.5	3.3	0
28-08-2025	05:00:00	30.1	29.8	29.4	97.4	96.5	95.8	0	1002.3	260.1	21.3	9.8	3.3	0.5
28-08-2025	06:00:00	29.6	29.3	28.8	99.2	98.4	96.8	0	1002.5	252.2	15.3	7.2	2.6	0
28-08-2025	07:00:00	29.7	29.3	28.9	99.1	98.2	97.5	0	1003.1	281	17.3	8	2.6	0
28-08-2025	08:00:00	30.1	29.6	29.2	98	96.7	95.7	6	1003.5	284.7	19.3	7.4	2	0
28-08-2025	09:00:00	30.1	29.5	28.7	99.4	96.9	95.6	5.8	1003.5	297.8	18.6	7.2	0.6	1
28-08-2025	10:00:00	30.1	29.5	28.5	100.3	98.7	97	95.3	1008.7	294.7	21.3	9.9	4	0
28-08-2025	11:00:00	31.2	30.5	29.7	97.7	93.6	93	88.7	1007.3	293.5	32.6	16.3	5.3	0
28-08-2025	12:00:00	31.2	30.2	29.4	94	92.8	91.4	75	1004.3	303.3	28	13.3	4.6	0
28-08-2025	13:00:00	29.7	29.2	28.8	98.2	96	93.2	21	1003.4	294.7	24.6	10.1	2.6	0
28-08-2025	14:00:00	30.1	29.6	29	99.1	98	97.2	79.5	1003	299.4	22.6	9.9	3.3	0
28-08-2025	15:00:00	30.2	29.7	29.3	98.3	96.7	95.4	70.7	1002.2	298.3	21.3	9.4	2	0
28-08-2025	16:00:00	30.3	29.8	29.3	96.4	94.9	93.7	29.7	1001.6	270.9	15.3	5.6	1.3	0
28-08-2025	17:00:00	30.3	29.9	29.6	97.2	95.5	94	1.7	1000.8	214.1	12.6	5.7	1.3	0
28-08-2025	18:00:00	29.9	29.5	29	101.4	98.9	96.8	0	1001.1	187.1	17.3	6.4	2	1
28-08-2025	19:00:00	29.8	29.3	28.5	108.8	106.2	100	0	1001.3	173.7	30	16.9	4	2.5
28-08-2025	20:00:00	29.6	29.2	28.7	108.6	107.4	106.1	0	1002	191.4	24.6	13.1	6	0.5
28-08-2025	21:00:00	29.8	29.4	28.8	108.5	107.8	107.1	0	1003.2	191.9	20.6	12.2	6	0
28-08-2025	22:00:00	30	29.6	29.1	108.5	107.9	107	0	1004	200.7	22	10.3	3.3	0
28-08-2025	23:00:00	30.2	29.7	29.1	108.5	107.8	106.4	0	1004.3	211.6	25.3	11	2.6	0
29-08-2025	00:00:00	30.2	29.8	29.2	108.3	107.3	106.3	0	1003.6	225.1	28.6	12.8	5.3	0
29-08-2025	01:00:00	30.4	29.9	29.4	108.7	107.4	106.1	0	1003.2	237.9	30	13.2	6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
29-08-2025	02:00:00	30.4	30	29.4	108.6	107.3	106.1	0	1001.8	239.2	33.3	14.8	6	0
29-08-2025	03:00:00	30.2	29.8	29.3	108.7	107.6	106	0	1001.1	246.1	34	15.8	6.6	0
29-08-2025	04:00:00	30.3	29.4	28.7	108.9	107.7	106.2	0	1000.5	255	41.3	19.7	8.6	0.5
29-08-2025	05:00:00	29.7	29.3	28.8	108.6	107.5	106	0	1001	257.9	38	18.3	7.3	0
29-08-2025	06:00:00	29.6	28.9	28.1	108.7	107.4	106.1	0	1001.5	270.9	42	15.6	5.3	0
29-08-2025	07:00:00	29.3	28.8	28	108.9	104.4	99.4	0.2	1002.2	270.2	29.3	12.6	4	0
29-08-2025	08:00:00	29.4	29	28.5	100	99.1	98.5	5.4	1002.8	256.1	35.3	16.7	6.6	0
29-08-2025	09:00:00	29.2	28.7	27.3	108.5	100.5	98.6	0	1003.5	272	30.6	12.5	5.3	0
29-08-2025	10:00:00	28.1	27.5	26.8	108.7	107.6	105.8	1.2	1003.8	291.2	29.3	12.1	4.6	0
29-08-2025	11:00:00	28.7	28.3	26.9	108.2	107.7	106.1	6.2	1007.3	282.9	28.6	10.5	3.3	0
29-08-2025	12:00:00	28.8	28.3	27.6	108.4	107.6	106.5	45.6	1006.4	289.8	19.3	7.8	2.6	0.5
29-08-2025	13:00:00	29.5	28.9	28.1	108.8	107.7	106	82.1	1008.3	299.6	15.3	3.2	0	0.5
29-08-2025	14:00:00	29.7	29.1	28.4	108.9	107.8	106	42	1005.7	232.7	10.6	2.9	0	1
29-08-2025	15:00:00	30.2	29.6	28.7	108.9	102.9	98.9	117.5	1009.1	241.5	9.3	2.1	0	0.5
29-08-2025	16:00:00	30.6	30.1	29.4	107.6	99.1	96.9	81.3	1007.1	201.2	12.6	2.7	0	0
29-08-2025	17:00:00	30.7	30.3	29.9	98	96.5	95.4	72.1	1002.4	169.6	19.3	5.2	0	0
29-08-2025	18:00:00	30.8	30.3	29.8	97.2	96	95.2	58.7	1001.8	189.1	21.3	11.8	4.6	0
29-08-2025	19:00:00	30.4	29.8	29.2	96.8	96.2	95.6	9.5	1002.4	196.5	19.3	11.1	4	0
29-08-2025	20:00:00	30	29.5	29.1	96.8	96.2	95.7	0	1002.8	208.1	17.3	9	2.6	0
29-08-2025	21:00:00	30	29.7	29.4	96.4	95.9	95.4	0	1003.5	211.4	27.3	12.6	5.3	0
29-08-2025	22:00:00	30.1	29.8	29.5	97.4	96.7	95.8	0	1004	206.5	25.3	13.1	5.3	0
29-08-2025	23:00:00	30.2	29.8	29.5	97.8	97.3	96.9	0	1004.1	206.6	30	14.3	6	0
30-08-2025	00:00:00	30.2	29.8	29.5	98.2	97.5	96.9	0	1004.4	219.4	27.3	13.6	5.3	0
30-08-2025	01:00:00	30.2	29.6	29	99.9	98.8	97.3	0	1004	217.6	28	14.6	7.3	0
30-08-2025	02:00:00	30	29.7	29.1	99.8	99.3	98.8	0	1003.9	211.5	31.3	16.7	8.6	0
30-08-2025	03:00:00	30.1	29.6	29.4	99.4	98.7	98.2	0	1003.5	217.9	32	14.1	6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
30-08-2025	04:00:00	30.1	29.8	29.4	99.3	98.8	98.2	0	1002.8	214.5	30.6	16.2	7.3	0
30-08-2025	05:00:00	30	29.5	29	100	99.2	98.2	0	1002.7	231.9	30.6	10.8	4	0
30-08-2025	06:00:00	30	29.7	29.3	99.8	99.3	98.9	0	1003.5	231.8	24	9.6	4	0
30-08-2025	07:00:00	30.2	29.8	29.3	100	99.4	98.8	0	1004.2	246.5	16.6	7.5	3.3	0
30-08-2025	08:00:00	30.2	29	27.8	108.8	102.6	98.2	0.3	1004	306.9	22.6	7.7	2	2
30-08-2025	09:00:00	28.9	28.4	27.8	108.5	107.4	106.1	17.5	1004.2	309.7	26.6	8.9	3.3	0.5
30-08-2025	10:00:00	29.3	28.7	27.9	108.6	107.4	106.1	31.6	1007.3	297.7	15.3	4.9	0	0
30-08-2025	11:00:00	29.4	28.8	28.3	108.6	107.6	106.1	14.8	1006.6	284.2	6.6	1.5	0	0
30-08-2025	12:00:00	29.4	28.8	28.1	108.8	107.6	105.9	73.8	1006.7	248.7	14	3.9	0	2.5
30-08-2025	13:00:00	30.2	29.4	28.4	108.9	103.1	98.5	116.8	1009.7	255.3	14	4.8	0	0.5
30-08-2025	14:00:00	31.6	30.2	29.4	100.5	98.2	95.6	140.1	1011.6	239.3	20.6	7.2	1.3	0
30-08-2025	15:00:00	31.6	30.3	29.4	97.6	95.9	94.2	98.2	1006.4	226.9	36	11.4	2	0
30-08-2025	16:00:00	30.8	30.4	30	95.9	93.4	92	108.7	1004.5	242.9	25.3	12.3	5.3	0
30-08-2025	17:00:00	31	30.7	30.3	92.9	91.5	90.2	81.3	1004.4	230.5	24	11.5	4.6	0
30-08-2025	18:00:00	30.8	30.4	30	96.2	94.6	92.4	39	1004.3	215.4	20.6	11.4	4.6	0
30-08-2025	19:00:00	30.4	30	29.6	98.3	96.7	95.2	4.7	1004.7	213.4	24.6	12.1	4	0
30-08-2025	20:00:00	30	29.7	29.3	99.8	99	98	0	1005	194.7	22	12.2	4.6	0
30-08-2025	21:00:00	30	29.4	29	99.3	98.6	98	0	1005.2	198.4	21.3	9.5	4	0
30-08-2025	22:00:00	30.1	29.8	29.5	100.1	99.1	98.3	0	1005.8	191.9	29.3	15.2	7.3	0
30-08-2025	23:00:00	30	29.7	29.3	100.5	98.4	95.8	0	1005.2	231.5	28	14.3	7.3	0
31-08-2025	00:00:00	30.1	29.6	29.1	99.7	99.5	99.4	0	1005.2	242.5	32	13.8	4.6	0
31-08-2025	01:00:00	30.1	29.8	28.7	109.1	100.4	99.2	0	1006.2	222.1	33.3	13.8	4	0
31-08-2025	02:00:00	30.2	29.8	29.3	100.1	99.3	98.7	0	1005.5	228.7	31.3	12.4	5.3	0
31-08-2025	03:00:00	30.1	29.7	29.3	99.6	99	98.4	0	1004.9	242.7	28.6	11.2	4.6	0
31-08-2025	04:00:00	30	29.5	29	99.4	98.9	97.8	0	1004.3	242.4	35.3	13.7	6	0
31-08-2025	05:00:00	30	29.6	29.2	99.4	98.3	97.4	0	1004.4	240.4	29.3	13.4	4.6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
31-08-2025	06:00:00	29.9	29.5	29.2	98.7	97.9	97.4	0	1004.5	238.9	25.3	9.8	4	0
31-08-2025	07:00:00	30	29.6	29.2	99	98.4	97.8	0.5	1005.2	236.3	24	10.2	4	0
31-08-2025	08:00:00	30	29.7	29.4	99.1	98.3	97.1	12.7	1005.9	228.8	28.6	13.1	5.3	0
31-08-2025	09:00:00	30.9	30.2	29.5	97.8	95.6	93	59.3	1006.7	227.7	28	12	4.6	0
31-08-2025	10:00:00	31.4	30.9	30.2	95	92.8	91.8	185.4	1008.1	238	24	11.1	5.3	0
31-08-2025	11:00:00	32.5	31.7	31.2	92	88.9	86.2	185.7	1008	223.5	38.6	14.3	4.6	0
31-08-2025	12:00:00	31.4	31.4	31.4	90.7	90.7	90.7	146.3	1007.4	207	0	2.6	2.6	0
31-08-2025	13:00:00	32.3	30.8	30.1	95.8	93.6	88.7	112.6	1006.6	242.5	32	12.6	4.6	0
31-08-2025	14:00:00	33.5	32.6	31	93.2	87.6	83.8	240	1006.7	229.4	32.6	14	4.6	0
31-08-2025	15:00:00	33.1	32.5	32	87.5	85.5	83.9	163.4	1005.8	231.1	32	13.8	4.6	0
31-08-2025	16:00:00	33.1	32.5	32	87.4	85.5	83.4	171.1	1004.9	224.8	36	17.1	6.6	0
31-08-2025	17:00:00	32.8	32	31.5	89.1	86.8	84.2	123.2	1004.3	236.2	38	16.6	8	0
31-08-2025	18:00:00	32.3	31.4	30.8	92	89.5	86.6	47.1	1003.8	232.3	40	16.5	7.3	0
31-08-2025	19:00:00	31.2	30.6	30.1	95.4	93.4	91.3	4.7	1003.3	231.6	39.3	16.3	7.3	0
31-08-2025	20:00:00	30.4	30.1	29.7	96	95.3	94.2	0	1003.6	233.5	39.3	16.7	6	0
31-08-2025	21:00:00	30.5	30.1	29.8	95.9	95.1	94.4	0	1004.3	233.8	43.3	16.3	7.3	0
31-08-2025	22:00:00	30.4	30.1	29.8	95.8	94.9	94.2	0	1004.5	238.4	40.6	17.5	8	0
31-08-2025	23:00:00	30.3	29.9	29.5	94.6	92.7	90.6	0	1004.8	246.3	38	18.4	7.3	0
01-09-2025	00:00:00	30.6	30.1	29.8	93.4	92.5	90.7	0	1004.6	241.1	33.3	14.3	6	0
01-09-2025	01:00:00	30.4	30	29.6	94.5	93.6	92.4	0	1004.1	240.7	33.3	14.5	6	0
01-09-2025	02:00:00	30.4	29.7	28.7	98.5	94.7	92.6	0	1003.3	236.5	40.6	16.2	6	0
01-09-2025	03:00:00	29.8	29.4	28.8	100.2	98.2	97	0	1002.6	239.4	38	15.2	7.3	0.5
01-09-2025	04:00:00	29.7	29.3	28.9	99.4	98.5	96.9	0	1002.3	236.6	44.6	16.7	6.6	0.5
01-09-2025	05:00:00	29	28.2	26.7	108.8	107.5	102.9	0	1002.1	256.5	36.6	16.8	4.6	1
01-09-2025	06:00:00	29.5	28.8	27.5	108.7	102	96.8	0	1002	248.5	64.6	19	8	1
01-09-2025	07:00:00	29.7	28.9	28.2	100.1	97.8	95.2	0.5	1002.5	257.6	40	17.8	7.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
01-09-2025	08:00:00	30.3	29.7	29.2	95.6	94	92.3	18.1	1003.1	252.8	34.6	15.8	6.6	0
01-09-2025	09:00:00	31.3	30.4	29.4	95.8	93.6	91.4	91.1	1004.1	246.1	33.3	14.3	4.6	0
01-09-2025	10:00:00	30.2	29.5	28.2	98.7	96.8	95	96.9	1004.4	270.3	34	13.2	4.6	0
01-09-2025	11:00:00	31.4	30.2	29.4	95.4	94	91.2	115.5	1004.7	235.4	43.3	15.1	2.6	0
01-09-2025	12:00:00	34.7	31.6	30.8	92.6	89.8	87.9	240.9	1004.8	236.3	45.3	19.3	9.3	0
01-09-2025	13:00:00	33.1	32.4	31.8	90.5	86.1	82.9	309.6	1004.6	232.6	43.3	18.7	6.6	0
01-09-2025	14:00:00	32.7	32	31.4	89	86.2	83.3	247.5	1003.6	235.7	46.6	19.7	6	0
01-09-2025	15:00:00	32.5	31.2	30.3	93.6	89.2	85.1	95.9	1002.6	237.8	47.3	20.8	9.3	0
01-09-2025	16:00:00	31.6	30.9	30	94.4	91.2	88.6	91.6	1001.9	239.1	39.3	17.6	7.3	0
01-09-2025	17:00:00	31.5	30.7	29	97.4	91.4	88.9	39.3	1001.3	249.4	41.3	17.8	6	1
01-09-2025	18:00:00	29.4	28.9	27.9	108.8	107.9	104	0.1	1000.6	250.3	49.3	18.2	4.6	2
01-09-2025	19:00:00	29.3	29	28.2	108.7	107.9	106.1	0	1001.3	248.3	45.3	22.3	10	0
01-09-2025	20:00:00	30	29.3	28.5	108.7	104	98.9	0	1002.4	245.1	48.6	21.6	9.3	0
01-09-2025	21:00:00	29.9	29.5	29.1	100	97.9	97.1	0	1002.5	247.1	47.3	23.3	6.6	0
01-09-2025	22:00:00	30.1	29.6	29.2	97.9	96.8	95.4	0	1002.9	247.3	47.3	22.2	9.3	0
01-09-2025	23:00:00	30.3	30	29.7	95.9	95.2	94.5	0	1003.5	248.4	45.3	21.2	7.3	0
02-09-2025	00:00:00	30.8	30	29.8	95.8	95.1	94.2	0	1003.3	247.4	43.3	21.5	10	0
02-09-2025	01:00:00	30.3	29.8	29	97.7	95.5	93.8	0	1003.1	247.6	54	20.5	8.6	0
02-09-2025	02:00:00	30.3	29.6	29.2	98.1	96.8	96	0	1002.6	253.3	44.6	21	5.3	0
02-09-2025	03:00:00	30	29.7	29.3	98	97	96.2	0	1002.4	255.8	42.6	18.6	7.3	0
02-09-2025	04:00:00	30.2	29.8	29.5	96.8	96	95.4	0	1002.1	258.4	37.3	17	5.3	0
02-09-2025	05:00:00	30	29.6	29.2	96.5	95.7	94.5	0	1001.9	264.8	38.6	17.5	4.6	0.5
02-09-2025	06:00:00	32.1	29.7	29.4	96.1	94.7	93.7	0	1002.2	261.5	36.6	17.4	8	0
02-09-2025	07:00:00	30	29.7	29.4	95.6	95	94.5	0	1002.5	262.2	35.3	16	6.6	0
02-09-2025	08:00:00	30.4	30	29.6	94.9	94.1	92.8	21.5	1003.4	261.2	39.3	16.9	8	0
02-09-2025	09:00:00	31.5	30.7	30	93.3	92.1	89.6	89.1	1004.5	265.2	33.3	13.9	4	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
02-09-2025	10:00:00	32.3	31.7	31	90.2	88.4	86.8	179.5	1005.7	258.4	26.6	11.8	3.3	0
02-09-2025	11:00:00	32.9	32.5	31.4	88.3	85	83.1	291.8	1006.6	246.9	32.6	15	0	0
02-09-2025	12:00:00	32.9	32.1	31.4	89.5	86.4	83.5	192.5	1005.7	255	32	14.5	4.6	0
02-09-2025	13:00:00	33.3	32.7	32	87.8	85	82.1	325.8	1005.3	245.7	33.3	14.7	5.3	0
02-09-2025	14:00:00	34.1	33.5	32.8	84.3	82.2	80	377.3	1004.6	234	34.6	16.2	6	0
02-09-2025	15:00:00	34.1	33.5	32.9	84.6	82.1	79.4	266.8	1003.9	231.6	32.6	16.2	7.3	0
02-09-2025	16:00:00	33.9	33.3	32.7	85.9	83.7	81.7	185.6	1003	224.2	36	16.7	6	0
02-09-2025	17:00:00	33.3	32.4	31.8	88.5	86.9	84.2	105.1	1002.3	224.5	45.3	19.9	8	0
02-09-2025	18:00:00	32.7	32	31	88.7	85.9	82.8	60.6	1002.1	226	42	20	8.6	0
02-09-2025	19:00:00	31.4	31	30.5	91	89.5	87.9	3.8	1002.2	224.6	46.6	20.1	7.3	0
02-09-2025	20:00:00	31	30.6	30.3	92.2	91.1	89.8	0	1002.7	226	46	20.6	8.6	0
02-09-2025	21:00:00	30.8	30.5	30.2	93.2	92.5	91.6	0	1003.5	227.8	44.6	20.6	8	0
02-09-2025	22:00:00	30.8	30.4	30.2	94	93.5	92.7	0	1004.2	225.2	42	19.9	8	0
02-09-2025	23:00:00	30.6	30.3	30	94.2	93.8	93.3	0	1004.8	227	42	20.4	8	0
03-09-2025	00:00:00	30.4	30.2	29.9	94.6	94	93.4	0	1004.6	236.2	44.6	16.3	8	0
03-09-2025	01:00:00	30.4	30	29.7	94.8	93.4	91.4	0	1004	244.5	38.6	17.9	6.6	0
03-09-2025	02:00:00	30.2	29.9	29.3	93.5	91.8	90.9	0	1003.6	247.1	33.3	16.9	4	0
03-09-2025	03:00:00	30.2	29.9	29.6	92.6	91.7	90.8	0	1003.2	257.2	34.6	16.9	6.6	0
03-09-2025	04:00:00	30.1	29.7	29.4	94	93	91.2	0	1002.8	274.1	30	13.4	6	0
03-09-2025	05:00:00	29.9	29.6	29.4	94.5	93.9	93.4	0	1002.6	283.3	26.6	11.6	4.6	0
03-09-2025	06:00:00	29.8	29.5	29.2	94.4	93.5	92.5	0	1003	284.4	29.3	11.9	4	0
03-09-2025	07:00:00	29.8	29.5	29.2	93	92.2	91.6	0	1003.5	290.3	31.3	11.8	4	0
03-09-2025	08:00:00	30	29.5	29.2	92	91.2	89.8	19.6	1004.4	294.6	29.3	12.6	4.6	0
03-09-2025	09:00:00	31.4	30.5	29.6	90.3	87.1	84.6	134.5	1005.6	297.9	32	14.9	5.3	0
03-09-2025	10:00:00	31.8	31.3	30.8	86	84.4	82.7	221.5	1006.7	297.3	33.3	15.4	5.3	0
03-09-2025	11:00:00	32.8	32.2	31.4	84.7	81	78.6	313.7	1007.5	301.1	26.6	11.7	2.6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
03-09-2025	12:00:00	32.8	32.4	31.8	82.1	79.4	77.6	306	1007	297.1	28.6	13.1	3.3	0
03-09-2025	13:00:00	33.7	32.9	31.9	81.5	77.2	73.4	374.7	1006.3	294.5	28	12	2.6	0
03-09-2025	14:00:00	34.4	33.9	33.1	77.1	72.3	69.4	314.7	1005.8	273.8	26	10.1	2.6	0
03-09-2025	15:00:00	33.4	32.5	31.6	94	88.3	84	199.3	1000.8	226.9	28.6	11.2	4	0
03-09-2025	16:00:00	32.7	32.4	31.8	91.1	89.9	89.1	152.9	1000.4	217.1	32.6	17.1	5.3	0
03-09-2025	17:00:00	33.2	32.5	31.4	93.1	89.9	85.6	138.2	999.8	217.5	37.3	19.6	8	0
03-09-2025	18:00:00	32.7	32.3	31.9	90.2	89.2	87.8	65.8	999.5	218.9	40	18.2	6.6	0
03-09-2025	19:00:00	32.1	31.4	30.8	92.7	90.5	88.5	30.5	1003.6	216.9	42	17.9	7.3	0
03-09-2025	20:00:00	31.4	31.1	30.8	93.4	92.2	89.2	0.4	1005.3	213.4	44	20.3	8.6	0
03-09-2025	21:00:00	31.4	30.9	30.4	94.2	93.1	91.8	0	1001	216.5	38	18.6	7.3	0
03-09-2025	22:00:00	31.1	30.8	30.4	94.3	93.1	91.8	0	1001.3	216.1	38	19	8.6	0
03-09-2025	23:00:00	31.2	30.7	30.4	96.1	94.9	93.8	0	1001.5	216.3	36.6	17.5	8	0
04-09-2025	00:00:00	28.3	27.8	27.3	106.1	106	106	0	1005	188.4	25.3	12.7	4	0.5
04-09-2025	01:00:00	27.9	27.3	26.8	108.4	107.2	106	0	1001.6	207.2	25.3	8.6	2	1
04-09-2025	02:00:00	27.3	26.8	26.3	108.6	107.6	106.7	0	1001.3	202.6	23.3	10	3.3	0.5
04-09-2025	03:00:00	26.5	26.2	25.6	108.6	108.1	106	0	999.3	209.5	25.3	11.6	4	0.5
04-09-2025	04:00:00	27.7	27	25.9	108.5	107.3	105.8	0	1000.8	306.6	37.3	15.2	6	3.5
04-09-2025	05:00:00	27.7	27.3	26.8	108.2	107.5	106.7	0	1001.6	328.7	32.6	14.4	4.6	2.5
04-09-2025	06:00:00	27.9	27.5	26.9	108.1	107.4	106.5	0	1002.6	295	20.6	8.8	0.6	0.5
04-09-2025	07:00:00	27.8	27.3	26.8	108.1	107.4	106.5	0	1003	269.4	14.6	5.9	0	0
04-09-2025	08:00:00	28.8	28.1	27.3	108.8	107.6	106	6	1005.4	269.2	16.6	6.5	0.6	0
04-09-2025	09:00:00	29.3	28.8	27.9	108.7	102.7	98.2	20.8	1006.5	271.9	25.3	9.8	2.6	0
04-09-2025	10:00:00	30	29.5	28.9	98.7	94.5	91.7	77.2	1010.1	288.8	32	13.4	4	0
04-09-2025	11:00:00	30.6	30.2	29.6	92.3	90.9	89.1	116.4	1005.9	284.3	36	14.6	4.6	0
04-09-2025	12:00:00	30.7	30.4	30.2	90.3	89.6	88.5	105	1005	286.2	33.3	14.7	2	0
04-09-2025	13:00:00	31.4	31	30.4	90	87.7	86.1	161.2	1004.8	281.6	31.3	13	4	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
04-09-2025	14:00:00	31.9	31.1	30.4	88.8	87.2	84.9	142.5	1003.8	269.1	36	14.1	4.6	0
04-09-2025	15:00:00	31.9	30.9	30.4	91.8	89.2	85.1	67.1	1003	252.6	34.6	16.9	6	0
04-09-2025	16:00:00	30.6	30.2	29.4	95.8	92.8	91.3	11.1	1002.4	252.2	35.3	15.9	7.3	0.5
04-09-2025	17:00:00	28.5	28.1	27.7	108.7	106.8	101.6	0	1001.8	293.5	25.3	14.3	2	0
04-09-2025	18:00:00	28.9	28.1	27.4	108.5	103.3	98.1	0	1005.3	253.1	32	13.4	4	0
04-09-2025	19:00:00	29	28.6	27.7	108.7	101.8	99.8	0	1002.7	255.4	32.6	16.7	7.3	0.5
04-09-2025	20:00:00	29.1	28.7	28.3	100.8	99.8	98.8	0	1002.7	248.6	40.6	19	7.3	0
04-09-2025	21:00:00	30	29.2	28.5	102.2	99.9	98.9	0	1004.4	241.8	34	14.2	6.6	0
04-09-2025	22:00:00	29.9	29.3	28.7	108.8	105.1	98.9	0	1003.7	244.1	47.3	20.8	8	0.5
04-09-2025	23:00:00	29.6	29.1	28.7	100.2	98	95.8	0	1003.4	254.6	56.6	27.8	13.3	0
05-09-2025	00:00:00	29.3	28.6	28.1	100	98.4	96.3	0	1003	247.4	51.3	24.3	12	0
05-09-2025	01:00:00	29.8	29.1	28.2	99.2	97.6	95	0	1002.7	252.8	48	24.4	10	0
05-09-2025	02:00:00	29.7	29.4	29	95.3	94.5	94	0	1002.1	262.2	41.3	15.6	4	0
05-09-2025	03:00:00	29.5	29	28.7	95.4	94.5	93.8	0	1001.6	281.9	16.6	7.2	2.6	0
05-09-2025	04:00:00	29.3	28.8	28.5	95.4	94.8	94.1	0	1001.7	281.7	19.3	7.8	2	0
05-09-2025	05:00:00	29	28.3	27	98.7	94.8	93.2	0	1001.9	303.6	20	8.2	2.6	1.5
05-09-2025	06:00:00	27.6	26.9	26.2	108.7	103.3	98.3	0	1001.5	294	15.3	5.9	0.6	1.5
05-09-2025	07:00:00	27.3	26.7	26	108.7	108	106	0	1002.4	299.4	12	4.1	0.6	0
05-09-2025	08:00:00	26.9	26.4	25.7	108.7	107.5	105.8	0	1002.1	251.4	10.6	2.9	0	1.5
05-09-2025	09:00:00	27.6	26.8	25.7	108.7	105.7	99.6	7.1	1004.9	266.9	26.6	11.9	4	0
05-09-2025	10:00:00	28.2	27.7	27	101.8	99.4	98.2	14.2	1005.8	264.8	32.6	14.2	4	0
05-09-2025	11:00:00	28.5	27.9	27.1	106.3	99.4	97	35	1006.7	259.9	35.3	16.6	5.3	0
05-09-2025	12:00:00	29.7	28.7	28.2	97.5	96	93.2	55.5	1006.9	261.8	34.6	15.9	5.3	0
05-09-2025	13:00:00	31	30.3	29.4	93.6	90	87.7	169.9	1005.4	257	37.3	17.4	6	0
05-09-2025	14:00:00	30.6	30.2	29.9	91.4	90.2	88.9	98.5	1004.5	246.3	35.3	16.3	7.3	0
05-09-2025	15:00:00	30.8	30.4	30	92	90.4	89.4	110.7	1003.8	239.6	35.3	16	7.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
05-09-2025	16:00:00	30.6	30.3	30	92.9	92	91	59.8	1003	235.1	30.6	13.2	5.3	0
05-09-2025	17:00:00	30.6	30.1	29.5	96.3	93.8	92.2	26.2	1002.5	236.2	32.6	12.4	6	0
05-09-2025	18:00:00	29.9	29.5	29.1	97.7	97	95.8	9.6	1002.1	239.7	36.6	14.6	6	0
05-09-2025	19:00:00	30.1	29.8	29.4	97.1	96.3	95.8	0.1	1002.9	236.8	40	15.3	6.6	0
05-09-2025	20:00:00	30	29.6	28.7	103.5	98.4	96.7	0	1003.1	234.3	40	16.8	6.6	1.5
05-09-2025	21:00:00	29.6	29.2	28.5	108.9	106.4	101.1	0	1003.5	237.1	44	19.2	7.3	0
05-09-2025	22:00:00	29.7	29.3	28.5	108.9	107.9	105.8	0	1004.4	231.5	42.6	17.2	8	0
05-09-2025	23:00:00	30	29.5	28.9	108.9	104.7	99.6	0	1005.2	236	44.6	15.7	7.3	0
06-09-2025	00:00:00	30	29.5	28.7	107.6	100.8	98.9	0	1004.8	233.5	32	13.4	5.3	0.5
06-09-2025	01:00:00	29.6	29.2	28.5	108.2	104.5	100.7	0	1004.3	239.3	29.3	12.7	6	0
06-09-2025	02:00:00	29.7	29.1	28.3	108.8	103.7	100.1	0	1003.9	250.4	41.3	17.4	8	1.5
06-09-2025	03:00:00	29.2	28.7	28.1	108.9	107.6	106.1	0	1003.3	258.1	32.6	15.3	4.6	2.5
06-09-2025	04:00:00	29.1	28.4	27.7	108.5	107.7	106.7	0	1002.8	264.8	30	13.1	4	1
06-09-2025	05:00:00	29	28.4	27.8	108.4	107.6	106.8	0	1002.5	244.6	24.6	11.5	3.3	0
06-09-2025	06:00:00	29.2	28.8	28.3	108.5	107.8	106.8	0	1003.1	247.9	23.3	11.3	2.6	0
06-09-2025	07:00:00	29.7	29.2	28.5	108.9	107.3	101.2	0	1003.9	259.1	23.3	9.8	3.3	0
06-09-2025	08:00:00	30.1	29.6	29	102	98.6	96.5	14.3	1004.6	259.2	22	10.5	3.3	0
06-09-2025	09:00:00	30.6	30.1	29.7	97.2	95.4	93.3	40.1	1005.3	246.9	24	11.6	4.6	0
06-09-2025	10:00:00	32	31.2	30.1	93.8	91.2	88.3	126.6	1006.2	234.5	28	11.5	4.6	0
06-09-2025	11:00:00	32.9	32.1	31.4	89.6	86.9	84.3	219	1006.9	227.1	32	15.2	6.6	0
06-09-2025	12:00:00	33.1	32.6	32.3	88	86.2	84.9	277.9	1007.2	229.3	40.6	17.8	6	0
06-09-2025	13:00:00	32.8	31.9	31.4	90.2	88.2	85.3	127.9	1006.3	235.2	35.3	15.6	6	0
06-09-2025	14:00:00	32.6	31.8	31.2	90.8	89.6	88	148.8	1005.4	236.2	38.6	16.2	6	0
06-09-2025	15:00:00	32.4	31.8	31.3	92.6	90.5	88.7	131.2	1004.5	237.9	38.6	16.3	4.6	0
06-09-2025	16:00:00	31.9	30.3	29.3	94.9	93	91.1	39.7	1003.4	275.4	37.3	14.5	5.3	0
06-09-2025	17:00:00	30.6	30.2	29.6	95	94.3	93.4	22.2	1002.9	265.5	30	7.2	1.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
06-09-2025	18:00:00	30.4	29.8	29.2	98.2	96.5	93.8	7	1002.9	232.5	40	15.4	4	0
06-09-2025	19:00:00	30.4	30.1	29.5	98	97	96	0	1003.3	234.4	43.3	16.8	6.6	0
06-09-2025	20:00:00	30.1	29.8	29.5	97.2	96.1	94.5	0	1003.9	252.8	44	19.9	9.3	0
06-09-2025	21:00:00	30.2	29.9	29.2	95.6	94.7	94	0	1004.6	255.3	37.3	18.2	7.3	0
06-09-2025	22:00:00	30.1	29.7	29.4	96.6	95.5	94.9	0	1004.9	241.7	39.3	16.7	6.6	0
06-09-2025	23:00:00	29.9	29.6	29.3	97.2	96.4	95.8	0	1005.1	234.4	41.3	17.7	8.6	0
07-09-2025	00:00:00	29.9	29.4	28.5	100.1	97.8	96.5	0	1005.1	233	45.3	18.7	7.3	0
07-09-2025	01:00:00	29.3	28.9	28.5	101.6	99.7	98.9	0	1004.5	239.9	55.3	20.8	10	0
07-09-2025	02:00:00	29.4	29	28.5	101.7	99.9	98.9	0	1003.9	241.4	49.3	21.8	10	0.5
07-09-2025	03:00:00	29.6	29.2	28.8	100.1	99.1	98.2	0	1003.4	237.6	52.6	20.7	10	0
07-09-2025	04:00:00	29.6	29.3	29	99.5	98.6	97.4	0	1003.2	244	54.6	23.4	8.6	0
07-09-2025	05:00:00	29.6	28.9	27.8	108.5	98.7	95.6	0	1002.9	253.7	59.3	22	8	1
07-09-2025	06:00:00	29.8	29.2	28.4	99.8	98.2	97.2	0	1003.1	250.9	50	25	10	0
07-09-2025	07:00:00	29.8	29.3	28.9	99.2	98.2	97.4	0	1003.4	252.1	51.3	22.5	8.6	0
07-09-2025	08:00:00	29.9	29.5	29.1	98.7	96.9	94.4	10.9	1004.5	242.4	51.3	21.7	8.6	0
07-09-2025	09:00:00	30.4	30	29.4	94.8	92.9	91.8	24.9	1005.7	241.8	48	18.6	8.6	0
07-09-2025	10:00:00	30.8	30.3	29.8	93.1	92	90.3	58.2	1006.3	239.3	52	21	8	0
07-09-2025	11:00:00	30.9	30.6	30.2	91.3	90.4	89.3	69.5	1006.4	242	51.3	22.2	7.3	0
07-09-2025	12:00:00	31.1	30.6	30.3	92.4	91.4	90	78.7	1006.4	236.8	52	21.3	9.3	0
07-09-2025	13:00:00	31.4	31	30.4	91.8	88.4	84.5	151.1	1006	241.2	54.6	25.1	10.6	0
07-09-2025	14:00:00	31.6	31.3	30.9	88	86.1	84	133.1	1005.3	237	52.6	23.5	9.3	0
07-09-2025	15:00:00	31.8	31.3	30.8	88.5	87	85.8	139.4	1004.9	237.3	50.6	22.1	10	0
07-09-2025	16:00:00	31.4	30.9	30.6	89.8	88.8	87.1	86.2	1004.2	234.1	45.3	19.5	9.3	0
07-09-2025	17:00:00	31	30.7	30	90.1	87.7	86.4	54.1	1003.6	229.4	49.3	19.8	0.6	0
07-09-2025	18:00:00	31	30.6	30.2	90	88	86.4	44.2	1003.3	225	48.6	22.5	9.3	0
07-09-2025	19:00:00	30.6	30.1	29.6	92.3	91	89.1	3.3	1003.6	220.6	41.3	21.5	9.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
07-09-2025	20:00:00	30.2	29.8	29.4	92.9	90.6	88.9	0	1004.2	226.3	44	19.8	9.3	0
07-09-2025	21:00:00	30.3	29.9	29.6	91.8	91	89.5	0	1004.8	219.3	43.3	20.5	7.3	0
07-09-2025	22:00:00	30.2	29.8	29.5	92.1	91.1	90	0	1005.6	227.8	43.3	18	8	0
07-09-2025	23:00:00	30	29.7	29.4	92.3	91.7	90.8	0	1005.9	225.7	38.6	17.8	7.3	0
08-09-2025	00:00:00	30	29.7	29.4	93.2	92.3	91.6	0	1005.9	219.9	37.3	18.8	7.3	0
08-09-2025	01:00:00	29.9	29.5	29.2	94.3	93.4	92.4	0	1005.3	220.9	43.3	19.8	8.6	0
08-09-2025	02:00:00	29.7	29.4	29.1	94.5	93.8	93.2	0	1004.5	214.3	41.3	21	9.3	0
08-09-2025	03:00:00	29.7	29.4	29	94.4	93.8	93.1	0	1004.2	216.6	42.6	20.8	10	0
08-09-2025	04:00:00	29.9	29.5	29.2	94.6	93.6	93	0	1003.7	213.8	43.3	21.2	7.3	0
08-09-2025	05:00:00	29.7	29.4	29	94.4	93.3	92	0	1003.4	210.7	43.3	21.7	9.3	0
08-09-2025	06:00:00	29.8	29.4	29.1	93.8	92.9	92.2	0	1003.7	208.7	42	21.7	10	0
08-09-2025	07:00:00	29.8	29.4	29	94.2	93.4	92.5	0.8	1003.8	201	48.6	23.6	10	0
08-09-2025	08:00:00	30.4	29.7	29.2	93.7	92.1	88.9	33.3	1004.8	202.2	46.6	24.9	11.3	0
08-09-2025	09:00:00	31	30.5	30.1	90.3	88.8	87.2	70	1006.2	203.8	48.6	24.6	11.3	0
08-09-2025	10:00:00	31.9	30.8	30.3	89.8	86.8	83.4	110.7	1006.8	210.5	45.3	24.5	8	0
08-09-2025	11:00:00	32.9	32.3	31.3	83.5	79.9	78.3	256.5	1008.4	216.8	53.3	27	11.3	0
08-09-2025	12:00:00	33.3	32.7	32.1	81.2	78.5	76.3	342.6	1008	214.3	58	29.5	14	0
08-09-2025	13:00:00	33.7	33.1	32.7	78.4	75.6	73.4	358.9	1007.8	214.2	52	27.6	9.3	0
08-09-2025	14:00:00	33.7	33.1	32.7	77.6	74.9	70	283.6	1007.4	216.4	47.3	25	10.6	0
08-09-2025	15:00:00	33.9	33.4	32.9	76.7	73.3	70.6	310.8	1006.9	216.3	45.3	23.6	9.3	0
08-09-2025	16:00:00	33.7	33.2	32.7	76.9	75.3	73.7	248	1006.5	209	46	25.5	9.3	0
08-09-2025	17:00:00	33.3	32.8	32.4	77.7	75.8	73.8	163.6	1005.9	205.5	44	24	10.6	0
08-09-2025	18:00:00	32.8	31.9	31.4	80.3	77.9	75.3	72.3	1005.4	206.8	42.6	23.1	8	0
08-09-2025	19:00:00	31.7	30.8	30	86.7	83.2	79.1	5.8	1005.3	210	37.3	19.2	8	0
08-09-2025	20:00:00	30.6	30.1	29.8	87.4	86.3	85.2	0	1005.5	212.5	44.6	20.1	8.6	0
08-09-2025	21:00:00	30.4	30	29.6	90	88.4	86.3	0	1006.4	211.3	34.6	18.5	6.6	0

Hazira station														
DATE	**TIME**	**AT_Max**	**AT_Avg**	**AT_Min**	**RH_Max**	**RH_Avg**	**RH_Min**	**SOLAR**	**BP**	**WD**	**WS_Max**	**WS_Avg**	**WS_Min**	**RAIN**
DD/MM/YY	**HH:MM:SS**	**DegC**	**DegC**	**DegC**	**%**	**%**	**%**	**W/m2**	**mbar**	**Deg**	**m/s**	**m/s**	**m/s**	**MM**
08-09-2025	22:00:00	30.2	29.8	29.4	90.5	89.7	88.9	0	1007.3	214	33.3	15.7	8	0
08-09-2025	23:00:00	30	29.6	29.3	91.2	90.3	89.4	0	1007.4	215.9	32.6	15.3	6.6	0
09-09-2025	00:00:00	29.8	29.4	29.1	91.4	90.4	89.6	0	1007.4	206.2	31.3	16	6.6	0
09-09-2025	01:00:00	29.7	29.3	29	92.2	91.4	90.5	0	1007.3	202.4	26.6	14	7.3	0
09-09-2025	02:00:00	29.7	29.2	28.8	92.9	92.2	91.6	0	1006.9	201.2	23.3	13.2	6	0
09-09-2025	03:00:00	29.6	29.2	28.8	93.9	93	92	0	1006.5	199.9	30	12.3	4.6	0
09-09-2025	04:00:00	29.4	29	28.7	94.3	93.3	92.4	0	1006	195.6	27.3	14.2	7.3	0
09-09-2025	05:00:00	29.6	28.9	28.3	99.3	97.1	94.2	0	1005.9	168.9	44.6	23.8	6.6	0
09-09-2025	06:00:00	29	28.6	27.8	108.7	101.5	98.7	0	1005.9	169.3	50	26.2	4.6	0
09-09-2025	07:00:00	28.7	28.4	27.8	108.8	108.2	104.9	0.7	1006.8	166.5	55.3	29	14.6	0
09-09-2025	08:00:00	29.4	28.9	28.1	108.8	104.8	99.2	39	1009.6	167.7	41.3	26.3	14	0.5
09-09-2025	09:00:00	30	29.3	28.6	102.4	99.5	98.3	85.3	1011.2	163.9	48	29.1	13.3	0
09-09-2025	10:00:00	29.6	28.8	28.1	91.2	86	80.9	190.2	1005.3	206.4	36	15.7	5.3	0
09-09-2025	11:00:00	30.4	29.1	27.8	94.4	93	91.6	247.5	1006	199.6	34	17.1	7.3	0
09-09-2025	12:00:00	31.7	30.2	28.8	87.1	86.8	86.5	352.6	1009.5	201.2	31.3	14.6	4	0
09-09-2025	13:00:00	31.4	31.3	31.2	92.7	84	75.3	350.7	1005.3	221.1	34	15.8	6	0
09-09-2025	14:00:00	33.1	32.5	32	84.8	81.9	80.2	365.2	1009.3	177.8	41.3	22.8	2	0
09-09-2025	15:00:00	34.1	33.3	32.7	81.1	77.6	73.9	322.9	1009	196.6	37.3	19	6.6	0
09-09-2025	16:00:00	34.4	33.7	33.2	77.1	75.4	72.9	258.8	1008.9	207	35.3	17.1	6.6	0
09-09-2025	17:00:00	33.7	33.2	32.7	78.9	77	75	161.3	1008.5	212	33.3	16.6	5.3	0
09-09-2025	18:00:00	33.2	32.5	31.7	82.3	78.8	76.1	64.5	1008.2	221.1	28	14.5	4	0
09-09-2025	19:00:00	32	31.2	30.4	86.9	84.2	81.8	4.5	1008.1	221.4	24	11.7	5.3	0
09-09-2025	20:00:00	30.8	30.3	30	87.3	86.6	85.5	0	1008.1	221.8	17.3	8	3.3	0
09-09-2025	21:00:00	30.4	30	29.5	89.9	88.1	86	0	1008.6	226.8	16	6.8	3.3	0
09-09-2025	22:00:00	30	29.5	29.2	90.9	90.4	89.4	0	1008.9	210.4	13.3	7.4	3.3	0
09-09-2025	23:00:00	29.6	29.3	29	92.8	91.5	90.3	0	1008.9	214.2	10.6	6.5	2.6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
10-09-2025	00:00:00	29.4	29.1	28.7	93.7	93.1	92.4	0	1008.7	221.3	11.3	6.1	2	0
10-09-2025	01:00:00	29.2	28.9	28.7	94.7	93.9	93.3	0	1008.4	225.7	13.3	6.6	3.3	0
10-09-2025	02:00:00	29	28.6	28.3	96.2	95.1	94.2	0	1008	213.8	10.6	5.4	2.6	0
10-09-2025	03:00:00	28.9	28.4	28.1	96.9	96.4	95.8	0	1007	210.9	12	6.1	2.6	0
10-09-2025	04:00:00	28.6	28.3	28	96.8	96.2	95.6	0	1007.4	197.4	13.3	8.3	3.3	0
10-09-2025	05:00:00	28.5	28.2	27.9	96.6	95.9	95.5	0	1007.5	200.4	13.3	7.5	4	0
10-09-2025	06:00:00	28.5	28.2	27.8	96.9	96.2	95.7	0	1007.9	195.2	13.3	7.6	4	0
10-09-2025	07:00:00	29.2	28.3	27.9	98.1	96	95	1.6	1008.4	180.9	15.3	7.4	4.6	0
10-09-2025	08:00:00	29.7	29.2	28.6	97.8	97	96.2	49	1009.9	158.1	22.6	12.6	4	0
10-09-2025	09:00:00	30.4	29.6	29.1	98.2	96.5	94.9	149.1	1011	154.6	28	19.1	4	0
10-09-2025	10:00:00	31.1	30.4	29.7	96.6	93.9	90.4	227.8	1008.2	150.3	26	18.4	10.6	0
10-09-2025	11:00:00	31.9	31.4	30.9	91.5	89.6	87.8	88.9	1003.5	238.7	44.6	19.8	5.3	0
10-09-2025	12:00:00	33.1	31.6	31.1	90.1	88.3	86.5	92.3	1003.3	234.8	48	18.9	8	0
10-09-2025	13:00:00	32.9	32.2	31	90.8	86.6	84.3	188.5	1003.3	234	54	22.1	8	0
10-09-2025	14:00:00	33.5	32.9	32.3	86.6	84.3	82.2	225.8	1003.3	226.3	50	23.3	9.3	0
10-09-2025	15:00:00	32.7	32.2	31.9	87.5	85.9	83.8	135.5	1002.2	224.8	56.6	26.5	12.6	0
10-09-2025	16:00:00	32.3	31.9	31.5	89.2	87.6	86.4	116.3	1001.7	226.4	62.6	26.2	11.3	0
10-09-2025	17:00:00	32.1	31.7	31.4	88.8	87.6	86.3	104.8	1001.4	225.5	52.6	25.4	11.3	0
10-09-2025	18:00:00	32.1	31.4	31	89.6	88.3	86.5	53.1	1001.6	227	54.6	25.6	11.3	0
10-09-2025	19:00:00	31.4	31	30.5	91.8	90.1	88.5	16.9	1001.4	228.2	51.3	24.6	10	0
10-09-2025	20:00:00	31.5	30.7	30.2	93.4	92.5	91.4	0	1002.2	224	48	22.5	8.6	0
10-09-2025	21:00:00	30.8	30.5	30.2	93.7	92.6	91.7	0	1002.4	221.2	45.3	24.6	12	0
10-09-2025	22:00:00	31.2	30.4	30.2	93.8	93.2	92.6	0	1002.7	223.4	50.6	23.6	10.6	0
10-09-2025	23:00:00	30.8	30.4	30	94.2	93.5	92.7	0	1002.8	227.7	48.6	21.4	8.6	0
11-09-2025	00:00:00	31	30.5	30.2	93.4	92.3	91.2	0	1001.9	223.8	55.3	24.1	10	0
11-09-2025	01:00:00	30.4	30.3	30.2	93.8	93	92	0	1003.4	227.1	50.6	23.2	10.6	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
11-09-2025	02:00:00	30.5	29.7	28.4	96.3	92.9	90.1	0	1003.9	231.9	67.3	22.2	8	0
11-09-2025	03:00:00	29.8	29.1	28.3	99.4	97.7	96	0	1002.2	231.1	52.6	15.3	6	0
11-09-2025	04:00:00	30.2	29.6	28.9	99.6	98	96.5	0	1003.8	230.1	46.6	20.6	9.3	0
11-09-2025	05:00:00	30.4	29.9	29.4	97	94.6	93.1	0	1003.8	235.4	49.3	21.1	8.6	0
11-09-2025	06:00:00	30.3	30	29.6	94.3	93.4	92.5	0	1002.4	227.5	55.3	22.8	9.3	0
11-09-2025	07:00:00	30.3	29.9	29.5	96.8	95.1	93.6	0.1	1002.9	227.2	43.3	18.8	9.3	0
11-09-2025	08:00:00	30.1	29.9	29.4	95.4	93.8	92.4	17.6	1003.8	234.5	44.6	18.4	8.6	0
11-09-2025	09:00:00	31.4	30.9	30.4	93.4	91.6	90	53.1	1004.8	236.1	41.3	17.4	7.3	0
11-09-2025	10:00:00	31.8	31.5	31.1	90.8	88.1	85.9	134	1005.7	239.2	41.3	19.2	8	0
11-09-2025	11:00:00	31.7	31.7	31.7	82.4	82.4	82.4	125.2	1010.2	236.6	24	9.9	3.3	0
11-09-2025	12:00:00	33.9	32.9	31.6	82.6	78	74.3	361	1011.3	241.3	32.6	12.3	4	0
11-09-2025	13:00:00	33.9	33.3	32.7	79.4	76.1	71.7	372.6	1010.5	243.2	28.6	11.9	2.6	0
11-09-2025	14:00:00	34.4	34.1	33.3	72.9	70.1	67.5	326.3	1010.2	241.9	30	12.6	0.6	0
11-09-2025	15:00:00	31.2	30.2	29.6	89.3	87.8	86.3	225.7	1008.3	252.3	26.6	12.7	6	0
11-09-2025	16:00:00	34.5	34	33.3	73.4	71.2	69.4	255.2	1009.3	239.3	30	14.2	0.6	0
11-09-2025	17:00:00	33.7	33	32.6	76.9	74.5	72	123.6	1008.1	235.5	31.3	14.4	4.6	0
11-09-2025	18:00:00	33.3	32.5	31.4	80	76.2	72.9	69.6	1007.9	238.3	31.3	14.8	6	0
11-09-2025	19:00:00	31.9	31.3	30.8	83.1	81	79.1	3.7	1007.7	237.5	28.6	11.9	5.3	0
11-09-2025	20:00:00	31.2	30.7	30.4	83.9	83	81.7	0	1007.9	238.9	24.6	10.7	4	0
11-09-2025	21:00:00	31	30.6	30.3	88.2	85.8	82.9	0	1008.5	237.6	27.3	9.5	3.3	0
11-09-2025	22:00:00	30.8	30.5	30.1	88.5	87.4	86.5	0	1009	245.4	25.3	10.3	3.3	0
11-09-2025	23:00:00	30.8	30.4	30.2	90	88.6	87.8	0	1008.9	251	32	14.9	6.6	0
12-09-2025	00:00:00	30.6	30.2	30	91.4	90.3	89.2	0	1008.4	252.2	33.3	16	6.6	0
12-09-2025	01:00:00	30.4	30.1	29.7	92.2	91.3	90.4	0	1008.1	254.6	34.6	16	6.6	0
12-09-2025	02:00:00	30.2	29.9	29.5	92.6	91.7	91.1	0	1007.9	262.8	29.3	14.2	4	0
12-09-2025	03:00:00	30.1	29.7	29.4	92.3	91.4	90.4	0	1007.5	265.7	28	12.9	3.3	0

Hazira station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
12-09-2025	04:00:00	30	29.5	29.2	92.9	92.2	91.2	0	1007.4	264.7	23.3	9.9	3.3	0
12-09-2025	05:00:00	29.7	29.4	29.1	93	92.3	91.8	0	1007.3	281.3	22	8.3	2.6	0
12-09-2025	06:00:00	29.7	29.4	29	92.5	91.8	91.4	0	1007.6	274.4	23.3	10	4	0
12-09-2025	07:00:00	29.4	29	28.4	93.6	92.2	91.3	1.5	1008.2	292.1	18	8.2	3.3	0
12-09-2025	08:00:00	30.7	29.9	28.9	91.6	87.8	83.2	53.2	1009.4	292.2	19.3	9.2	3.3	0
12-09-2025	09:00:00	31.8	31.1	30.4	83.5	79.6	76.1	146.4	1011.3	294.2	20.6	10.2	3.3	0
12-09-2025	10:00:00	32.7	32	31.4	77.9	75.4	72.9	232.5	1012.3	299.4	24.6	10.4	2.6	0
12-09-2025	11:00:00	33.3	32.9	31.6	76.6	69.9	68.9	322.9	1009.4	289.1	25.3	10.5	4	0
12-09-2025	12:00:00	33.9	33.2	32.5	70.7	67.7	64.7	350.7	1012.2	264.8	28.6	11	3.3	0
12-09-2025	13:00:00	33.9	33.2	32.7	70	66.4	63.1	373.6	1011	271	29.3	12.4	4	0
12-09-2025	14:00:00	34.4	33.6	33	66.9	63.8	60.5	338.8	1010.4	269.6	28	13.1	4.6	0
12-09-2025	15:00:00	34	33.4	32.9	67.4	64.3	61.3	232.8	1009.4	261.6	28.6	13.1	3.3	0
12-09-2025	16:00:00	34.6	33.9	33.1	66.2	62.2	58.9	240.2	1009.1	274	22	10.8	4.6	0
12-09-2025	17:00:00	34.7	33.9	33.1	68.9	64.4	58.8	127.5	1008.3	235.7	24	10.2	2.6	0
12-09-2025	18:00:00	34.1	32.9	31.8	73.5	69.5	64.9	63.6	1007.9	234.3	21.3	10.5	4	0
12-09-2025	19:00:00	32.2	31.6	30.9	80.8	78.3	73	2.2	1007.7	241.9	20.6	9.7	4	0
12-09-2025	20:00:00	31.4	31	30.6	84	82.2	80.3	0	1007.9	244.1	21.3	9	2.6	0
12-09-2025	21:00:00	31.2	30.8	30.5	85.1	83.3	82	0	1008	244.2	22	8.1	2.6	0
12-09-2025	22:00:00	31	30.7	30.4	88.3	86.2	84.3	0	1008.7	240.9	53.3	7.8	3.3	0
12-09-2025	23:00:00	30.8	30.5	30.2	90.7	89.3	87.8	0	1008.8	241.1	18.6	8.2	2.6	0

Ghogha Meteorological Data

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
13-08-2025	00:00:00	28.9	28.2	27.9	82.5	81.7	80.3	0	1002.6	233.7	14	4.6	0.6	0
13-08-2025	01:00:00	28.9	28.3	27.8	82.1	80.3	78.5	0	1002.4	230.3	7.3	2.2	0	0
13-08-2025	02:00:00	29	27.9	26.7	83.4	80.2	77.6	4.1	1001.9	244.3	15.3	3.9	0	0
13-08-2025	03:00:00	28.5	27.4	26.6	84.8	84.1	82.7	3.1	1000.8	233.8	8.6	2.9	0	0
13-08-2025	04:00:00	28.1	27.6	27	84.3	83.1	82.4	0	1000.7	238.4	8.6	2.9	0	0
13-08-2025	05:00:00	28.1	27.7	27.3	82.8	82.1	81.5	0	1000.8	238.6	8.6	2.6	0	0
13-08-2025	06:00:00	28	27.5	27	83.3	82.5	81.6	0	1001.2	242	9.3	2.6	0	0
13-08-2025	07:00:00	27.8	27.3	26.9	84	83.2	82.2	0.6	1001.5	240.5	8	1.5	0	0
13-08-2025	08:00:00	29.1	28.2	27.3	82.7	81.1	78.7	23.9	1002.1	236.8	8.6	2	0	0
13-08-2025	09:00:00	31.9	29.9	28.5	78.9	74.5	67.2	111.2	1003.2	249.8	15.3	4.1	0	0
13-08-2025	10:00:00	32.9	31.9	30.8	67.7	65	61.8	167.6	1004.1	304	22	5.1	0.6	0
13-08-2025	11:00:00	33.9	32.8	31.4	67.4	60.6	56.8	225.8	1004.2	325.4	18	4.8	0	0
13-08-2025	12:00:00	34	33	31.9	65.3	61.3	56.7	134.7	1003.7	10	12	2.3	0	0
13-08-2025	13:00:00	33.6	30.7	28.5	82.4	73.6	60.6	115.9	1002.5	120.7	26.6	6.8	1.3	0
13-08-2025	14:00:00	32.6	31	28.8	82.2	72.9	64.5	220	1002	142	20	6.1	1.3	0
13-08-2025	15:00:00	32.6	32	31.6	67.5	66.1	64.5	160.4	1001.7	163.4	18.6	5	1.3	0
13-08-2025	16:00:00	32.1	30.9	29.9	75.2	71.3	64.6	80.5	1000.6	181.9	20	7	2	0
13-08-2025	17:00:00	30.5	30	29.5	77.2	75.4	73.2	64.5	999.7	197	26	9.2	3.3	0
13-08-2025	18:00:00	30.4	29.9	29.5	76.8	75.8	73.2	6.5	999.7	200	27.3	9.1	2.6	0
13-08-2025	19:00:00	30.2	29.7	29.3	75.7	74.7	74.2	0	1000.2	204.9	26.6	8	0.6	0
13-08-2025	20:00:00	29.9	29.4	29	75.9	74.6	73	0	1000.1	200.5	21.3	7.1	2	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
13-08-2025	21:00:00	29.7	29.2	28.8	76.1	74.9	73.3	0	1000.7	201	21.3	8	2.6	0
13-08-2025	22:00:00	28.6	28.3	27.8	79.8	79	78.5	0	1001.8	233.9	11.3	4.8	0.6	0
13-08-2025	23:00:00	28.6	28	27.6	80.8	79.8	78.4	0	1001.6	246	8	0.8	0	0
14-08-2025	00:00:00	28.1	27.6	27.2	84.8	83.1	80.6	0	1001.2	280.7	3.3	0	0	0
14-08-2025	01:00:00	27.9	27.5	27.2	85.6	84.9	84.2	0	1000.7	238.1	11.3	2.8	0	0
14-08-2025	02:00:00	28	27.6	27.3	85.9	84.9	84	0	1000.2	235.8	10.6	4.1	0	0
14-08-2025	03:00:00	28	27.5	27.1	88.4	87	85.4	0	1000.1	318.8	5.3	0.7	0	0
14-08-2025	04:00:00	27.7	27	26.1	91.7	90.2	87.9	0.4	1000	271.7	3.3	0.1	0	0
14-08-2025	05:00:00	28	26.8	25.8	93.2	92.1	91.1	8	1000.1	263	4.6	0	0	0
14-08-2025	06:00:00	27.8	26.7	25.7	94.2	93.3	92.3	8.2	1000.4	263.2	3.3	0	0	0
14-08-2025	07:00:00	27.9	26.7	25.8	95.2	94.4	93.7	11.3	1001	252.2	2.6	0.1	0	0
14-08-2025	08:00:00	28.7	27.4	26	95.1	93.3	89.1	31.3	1001.8	220.1	6.6	1.9	0	0
14-08-2025	09:00:00	31.2	29.7	27.6	89.3	76.9	68.6	98.5	1003.2	206.5	8.6	3.1	0	0
14-08-2025	10:00:00	32.8	31.8	30.6	69.6	66	62.8	174.6	1004.1	174.5	12	3.1	0	0
14-08-2025	11:00:00	33.2	32.1	30.6	72.1	65.8	60.6	188.6	1004.2	134.7	21.3	5.7	0	0
14-08-2025	12:00:00	32.9	32.1	30.7	72.1	66.9	63.7	287.6	1003.7	121.9	30	9.3	2.6	0
14-08-2025	13:00:00	34.3	33.2	31.6	67.3	61.7	57.4	301.3	1003.4	141	24.6	7.4	2.6	0
14-08-2025	14:00:00	34.3	33.4	32.7	64.5	60.7	58.4	287.8	1003	162.7	25.3	7.4	2	0
14-08-2025	16:00:00	34.4	33.3	32.2	64.9	61	57.3	277.3	1001.9	188.8	27.3	8.7	2	0
14-08-2025	17:00:00	33.2	32.1	31	70	66.7	61.9	139.6	1000.3	198.9	23.3	8.5	2	0
14-08-2025	19:00:00	31.6	30.8	30	72.7	70.6	69.2	24.5	1000.7	196.6	22	8.6	2	0
14-08-2025	20:00:00	30.2	29.7	29.3	76.4	74.6	72.3	0	1000.5	199.3	23.3	8.8	2.6	0
14-08-2025	21:00:00	29.8	29.2	28.8	78.6	77.3	76	0	1000.8	206.9	18.6	6.6	2	0
14-08-2025	22:00:00	29.4	29	28.6	81.2	79.6	78.1	0	1001.3	214.3	16.6	5.3	0.6	0
14-08-2025	23:00:00	29.2	28.7	28.5	83.3	82.1	80.8	0	1001.4	204.1	10	3.4	0	0
15-08-2025	00:00:00	29.1	28.7	28.4	83.3	82.8	82.1	0	1001.4	207.2	14	5	0.6	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
15-08-2025	01:00:00	28.9	28.4	28.1	85.1	84.2	82.8	0	1001.3	218.7	14.6	4.8	1.3	0
15-08-2025	02:00:00	28.7	28.2	27.9	84.8	82.9	81.7	0	1000.5	234.3	10	2.7	0	0
15-08-2025	03:00:00	28.5	27.9	27.4	87.6	85.3	82.5	0	999.6	238.2	3.3	0.1	0	0
15-08-2025	04:00:00	28.2	27.7	27.4	87.8	87.4	86.8	0	999.2	238.8	0.6	0	0	0
15-08-2025	05:00:00	28.1	27.7	27.4	88.2	87.6	87	0	999.1	227.6	5.3	0.2	0	0
15-08-2025	06:00:00	28	27.5	27.2	89.8	88.5	87.6	0	999.3	237.1	6	1.5	0	0
15-08-2025	07:00:00	27.9	27.4	27.1	90.7	90	89.2	0	1000.1	237.8	5.3	0.9	0	0
15-08-2025	08:00:00	28.9	27.9	27.3	90.6	87.5	82.8	13.7	1001.3	305.4	8.6	1.6	0	0
15-08-2025	09:00:00	31.4	30	28.5	83.2	77.2	72	97.1	1002.4	264.3	10	2.3	0	0
15-08-2025	10:00:00	32.5	31.7	31	72.2	68.2	65.1	110	1003.2	252	10	1.6	0	0
15-08-2025	11:00:00	33.2	32.3	31.8	66	64	60.9	111.5	1003.5	266	6.6	0.8	0	0
15-08-2025	12:00:00	33.4	32.7	31.8	68.3	63.1	59.7	124.1	1003.6	84.2	9.3	0.6	0	0
15-08-2025	13:00:00	32.4	31.8	31.2	71.3	69.6	67.9	149.4	1002.9	118.7	15.3	5.7	0.6	0
15-08-2025	14:00:00	33.3	32.7	32.2	68.5	66	64.1	239	1002.3	126.4	20.6	7.7	3.3	0
15-08-2025	15:00:00	33	32	31.4	72.5	69.4	67	159.1	1000.6	114.2	22.6	7.2	0.6	0
15-08-2025	16:00:00	33.2	32.3	31.8	69.2	66.9	63.7	221.6	999.7	158.1	24.6	6.8	2	0
15-08-2025	17:00:00	34	32.1	30.8	75.5	68.9	62	137.9	998.9	198.3	34	8.7	2.6	0
15-08-2025	18:00:00	32	31.3	30.8	75.5	71.6	67.1	94.9	998.4	198.8	31.3	10.8	3.3	0
15-08-2025	19:00:00	31.4	30.6	30	77.6	75.2	72.8	15.7	998.6	200.5	28.6	10.9	3.3	0
15-08-2025	20:00:00	30.6	30.1	29.8	77.9	76.4	74.9	0	999.2	210.3	23.3	6.5	1.3	0
15-08-2025	21:00:00	30.4	29.9	29.4	76.6	75.3	74.6	0	1000	196.4	9.3	3.3	0	0
15-08-2025	22:00:00	30	29.5	29.2	77.6	76.3	75.5	0	1000.4	205.3	13.3	4.3	0	0
15-08-2025	23:00:00	29.8	29.1	28.6	81.7	79.3	76.8	0	1000.7	229.3	10.6	2.8	0	0
16-08-2025	00:00:00	29.2	28.7	28.3	82.4	79.6	77	0	1000	238.3	12	3.7	0.6	0
16-08-2025	01:00:00	28.9	28.3	28	81.2	80	78.3	0	999.5	254.4	5.3	0.3	0	0
16-08-2025	02:00:00	28.6	28.1	27.8	82.2	81.3	79.9	0	998.9	238	8	2.8	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
16-08-2025	03:00:00	28.3	27.8	27.5	84.7	83.3	81.6	0	998.2	235.1	5.3	0.3	0	0
16-08-2025	04:00:00	28.1	27.6	27.3	85.9	85	84.1	0	998.1	230.5	2.6	0	0	0
16-08-2025	05:00:00	27.8	27.3	26.9	88.6	87	85.4	0	997.9	230.5	6	1	0	0
16-08-2025	06:00:00	27.6	27.1	26.9	88.9	88.4	87.9	0	998.1	224.4	6	2	0	0
16-08-2025	07:00:00	27.6	27.2	26.9	89.6	88.9	88.2	0	998.5	221.8	6	0.5	0	0
16-08-2025	08:00:00	28.4	27.7	27.1	89.8	89.1	87.6	20.3	998.9	223	6	1.1	0	0
16-08-2025	09:00:00	30.4	29.1	27.9	87.8	82.1	77.3	67.2	1000.2	315.5	16.6	3	0	0
16-08-2025	10:00:00	31.5	30.6	29.8	77.4	74.3	69.7	111.9	1001.3	328.4	15.3	5.2	0	0
16-08-2025	11:00:00	32.5	31.4	30.4	71.9	68.5	63.5	129.2	1001.7	335	16.6	5.3	0	0
16-08-2025	12:00:00	34.7	33.4	31.8	66	61.4	57.8	194.6	1001.7	349.2	14	4	0	0
16-08-2025	13:00:00	37.5	35.6	34.1	59.6	55.3	50.2	342.1	1001.3	10.4	15.3	3	0	0
16-08-2025	14:00:00	37.4	35.2	33.7	63.1	57.2	49.4	274.2	1000.1	50	17.3	3.9	0	0
16-08-2025	15:00:00	35	33	31.7	70	65.7	57.9	216	998.6	111.3	16.6	5	0	0
16-08-2025	16:00:00	35.3	33.7	32.6	67.5	63.1	57.4	271.3	998.3	124.7	19.3	6.5	0	0
16-08-2025	17:00:00	34	32.7	32	68.3	66.4	62.6	140.7	997.9	144.3	20	6.6	1.3	0
16-08-2025	18:00:00	32.7	31.4	30.4	75.9	71.3	67.3	59.1	997.6	194.9	29.3	9.8	2.6	0
16-08-2025	19:00:00	31	30.2	29.4	76.5	74.3	72.1	3.9	997.8	231	26.6	6.7	2	0
16-08-2025	20:00:00	30	29.2	28.6	80.3	78.3	76.2	0	998.1	257	14	3.2	0.6	0
16-08-2025	21:00:00	29.2	28.4	27.9	81	79.3	77.9	0	998.2	245.9	12.6	3.8	0.6	0
16-08-2025	22:00:00	28.7	28.3	27.9	81.5	80	79.2	0	998.9	240.9	12	3.2	0	0
16-08-2025	23:00:00	28.5	27.7	26.7	89.3	85	81.2	3.2	998.7	241.1	13.3	2.9	0	0.5
17-08-2025	00:00:00	27.8	26.9	26	93	91.4	89	4.1	998	241	12	3.4	0	1
17-08-2025	01:00:00	27.5	26.6	25.9	94.5	93.5	92.5	4.4	997.7	237.3	6.6	0.8	0	0
17-08-2025	02:00:00	27.5	26.7	25.9	95.2	94.4	93.8	4.7	997.7	302.3	0.6	0	0	0
17-08-2025	03:00:00	27.5	26.6	25.9	95.5	95	94.5	3	996.7	295.2	6	0.3	0	0
17-08-2025	04:00:00	27.3	26.6	25.9	95.9	95.4	95	2	996.6	317.8	10.6	1.2	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
17-08-2025	05:00:00	27.1	26.6	26.1	95.7	95.1	94.8	0.1	997	298.5	10	1.5	0	0
17-08-2025	06:00:00	27.1	26.7	26.3	95.5	95	94.5	0	997.5	321.9	9.3	2.2	0	0
17-08-2025	07:00:00	27.4	26.8	26.3	95.1	94.8	94.4	0	997.6	323.8	8.6	1.8	0	0
17-08-2025	08:00:00	27.9	27	26.5	95.3	94.9	94.5	4	997.5	297.7	6.6	0.5	0	0
17-08-2025	09:00:00	28.6	27.6	26.7	95.3	94.3	92.5	37.3	998	317	9.3	2.2	0	0
17-08-2025	10:00:00	30	28.8	27.6	92.9	89.2	84.4	84.8	998.7	326.8	9.3	2.7	0	0
17-08-2025	11:00:00	31	30.3	29.5	84.6	80.2	77.4	88.4	999.2	348.5	8.6	2.3	0	0
17-08-2025	12:00:00	32	30.8	30	80	77.6	74	103.5	999.2	332.5	8	2.5	0	0
17-08-2025	13:00:00	32.7	31.4	28.9	83	76.6	70.2	84.1	998.9	16.8	6.6	0.6	0	2
17-08-2025	14:00:00	30.4	29.3	28.2	88.3	86.8	82.6	82.3	998	187.4	19.3	3.8	0	0
17-08-2025	15:00:00	31.8	30.2	28.8	87.6	82.8	75.5	146.6	997.8	196	18	6.4	1.3	0
17-08-2025	16:00:00	32.1	30.8	29.9	78.1	76.6	74	111.3	997.7	194	18.6	6.6	0.6	0
17-08-2025	17:00:00	32.6	31.7	30.4	77.5	71.6	68.3	157	997.6	180.5	26	6	1.3	0
17-08-2025	18:00:00	31.6	29.6	27.3	88.7	81.1	74.4	71.4	996.2	190.7	30	8.2	2.6	0
17-08-2025	19:00:00	29.3	28.3	27.3	90.5	89.5	88.3	14.1	996.5	207.6	18.6	6.4	1.3	0
17-08-2025	20:00:00	29.1	28.1	27.4	90.8	90.3	89.6	3.3	997.5	194.9	16.6	6.7	1.3	0
17-08-2025	21:00:00	28.6	27.9	27.2	91.6	90.9	90.3	1.8	997.8	194.3	14	4	0	0
17-08-2025	22:00:00	28.3	27.7	27.1	90.9	90	89.1	0.1	998.1	206.5	16.6	6.5	2.6	0
17-08-2025	23:00:00	27.9	27.4	27	89.9	89.3	88.7	0	998.8	200.3	14.6	6.5	1.3	0
18-08-2025	00:00:00	27.9	27.3	26.9	90.3	89.3	88.5	0	999	215.1	17.3	6	2	0
18-08-2025	01:00:00	27.8	27.1	26.7	91.5	90.5	89.8	0	998.9	226.8	10.6	2.2	0	0
18-08-2025	02:00:00	27.6	27	26.5	92.1	91.7	91.2	0	998.4	197.1	8.6	1.6	0	0
18-08-2025	03:00:00	27.5	27	26.5	92.3	91.9	91.4	0	998.1	185.3	7.3	0.8	0	0
18-08-2025	04:00:00	27.8	27.1	26.7	91.9	90.8	89.6	0	998.2	209.7	6.6	1.6	0	0
18-08-2025	05:00:00	27.7	27.1	26.6	91.2	90.4	89.7	0	998.1	199.4	3.3	0	0	0
18-08-2025	06:00:00	27.3	26.7	26.1	93	91.8	90.8	0	997.9	0	0	0	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
18-08-2025	07:00:00	27.7	26.6	26.1	93.9	93.1	91.9	3.6	998.1	196.8	9.3	1.9	0	0
18-08-2025	08:00:00	31.1	29.2	26.9	92.1	82.6	73.8	65.2	999.6	189.1	12.6	4.9	0.6	0
18-08-2025	09:00:00	31.7	31.1	30.5	76.2	74.1	72.3	97.7	1000.8	113.5	16.6	6.5	0	0
18-08-2025	10:00:00	32.1	31.7	30.7	74.3	72.1	70.4	192.9	1001.9	119	19.3	7.8	1.3	0
18-08-2025	11:00:00	33.3	32.7	32.1	69.4	67.8	66.6	327.6	1002	131.4	31.3	9.8	4.6	0
18-08-2025	12:00:00	33.9	32.9	32	69.1	66.7	63.2	262.5	1001.4	140.8	26.6	8.1	2	0
18-08-2025	13:00:00	33.6	32.6	32	70.9	68.4	66	305.3	1001.2	123.3	28.6	10.7	4	0
18-08-2025	14:00:00	34.4	33.1	32.2	69.2	66.2	61.9	388.5	1000.4	124.1	27.3	10.6	2.6	0
18-08-2025	15:00:00	34.1	33	32.3	68.8	66.9	64	276.1	999.3	137.9	26.6	9	1.3	0
18-08-2025	16:00:00	33.7	32.7	31.8	71.3	68.5	64.5	240.4	998.6	134.7	27.3	9.8	3.3	0
18-08-2025	17:00:00	32.4	31.5	30.9	74	71.8	68.6	108.5	998	149.3	27.3	7.9	2	0
18-08-2025	18:00:00	31.6	30.9	30.4	76.9	74.7	73	60.4	997.9	156.5	22.6	6.9	0.6	0
18-08-2025	19:00:00	30.9	30.1	29.1	82.4	77.8	74.7	12.4	997.9	168.4	24.6	7.6	2.6	0
18-08-2025	20:00:00	29.7	29	28.6	83.8	82.9	81.9	0	997.9	151.1	26.6	7.9	2.6	0
18-08-2025	21:00:00	29.6	28.9	28.3	85.5	83.8	82.2	0.2	998.2	126.4	30.6	9.6	3.3	0
18-08-2025	22:00:00	29.4	28.7	28	88.1	87.1	85.1	0.4	998.7	105	32.6	10.3	2.6	0
18-08-2025	23:00:00	29.1	28.6	28.2	88.7	88.1	87.5	0	999	100.1	30	9.2	2.6	0
19-08-2025	00:00:00	29	28.5	28.2	88.5	87.7	87.1	0	998.7	110	28.6	10.6	2.6	0
19-08-2025	01:00:00	28.9	28.4	28	90.2	89	87.5	0	998.3	104.6	24	6	0	0
19-08-2025	02:00:00	29.1	28.5	28.1	90.2	89	88	0	997.6	109.2	13.3	4.4	0	0
19-08-2025	03:00:00	29.2	28.7	28.2	89.3	87.5	85.2	0	996.8	114.9	22.6	8.2	2	0
19-08-2025	04:00:00	29.1	28.6	28.2	89.3	88.7	87.8	0	996.6	91.7	25.3	7.3	2.6	0
19-08-2025	05:00:00	28.8	28.3	27.8	88.7	87.8	86.8	0	996.2	66.2	20.6	5.2	1.3	0
19-08-2025	06:00:00	28.9	28.3	27.8	90	89.3	88.5	0	995.7	46.5	26	5.7	1.3	0
19-08-2025	07:00:00	28.8	28.3	27.9	89.3	88.5	87.8	1.3	996.7	70.1	28.6	5.8	2.6	0
19-08-2025	08:00:00	29.2	28.5	27.8	88.5	87.3	85.1	32.5	998	59.6	28	4.9	2	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
19-08-2025	09:00:00	30.6	29.3	28.4	86.2	83.6	79	91.4	998.5	76.4	23.3	5.7	1.3	0
19-08-2025	10:00:00	31.8	30.7	30.1	79.7	76	72.8	130.7	1000	64.1	18	4.8	0.6	0
19-08-2025	11:00:00	32.8	31.7	30.4	77	72.8	68.5	184.4	999.9	57.2	21.3	4.7	0	0
19-08-2025	12:00:00	33.2	32.2	30.6	77.2	71.1	67.8	312.4	999.2	95.7	22.6	7.4	1.3	0
19-08-2025	13:00:00	34.4	33.4	31.9	69.4	65.7	62.4	340.8	999.2	102.6	21.3	7.7	2	0
19-08-2025	14:00:00	34	33	31.6	71.6	67.3	64.3	363.5	998.8	119.2	24.6	9.8	4	0
19-08-2025	15:00:00	34.4	33.6	33	67.6	64.7	63	344.6	998.2	128	25.3	9.5	3.3	0
19-08-2025	16:00:00	34.5	33.8	33	67.7	64.7	61.8	266.9	997.2	143.5	20	6.9	2	0
19-08-2025	17:00:00	33.8	32.8	31.4	73.2	68.4	65.1	130.4	996.1	178.4	17.3	6	1.3	0
19-08-2025	18:00:00	32.7	32.1	31.4	72.4	70.1	68.5	43.1	995.6	172.9	19.3	3.7	0	0
19-08-2025	19:00:00	32.3	29.5	28	89.4	84.4	71.7	13.8	994.9	169.1	21.3	3.2	0	0
19-08-2025	20:00:00	30	29	28	90.5	89.8	88.8	6.8	995.2	178.9	10	0.2	0	0
19-08-2025	21:00:00	29.6	28.8	28.2	89.1	87.6	86.4	2.5	996	79.7	13.3	3.2	0	0
19-08-2025	22:00:00	29.6	28.9	28.3	86.8	85.8	84.7	0.2	997.4	63	7.3	1.2	0	0
19-08-2025	23:00:00	29.6	29	28.5	85.8	85.2	84.5	0	997.9	265.8	5.3	0.7	0	0
20-08-2025	00:00:00	29.4	28.4	27.8	85.9	85.1	84.1	0	996.4	312	42	6.5	0.6	0
20-08-2025	01:00:00	28.7	28.1	27.3	88.1	85.9	85.2	0.7	995.7	310.4	24.6	7	2.6	0
20-08-2025	02:00:00	28.5	27.6	26.5	92.9	90.8	87.7	4.5	995.2	322.4	30	7.6	2	1
20-08-2025	03:00:00	28.4	27.1	26	93.9	93.2	92.5	4.9	994.7	294.5	25.3	4.6	1.3	0.5
20-08-2025	04:00:00	27.9	26.7	25.7	95	94.1	93.4	6.2	993.8	261.3	19.3	5.2	2	1
20-08-2025	05:00:00	27.5	26.5	25.6	96.4	95.9	95.5	6.7	994.2	254.6	16	5	2	0
20-08-2025	06:00:00	27.7	26.7	25.7	95.9	94.9	94	6.3	994.4	273.5	18.6	4.2	0.6	0
20-08-2025	07:00:00	27.9	26.9	26.1	94.4	93.6	93.1	6.6	995.3	253.2	18	5	1.3	0
20-08-2025	08:00:00	27.9	26.9	26	95.9	94.6	93.5	12.1	996	320.2	15.3	3.4	0	1
20-08-2025	09:00:00	28.3	27.3	26.2	96.2	95.6	95.1	30.2	997.1	246.5	14.6	4.6	0	0
20-08-2025	10:00:00	27.5	26.6	25.8	96.5	96	95.5	55.1	997.9	234.9	18	7.4	1.3	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
20-08-2025	11:00:00	27.6	26.6	25.7	96.4	95.3	94.9	47	998.2	240.1	24.6	8.6	2	1
20-08-2025	12:00:00	27.8	26.7	25.8	96.3	95.6	95.1	33.9	997.8	244.2	22	6.1	0.6	1
20-08-2025	13:00:00	27.6	25.8	24.6	98.2	96.3	95.1	18.4	997.7	249	28	6.7	2	24.5
20-08-2025	14:00:00	27.3	25.9	24.6	98.7	97.6	96.5	68.3	997.1	241.8	24.6	7.3	1.3	1.5
20-08-2025	15:00:00	27.9	26.8	25.7	97	95.3	94.4	46.2	996.9	241.7	28	8.4	2	1
20-08-2025	16:00:00	29	27.7	26.4	95.4	93.6	90.3	94.3	995.8	240.4	26.6	9.1	2.6	0.5
20-08-2025	17:00:00	29.7	28.7	27.6	90.7	86.2	83.3	75.8	996.3	240.4	26.6	9.8	2	0
20-08-2025	18:00:00	29.4	28.6	28	87.4	85.8	83.4	24.4	997.4	238	30.6	7	2	0
20-08-2025	19:00:00	29.3	28.5	27.8	85.5	84.7	83.4	10.6	997.6	232.3	17.3	6.1	0.6	0
20-08-2025	20:00:00	28.7	27.9	27.2	88.1	86.5	84.8	0.2	997.9	229.2	16.6	5.6	0.6	0
20-08-2025	21:00:00	28.2	27.5	27	88.3	87.6	86.7	0	998.5	232.3	18	6.4	1.3	0
20-08-2025	22:00:00	27.9	27.3	26.9	87.9	87.4	86.9	0	998.9	227.6	22	8	2	0
20-08-2025	23:00:00	27.8	27.3	26.9	88.8	88.2	87.5	0	1000	219	20.6	6.8	0	0
21-08-2025	00:00:00	27.7	27.2	26.6	90.5	89.4	88.3	0	1000.3	225.7	23.3	6.7	1.3	0
21-08-2025	01:00:00	27.6	27	26.5	91.5	90.8	89.9	0	1000.2	224.8	22	6.9	1.3	0
21-08-2025	02:00:00	27.7	27.1	26.6	91.1	90	88.9	0	999.8	227	21.3	8	2	0
21-08-2025	03:00:00	27.8	27.1	26.6	89.7	88.9	88.1	0	999.4	227.1	24	7.4	0.6	0
21-08-2025	04:00:00	27.4	26.9	26.5	91	90.1	89.3	0	999.8	229.2	18.6	6.8	2	0
21-08-2025	05:00:00	27.3	26.7	26	92.3	91.3	90.4	0	999.4	220.7	16	6.6	2	0
21-08-2025	06:00:00	27.1	26.5	26	93.1	92.7	92.1	0	999.3	220.6	26	7.6	2	0
21-08-2025	07:00:00	27.7	26.7	26.1	93	92.1	89.3	4.9	1000	230.7	24	7.6	2	0
21-08-2025	08:00:00	28.8	28	27.1	89.5	85.5	83.1	25.7	1001.7	233.6	27.3	8.6	2.6	0
21-08-2025	09:00:00	29.9	28.9	27.5	86.1	81.4	77.8	93.4	1002.7	231.5	32	10.4	3.3	0
21-08-2025	10:00:00	29.9	29.3	28.9	79.7	78.7	77.8	78.3	1003.4	232.1	29.3	10.2	2.6	0
21-08-2025	11:00:00	31.8	30.8	29.2	78.6	73.8	70	196.4	1004.4	237.5	28	9.6	2	0
21-08-2025	12:00:00	33.4	32.8	32.1	67.2	65.5	63.4	216.3	1004.3	227.5	29.3	8.5	2.6	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
21-08-2025	13:09:20	29.3	28.2	27.1	90.3	88.8	86.5	82.6	1001.5	219.3	26.6	8.5	2.6	0
21-08-2025	14:00:00	29.7	27.7	26.5	90.2	86.5	77.8	64.2	1002.1	226.4	35.3	8.7	2	2
21-08-2025	15:00:00	29.3	28.2	27.1	90.3	88.8	86.5	82.6	1001.5	219.3	26.6	8.5	2.6	0
21-08-2025	16:00:00	29.2	28.7	28.2	87.3	86.7	86.2	41.8	1001.6	234.5	14	6.7	2	0
21-08-2025	17:00:00	29.8	28.9	28	89.9	88.2	85.2	48.3	1001.1	233.1	24	7	1.3	0
21-08-2025	18:00:00	29.4	28.6	27.3	89	85.9	84.4	13.5	1001.5	239	27.3	7.7	1.3	0
21-08-2025	19:00:00	28.8	27.8	26.7	93.3	91.3	88.7	9.8	1001.5	231.7	14.6	3.7	0	0
21-08-2025	20:00:00	28.2	27.4	26.5	95	93.8	92.5	6.5	1002.2	235	8	1.7	0	0
21-08-2025	21:00:00	28.4	27.3	26.4	95.5	94.9	94.3	6.7	1003.1	214.4	6.6	1.3	0	0
21-08-2025	22:00:00	28.2	27.3	26.5	95.5	95.1	94.6	5.9	1003.4	223.7	16	5.6	1.3	0
21-08-2025	23:00:00	28.1	27.1	26.3	95	93.9	92.8	4.5	1003.6	226.7	18	7	2	0
22-08-2025	00:00:00	27.6	26.9	26.2	93.4	92.9	92.4	3.1	1003.7	225.1	22	7.6	2.6	0
22-08-2025	01:00:00	27.5	26.7	26.2	93.1	92.6	92.1	1.8	1003.3	223.5	22.6	8	3.3	0
22-08-2025	02:00:00	27.3	26.7	26.1	92.7	92.2	91.7	1.1	1002.7	218.5	29.3	8.4	2.6	0
22-08-2025	03:00:00	27.3	26.7	26.2	92.7	92.1	90.8	0.2	1002	220.9	24.6	7.8	1.3	0
22-08-2025	04:00:00	27.3	26.7	26.1	91.1	90.3	89.8	0	1001.7	228.1	22.6	7.2	0.6	0
22-08-2025	05:00:00	27.1	26.5	26	91.7	90.9	90.3	0	1001.6	232	17.3	5.6	0.6	0
22-08-2025	06:00:00	27	26.5	26.1	91.9	91.2	90.5	0	1001.9	234.7	19.3	6.1	1.3	0
22-08-2025	07:00:00	27.1	26.5	26.1	91.2	90.7	90.1	2.2	1002.7	228	16.6	6.5	2	0
22-08-2025	08:00:00	28.6	28	27.2	87.2	85.6	84.3	58.8	1004.4	233.7	22.6	9	3.3	0
22-08-2025	09:00:00	29.8	29.1	28	84.7	80	76.8	103.1	1004.9	234.7	30.6	10.1	3.3	0
22-08-2025	10:00:00	29.27	28.64	27.55	85.73	80.55	77.36	123.9	998.6	221.2	19.8	7.4	1.43	0
22-08-2025	11:00:00	29.91	29.64	28.45	81.09	77.91	76.64	176.0	999.0	216.8	24.2	8.8	2.2	0
22-08-2025	12:00:00	29.91	29.27	28.73	80.73	78.73	76.18	193.9	1000.1	208.6	22.66	7.48	0	0
22-08-2025	13:00:00	29.73	29.18	28.36	82.27	78.73	76.36	191.2	1000.4	215.0	25.63	7.37	1.43	0
22-08-2025	14:00:00	30.09	29.45	28.91	79.82	77.09	74.73	183.4	1000.3	214.1	24.2	7.59	1.43	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
22-08-2025	15:00:00	30.09	29.64	29.18	77.00	75.27	73.73	177.2	999.9	216.2	23.43	8.8	2.2	0
22-08-2025	16:00:00	29.55	28.73	26.91	85.09	78.36	75.00	147.2	999.5	216.3	26.4	8.14	0.66	0
22-08-2025	17:00:00	29.55	28.36	25.91	87.55	79.73	76.00	86.9	999.9	218.3	20.46	7.48	2.2	0
22-08-2025	18:00:00	28.36	26.09	24.82	98.91	90.73	86.64	13.9	999.5	210.2	17.6	7.26	2.2	0
22-08-2025	19:00:00	27.82	27.45	26.91	87.36	84.09	82.09	1.4	999.4	210.1	28.6	8.36	2.2	0
22-08-2025	20:00:00	27.82	27.45	27.27	83.73	82.82	82.09	0	1000.1	219.7	26.4	8.36	2.2	0
22-08-2025	21:00:00	27.82	27.27	26.73	86.45	83.82	82.18	0	1001.8	222.5	30.03	9.46	2.86	0
22-08-2025	22:00:00	27.82	27.45	27.18	83.64	82.64	81.45	0	1002.8	220.5	35.2	11.44	3.63	0
22-08-2025	23:00:00	27.64	27.45	27.09	83.45	82.36	80.00	0	1003.5	221.0	32.23	11.22	2.86	0
23-08-2025	00:00:00	27.64	27.27	27.00	84.64	83.91	82.73	0	1004.5	226.2	30.8	10.56	2.2	0
23-08-2025	01:00:00	27.55	27.27	27.00	83.82	83.09	82.36	0	1004.4	216.7	32.23	9.35	2.86	0
23-08-2025	02:00:00	27.55	27.27	27.00	83.64	82.73	82.00	0	1001.6	208.9	29.26	9.35	2.86	0
23-08-2025	03:00:00	27.45	27.18	26.91	84.27	83.00	82.00	0	1002.2	215.6	38.83	9.57	2.2	0
23-08-2025	04:00:00	27.45	27.18	26.82	85.00	83.82	82.73	0	1001.6	208.9	29.26	9.35	2.86	0
23-08-2025	05:00:00	27.36	26.64	26.09	88.09	86.27	83.45	0	1001.7	223.3	15.4	7.37	2.2	0
23-08-2025	06:00:00	27.00	26.55	26.09	87.91	87.09	86.18	0	1001.2	222.0	26.4	7.7	1.43	0
23-08-2025	07:00:00	27.27	26.82	26.36	86.55	85.36	84.36	3	1001.6	227.6	30.03	8.47	1.43	0.4
23-08-2025	08:00:00	27.36	27.00	26.36	88.55	85.91	85.00	12.1	1001.6	220.7	16.06	4.07	0	0
23-08-2025	09:00:00	27.36	26.64	25.91	87.73	85.45	83.18	15.4	1002.3	223.8	8.8	1.87	0	0.42
23-08-2025	10:00:00	25.73	25.27	24.73	98.82	97.55	91.36	19.4	1003.2	204.2	7.26	1.43	0	0.3
23-08-2025	11:00:00	26.36	25.45	24.64	98.91	97.82	96.36	27.6	1003.5	213.0	17.6	6.16	1.43	0.0
23-08-2025	12:00:00	26.36	25.45	24.64	85.73	83.73	81.82	73.9	1003.7	215.9	19.8	7.7	2.2	0.3
23-08-2025	13:00:00	28.18	27.82	26.82	85.91	82.27	80.18	78.3	1003.8	214.4	24.2	8.36	2.86	0
23-08-2025	14:00:00	28.55	28.18	27.55	80.82	79.27	78.36	77.5	1003.4	212.9	24.86	8.8	3.63	0.4
23-08-2025	15:00:00	29.18	28.36	27.64	79.73	77.82	75.27	107.9	1002.8	208.1	32.23	9.24	2.86	0.3
23-08-2025	16:00:00	29.27	28.64	28.09	79.82	77.82	75.36	93.3	1002.1	210.4	27.06	8.58	1.43	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
23-08-2025	17:00:00	28.36	27.55	26.73	85.45	81.91	78.45	27.5	1001.8	217.2	24.86	7.92	0.66	0.4
23-08-2025	18:00:00	27.82	27.55	27.18	82.91	81.27	79.73	8.8	1001.7	221.0	19.03	6.16	0.66	0
23-08-2025	19:00:00	27.82	27.55	27.27	82.27	81.27	80.27	0.9	1002.0	223.5	21.23	6.71	1.43	0.3
23-08-2025	20:00:00	27.82	27.55	27.27	81.64	80.64	79.82	0	1002.8	217.1	18.26	7.15	2.2	0
23-08-2025	21:00:00	27.82	27.45	27.27	81.82	80.91	79.82	0	1004.5	222.6	24.86	9.9	3.63	0.4
23-08-2025	22:00:00	29.82	27.45	27.18	81.55	80.55	79.18	0	1005.0	223.5	33.66	11.11	3.63	0.3
23-08-2025	23:00:00	27.82	27.45	27.09	81.82	80.55	79.73	0	1004.8	234.6	23.43	6.82	1.43	0
24-08-2025	00:00:00	27.73	27.00	26.27	86.64	83.45	80.82	0	1004.1	234.1	32.23	7.7	2.2	0.4
24-08-2025	01:00:00	27.27	26.36	25.27	90.36	86.82	84.27	0	1003.0	234.6	24.2	6.27	1.43	0
24-08-2025	02:00:00	27.45	28.00	28.64	95.45	90.09	84.73	0	1002.2	261.3	49.06	6.6	1.43	0.3
24-08-2025	03:00:00	26.36	25.73	24.45	92.73	90.18	88.36	0	1000.7	233.1	22	5.94	0	0
24-08-2025	04:00:00	27.00	26.45	25.82	89.55	88.09	86.55	0	1000.8	227.6	0	3.63	3.63	0.4
24-08-2025	05:00:00	26.91	26.36	25.91	89.45	87.73	86.00	0	1000.1	234.0	24.86	6.05	0.66	0.3
24-08-2025	06:00:00	27.18	26.73	26.27	88.55	86.00	83.00	0	1000.2	222.8	13.2	5.06	0	0
24-08-2025	07:00:00	27.09	26.36	25.73	87.55	85.82	83.36	0.4	1001.0	226.9	11.66	3.74	0	0
24-08-2025	08:00:00	27.18	26.55	26.09	88.36	87.36	86.45	15.6	1001.9	227.0	9.46	4.51	0.66	0
24-08-2025	09:00:00	27.09	26.18	24.73	98.45	89.18	86.09	9.1	1002.8	224.0	11.66	3.96	0.66	0
24-08-2025	10:00:00	26.09	25.36	24.64	98.82	97.73	96.36	12.2	1003.1	222.6	20.46	6.05	1.43	0
24-08-2025	11:00:00	27.64	26.64	25.45	99.00	93.27	88.18	49.0	1003.2	227.2	18.26	6.27	1.43	0
24-08-2025	12:00:00	28.64	27.73	26.55	90.36	85.45	80.45	89.4	1002.8	218.4	19.03	6.16	0.66	0
24-08-2025	13:00:00	29.27	28.55	28.00	81.18	79.45	74.91	126.5	1002.1	193.6	10.23	4.29	0.66	0
24-08-2025	14:00:00	29.73	29.36	28.82	78.27	76.09	74.00	196.8	1001.3	205.0	19.03	6.6	2.2	0
24-08-2025	15:00:00	29.73	29.27	28.73	77.55	75.64	74.55	157.9	1001.5	206.5	15.4	5.39	0	0
24-08-2025	16:00:00	29.73	29.18	28.73	77.27	75.09	73.64	134.2	1001.9	218.6	9.46	2.97	0	0
24-08-2025	17:00:00	29.82	29.09	28.45	76.91	75.64	73.82	95.6	1002.3	225.1	8.03	2.97	0	0
24-08-2025	18:00:00	29.18	28.45	27.82	79.27	77.73	75.55	40.9	1002.6	229.0	5.06	1.54	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
24-08-2025	19:00:00	28.18	27.82	27.45	80.82	79.73	78.45	2.7	1003.3	224.2	13.86	2.2	0	0
24-08-2025	20:00:00	28.00	27.55	27.27	82.36	81.36	80.18	0	1002.8	220.5	35.2	11.44	3.63	0
24-08-2025	21:00:00	27.82	27.36	26.64	84.27	82.73	80.82	0	1003.5	221.0	32.23	11.22	2.86	0
24-08-2025	22:00:00	26.91	25.36	24.27	98.82	92.00	83.91	0	1004.5	226.2	30.8	10.56	2.2	0
24-08-2025	23:00:00	25.64	24.91	24.27	98.45	97.73	96.55	0	1004.4	216.7	32.23	9.35	2.86	0
25-08-2025	00:00:00	26.45	26.18	25.73	98.64	93.09	91.00	0	1001.6	208.9	29.26	9.35	2.86	0
25-08-2025	01:00:00	27.27	26.73	25.91	91.55	88.18	85.09	0	1002.2	215.6	38.83	9.57	2.2	0
25-08-2025	02:00:00	27.27	27.00	26.73	86.18	85.27	84.36	0	1001.6	208.9	29.26	9.35	2.86	0
25-08-2025	03:00:00	27.00	25.55	24.82	98.45	91.45	84.36	0	1001.7	223.3	15.4	7.37	2.2	0
25-08-2025	04:00:00	26.09	25.55	24.82	98.82	97.64	91.09	0	1001.2	222.0	26.4	7.7	1.43	0
25-08-2025	05:00:00	26.18	25.73	24.91	98.91	97.82	91.27	0	1001.6	227.6	30.03	8.47	1.43	0
25-08-2025	06:00:00	26.64	26.09	25.55	98.91	97.36	90.91	0	1001.6	220.7	16.06	4.07	0	0
25-08-2025	07:00:00	28.00	25.55	24.91	98.73	97.73	96.36	0	1002.3	223.8	8.8	1.87	0	0
25-08-2025	08:00:00	26.36	25.73	25.00	98.82	97.73	96.45	0.8	1003.2	204.2	7.26	1.43	0	0
25-08-2025	09:00:00	27.36	26.73	25.91	98.64	90.45	86.18	31.6	1003.5	213.0	17.6	6.16	1.43	0
25-08-2025	10:00:00	27.45	27.00	26.45	88.55	86.91	83.91	30.3	1003.7	215.9	19.8	7.7	2.2	0
25-08-2025	11:00:00	26.82	26.09	25.45	98.73	92.55	88.27	34.5	1000.4	215.0	25.63	7.37	1.43	0
25-08-2025	12:00:00	31.2	30.1	29.5	75.5	74	71.7	128.5	1004.7	246.3	21.3	6.2	1.3	0
25-08-2025	13:00:00	31.8	30.8	28.5	80.8	71.4	68.3	116.4	1004	245.8	29.3	7	2	0
25-08-2025	14:00:00	33.2	30.7	28.6	83.2	76.8	63.6	224.2	1002.9	246.3	22	5.7	1.3	0
25-08-2025	15:00:00	33.1	31.6	27.3	86.1	68.9	63.9	124.8	1002.1	274.4	44.6	6	1.3	4
25-08-2025	16:00:00	29.7	28.6	27.1	91.2	87.3	79.9	98	1000.6	244.8	20	5.4	0	0.5
25-08-2025	17:00:00	29.2	29.2	29.2	79.8	79.8	79.8	29.6	1000.7	239	0	3.3	3.3	0
25-08-2025	18:00:00	30.1	29.3	27.5	86.4	79.5	76.8	22.5	1000	245.7	22.6	5.5	0.6	0
25-08-2025	19:00:00	29.2	28	27.2	88	87	85.8	10.5	1000.1	233.9	12	4.6	0	0
25-08-2025	20:00:00	28.5	27.7	27.2	88.5	86.9	85.8	0	1000.9	238.2	10.6	3.4	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
25-08-2025	21:00:00	27.9	27.3	26.9	88.7	87.8	87.1	0.1	1001.8	238.3	8.6	4.1	0.6	0
25-08-2025	22:00:00	27.4	27	26.7	90.2	89.2	87.7	0	1002.7	235.2	10.6	3.6	0.6	0
25-08-2025	23:00:00	27.6	27.1	26.7	89.8	87.4	85.3	0	1003	233.7	18.6	5.5	1.3	0
26-08-2025	00:00:00	27.3	26.9	26.6	90	88.7	87.6	0	1003.1	238.6	16.6	5.7	1.3	0
26-08-2025	01:00:00	27.3	26.8	26.5	91.2	89.9	88.7	0	1002.7	229.3	17.3	5.6	0.6	0
26-08-2025	02:00:00	26.7	26.4	25.9	94.4	94	93.5	0	1002	203.3	9.3	3.9	0.6	0
26-08-2025	03:00:00	26.7	26.2	25.6	95.8	94.6	93.6	0	1001.2	215.3	17.3	6	2	0
26-08-2025	04:00:00	26.6	26.1	25.6	96.1	95.7	95.2	0	1001.4	216.8	14	4.9	0	0
26-08-2025	05:00:00	26.5	26.1	25.6	95.9	95.6	95.3	0	1001.8	229.5	8.6	2.7	0	0
26-08-2025	06:00:00	26.5	26.1	25.6	96.5	96	95.5	0	1002.2	236.4	7.3	2.7	0	0
26-08-2025	07:00:00	26.7	26.1	25.7	96.6	96.1	95.6	0.7	1002.5	240.5	4.6	1.4	0	0
26-08-2025	08:00:00	28	26.9	26	96.1	94.5	91	27.9	1003.2	235.4	12.6	2	0	0
26-08-2025	09:00:00	29.9	28.9	27.5	86.1	81.4	77.8	93.4	1002.7	231.5	32	10.4	3.3	0
26-08-2025	10:00:00	29.9	29.3	28.9	79.7	78.7	77.8	78.3	1003.4	232.1	29.3	10.2	2.6	0
26-08-2025	11:00:00	31.8	30.8	29.2	78.6	73.8	70	196.4	1004.4	237.5	28	9.6	2	0
26-08-2025	12:00:00	33.4	32.8	32.1	67.2	65.5	63.4	216.3	1004.3	227.5	29.3	8.5	2.6	0
26-08-2025	13:00:00	29.3	28.2	27.1	90.3	88.8	86.5	82.6	1001.5	219.3	26.6	8.5	2.6	0
26-08-2025	14:00:00	29.7	27.7	26.5	90.2	86.5	77.8	64.2	1002.1	226.4	35.3	8.7	2	2
26-08-2025	15:00:00	29.3	28.2	27.1	90.3	88.8	86.5	82.6	1001.5	219.3	26.6	8.5	2.6	0
26-08-2025	16:00:00	29.2	28.7	28.2	87.3	86.7	86.2	41.8	1001.6	234.5	14	6.7	2	0
26-08-2025	17:00:00	29.8	28.9	28	89.9	88.2	85.2	48.3	1001.1	233.1	24	7	1.3	0
26-08-2025	18:00:00	29.4	28.6	27.3	89	85.9	84.4	13.5	1001.5	239	27.3	7.7	1.3	0
26-08-2025	19:00:00	28.8	27.8	26.7	93.3	91.3	88.7	9.8	1001.5	231.7	14.6	3.7	0	0
26-08-2025	20:00:00	28.2	27.4	26.5	95	93.8	92.5	6.5	1002.2	235	8	1.7	0	0
26-08-2025	21:00:00	28.4	27.3	26.4	95.5	94.9	94.3	6.7	1003.1	214.4	6.6	1.3	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
26-08-2025	22:00:00	28.2	27.3	26.5	95.5	95.1	94.6	5.9	1003.4	223.7	16	5.6	1.3	0
26-08-2025	23:00:00	28.1	27.1	26.3	95	93.9	92.8	4.5	1003.6	226.7	18	7	2	0
27-08-2025	00:00:00	27.7	27.2	26.6	90.5	89.4	88.3	0	1000.3	225.7	23.3	6.7	1.3	0
27-08-2025	01:00:00	27.6	27	26.5	91.5	90.8	89.9	0	1000.2	224.8	22	6.9	1.3	0
27-08-2025	02:00:00	27.7	27.1	26.6	91.1	90	88.9	0	999.8	227	21.3	8	2	0
27-08-2025	03:00:00	27.8	27.1	26.6	89.7	88.9	88.1	0	999.4	227.1	24	7.4	0.6	0
27-08-2025	04:00:00	27.4	26.9	26.5	91	90.1	89.3	0	999.8	229.2	18.6	6.8	2	0
27-08-2025	05:00:00	27.3	26.7	26	92.3	91.3	90.4	0	999.4	220.7	16	6.6	2	0
27-08-2025	06:00:00	27.1	26.5	26	93.1	92.7	92.1	0	999.3	220.6	26	7.6	2	0
27-08-2025	07:00:00	27.7	26.7	26.1	93	92.1	89.3	4.9	1000	230.7	24	7.6	2	0
27-08-2025	08:00:00	28.8	28	27.1	89.5	85.5	83.1	25.7	1001.7	233.6	27.3	8.6	2.6	0
27-08-2025	09:00:00	29.9	28.9	27.5	86.1	81.4	77.8	93.4	1002.7	231.5	32	10.4	3.3	0
27-08-2025	10:00:00	29.9	29.3	28.9	79.7	78.7	77.8	78.3	1003.4	232.1	29.3	10.2	2.6	0
27-08-2025	11:00:00	31.8	30.8	29.2	78.6	73.8	70	196.4	1004.4	237.5	28	9.6	2	0
27-08-2025	12:00:00	33.4	32.8	32.1	67.2	65.5	63.4	216.3	1004.3	227.5	29.3	8.5	2.6	0
27-08-2025	13:00:00	29.3	28.2	27.1	90.3	88.8	86.5	82.6	1001.5	219.3	26.6	8.5	2.6	0
27-08-2025	14:00:00	29.7	27.7	26.5	90.2	86.5	77.8	64.2	1002.1	226.4	35.3	8.7	2	2
27-08-2025	15:00:00	29.3	28.2	27.1	90.3	88.8	86.5	82.6	1001.5	219.3	26.6	8.5	2.6	0
27-08-2025	16:00:00	29.2	28.7	28.2	87.3	86.7	86.2	41.8	1001.6	234.5	14	6.7	2	0
27-08-2025	17:00:00	29.8	28.9	28	89.9	88.2	85.2	48.3	1001.1	233.1	24	7	1.3	0
27-08-2025	18:00:00	29.4	28.6	27.3	89	85.9	84.4	13.5	1001.5	239	27.3	7.7	1.3	0
27-08-2025	19:00:00	28.8	27.8	26.7	93.3	91.3	88.7	9.8	1001.5	231.7	14.6	3.7	0	0
27-08-2025	20:00:00	28.2	27.4	26.5	95	93.8	92.5	6.5	1002.2	235	8	1.7	0	0
27-08-2025	21:00:00	28.4	27.3	26.4	95.5	94.9	94.3	6.7	1003.1	214.4	6.6	1.3	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
27-08-2025	22:00:00	28.2	27.3	26.5	95.5	95.1	94.6	5.9	1003.4	223.7	16	5.6	1.3	0
27-08-2025	23:00:00	28.1	27.1	26.3	95	93.9	92.8	4.5	1003.6	226.7	18	7	2	0
28-08-2025	00:00:00	27.6	26.9	26.2	93.4	92.9	92.4	3.1	1003.7	225.1	22	7.6	2.6	0
28-08-2025	01:00:00	27.5	26.7	26.2	93.1	92.6	92.1	1.8	1003.3	223.5	22.6	8	3.3	0
28-08-2025	02:00:00	27.3	26.7	26.1	92.7	92.2	91.7	1.1	1002.7	218.5	29.3	8.4	2.6	0
28-08-2025	03:00:00	27.3	26.7	26.2	92.7	92.1	90.8	0.2	1002	220.9	24.6	7.8	1.3	0
28-08-2025	04:00:00	27.3	26.7	26.1	91.1	90.3	89.8	0	1001.7	228.1	22.6	7.2	0.6	0
28-08-2025	05:00:00	27.1	26.5	26	91.7	90.9	90.3	0	1001.6	232	17.3	5.6	0.6	0
28-08-2025	06:00:00	27	26.5	26.1	91.9	91.2	90.5	0	1001.9	234.7	19.3	6.1	1.3	0
28-08-2025	07:00:00	27.1	26.5	26.1	91.2	90.7	90.1	2.2	1002.7	228	16.6	6.5	2	0
28-08-2025	08:00:00	28.6	28	27.2	87.2	85.6	84.3	58.8	1004.4	233.7	22.6	9	3.3	0
28-08-2025	09:00:00	28.1	27.3	26.3	94.7	94.3	93.8	13.1	1002.8	264.5	14.6	3.6	0	0
28-08-2025	10:00:00	28.2	27.3	26.5	94.8	94.2	93.6	15.1	1002.7	251.2	12	2.6	0	0
28-08-2025	11:00:00	29.4	28	26.9	94	92	87.4	52	1003.1	246.1	10	2.3	0	0
28-08-2025	12:00:00	30.6	29.5	28.3	87.5	82.8	78.3	96.8	1003.3	257.2	13.3	3.4	0	0
28-08-2025	13:00:00	33.6	31.4	30	79.1	74	64.9	176.9	1003.5	249	14.6	3.4	0	0
28-08-2025	14:00:00	33.4	32.8	32.1	69.2	66.6	64.5	183.2	1002.7	265.8	16.6	3.4	0	0
28-08-2025	15:00:00	33	31.1	29.4	82.3	75.6	66.2	82.5	1001	331.2	20.6	4.6	0	0
28-08-2025	16:00:00	31.6	31	30.4	77.4	76.1	74.9	47.7	1000	334	15.3	2.9	0	0
28-08-2025	17:00:00	31.3	30.9	30.4	79.4	78.3	76.9	27.8	999.7	344	5.3	0.3	0	0
28-08-2025	18:00:00	31.2	30.6	30.1	83	80.6	78.6	16.7	999.7	166.7	10.6	0.7	0	0
28-08-2025	19:00:00	30.4	29.7	29	86.3	84.6	82.5	3.3	999.9	195.8	18	5.7	1.3	0
28-08-2025	20:00:00	29.4	28.9	28.4	89.1	87.6	86	0	1000.4	199.5	19.3	6	1.3	0
28-08-2025	21:00:00	29.1	28.7	28.3	90.3	89.5	88.8	0	1001.5	207.8	14.6	5.9	1.3	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
28-08-2025	22:00:00	29.1	28.7	28.3	90.1	88.9	88	0	1001.9	218.5	13.3	5.3	2	0
28-08-2025	23:00:00	29.2	28.5	28.1	88.5	88.1	87.2	0	1001.9	229.7	14	5	0	0
29-08-2025	00:00:00	26.3	24.9	23.8	93.7	92	90.3	7.5	1002.1	74.3	24	4.2	1.3	17
29-08-2025	01:00:00	25.9	24.7	23.7	97.2	95.6	93.4	7.3	1000.7	231.9	19.3	2.9	0	3
29-08-2025	02:00:00	26.3	25.1	24	100	98.1	96.6	7.1	999.3	241.9	9.3	3.2	0	0
29-08-2025	03:00:00	26.9	25.7	24.6	103.1	101	99.1	6.5	998.6	236.6	12	3.2	0	0
29-08-2025	04:00:00	27.1	26.1	25.1	102.4	100	98.8	6.2	998.9	239.2	9.3	0.9	0	0
29-08-2025	05:00:00	27.6	26.4	25.4	102.9	100.5	99.1	5.2	999.2	240.9	8	2.6	0	0
29-08-2025	06:00:00	27.7	26.8	25.7	104.5	102.3	99.8	3.9	999.9	260	12.6	2.6	0	0
29-08-2025	07:00:00	27.6	26.7	25.8	101.1	98	96	4.4	1000.6	263.1	13.3	3.3	0.6	0
29-08-2025	08:00:00	27.8	26.8	25.9	96.6	96	95.6	14.1	1001.5	318.2	9.3	1.6	0	0
29-08-2025	09:00:00	28.5	27.7	26.3	96.3	94.9	93.4	28.4	1002.6	298.8	8	0.9	0	0
29-08-2025	10:00:00	27.7	26.8	25.7	104.5	102.3	99.8	3.9	999.9	260	12.6	2.6	0	0
29-08-2025	11:00:00	32.8	31.8	30.4	76.7	69.9	66	242.7	1004.4	307.6	16	3.7	0	0
29-08-2025	12:00:00	33.8	32.8	32	67.4	64.5	60.3	206.6	1004	296.3	18.6	3.5	0	0
29-08-2025	13:00:00	33.8	32.3	31.2	68.7	66	61.3	129.2	1003.2	330.5	14.6	4.2	0	0
29-08-2025	14:00:00	33.1	32.1	31.2	75.5	68.3	63.4	101.5	1002.3	206.9	16	1.8	0	0
29-08-2025	15:00:00	30.8	29.7	28.8	86.3	83.3	80.3	19.7	1001.5	131.6	21.3	8.5	0.6	0
29-08-2025	16:00:00	29.4	28.7	27.5	91.4	87.9	86.1	12.1	999.9	197.5	14	5.6	1.3	1
29-08-2025	17:00:00	29.5	28.5	27.4	94.2	93.4	91	46.8	999.2	213.2	13.3	4.9	0	0
29-08-2025	18:00:00	29.3	28.6	27.9	93.9	93.1	92.3	30.2	999.9	215.8	12	4.6	0	0
29-08-2025	19:00:00	28.6	28.1	27.5	93.6	93	92.6	8.4	1000.4	204.8	14.6	5.3	0.6	0
29-08-2025	20:00:00	28.4	27.8	27.4	94.6	94.1	93.3	0	1001.3	198.9	13.3	4.8	0	0
29-08-2025	21:00:00	28.5	27.9	27.4	94.7	94.2	93.8	0	1001.3	208.2	16.6	6.9	2	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
29-08-2025	22:00:00	28.4	27.8	27.3	95.1	94.6	94	0	1001.9	217.9	20.6	7.4	1.3	0
29-08-2025	23:00:00	28.2	27.8	27.5	94.2	93.3	92.4	0	1002.5	222	26	8.4	2	0
30-08-2025	00:00:00	28.2	27.8	27.5	92.9	92.4	91.9	0	1002.8	228.1	22	7.8	2.6	0
30-08-2025	01:00:00	28.1	27.8	27.4	93.4	92.9	92.4	0	1002.2	223.5	19.3	6.9	1.3	0
30-08-2025	02:00:00	28	27.6	27.3	92.8	91.5	90.4	0	1001.9	232.5	19.3	6.2	1.3	0
30-08-2025	03:00:00	28.4	27.4	26.3	92.9	91.1	89.9	3.9	1001.6	233.8	14.6	5	0.6	0
30-08-2025	04:00:00	28.2	27.1	26.2	93.4	93	92.5	4.7	1000.9	237.9	10	2.8	0	0
30-08-2025	05:00:00	27.9	27.1	26.5	93.4	92.8	92.1	0.2	1001.2	241.6	5.3	0.6	0	0
30-08-2025	06:00:00	28.2	26.9	25.7	94.2	92.6	91.7	6.4	1001.6	241	10	1.6	0	0.5
30-08-2025	07:00:00	27.9	26.7	25.7	96.1	94.9	93.7	8.5	1002.7	235	9.3	3.6	0	0
30-08-2025	08:00:00	28.1	27.1	25.9	96.8	96.1	95.2	14.6	1003.6	236.1	10	4.4	0.6	0
30-08-2025	09:00:00	28.9	27.7	26.4	95.8	93.2	90.7	34.1	1003.7	237.5	10.6	3.1	0	0
30-08-2025	10:00:00	31.9	30.2	27.6	91.1	80.6	72.6	165.6	1005.2	260.8	17.3	4.5	0	0
30-08-2025	11:00:00	31.3	30.6	29.8	78.1	75.9	73.7	114.1	1005.3	257.2	14.6	3.4	0.6	0
30-08-2025	12:00:00	33.1	32.2	30.6	75	68.4	64.5	202.6	1005.8	252.5	19.3	3.7	0	0
30-08-2025	13:00:00	34	32.9	31.8	67.9	64.2	59.5	171.4	1005.6	251.1	12.6	3.5	0	0
30-08-2025	14:00:00	33.8	32.2	29	80.1	67.8	60.7	78.8	1004.6	320.9	23.3	2.2	0	0
30-08-2025	15:00:00	29.8	27.7	26.2	94	89.1	79.6	17.6	1002.8	22.9	23.3	2	0	17.5
30-08-2025	16:00:00	28.6	27.4	26.3	94.7	94.1	93.3	56.8	1002.1	230.8	16	4.9	0	0.5
30-08-2025	18:00:00	30	28.8	28	91.5	89.9	88.5	18	1002.9	204.4	8.6	1	0	0
30-08-2025	19:00:00	29.3	28.4	27.4	93.5	92.1	91.1	5.2	1003	216.6	10.6	4.3	0.6	0
30-08-2025	20:00:00	29	27.8	26.7	95.6	94.4	93.1	7.4	1003.2	198.4	12.6	5.5	1.3	0
30-08-2025	21:00:00	28.4	27.4	26.3	96.8	96	95.1	7.2	1003.2	204.8	14.6	5.4	0.6	0
30-08-2025	22:00:00	28.8	27.4	26.3	98.2	97.2	96.4	6.9	1003.8	214.4	18.6	5.4	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
30-08-2025	23:00:00	28.3	27.2	26.3	98	96.9	95.9	5.5	1004.2	220.5	17.3	6.6	2.6	0
31-08-2025	00:00:00	28.1	27.2	26.3	96.5	95.9	95.5	4.4	1004.1	224.2	18.6	6.8	2	0
31-08-2025	01:00:00	28.2	27.2	26.4	96	95.6	95.2	3.7	1003.6	232.4	18.6	7.2	2	0
31-08-2025	02:00:00	28	27.2	26.5	96	95.6	95.2	3.3	1003.1	233.4	18	7	2	0
31-08-2025	03:00:00	28.2	27.1	26.4	96.2	95.7	95.3	2.6	1002.8	234.8	14.6	5.7	1.3	0
31-08-2025	04:00:00	28	27	26.3	95.8	95.3	94.9	2.2	1002.6	230.5	12	2.7	0	0
31-08-2025	05:00:00	27.8	27	26.3	95.9	95.4	94.9	1.9	1002.8	236.1	8.6	2.9	0	0
31-08-2025	06:00:00	27.6	26.9	26.2	96.6	95.9	95.5	1.8	1003	234.3	8	3.1	0	0
31-08-2025	07:00:00	27.6	26.8	26.1	97	96.5	96.1	3	1003.4	234.7	9.3	1.7	0	0
31-08-2025	08:00:00	27.9	27	25.7	97.2	96.5	95.7	11.2	1004.1	221.1	8	2.2	0	0
31-08-2025	09:00:00	28.1	27.4	26.5	96.1	94.5	92.4	20.6	1004.9	226.8	12.6	3	0	0
31-08-2025	10:00:00	29.3	28.2	27.1	92.7	87.7	82.7	65.7	1005.4	237.2	17.3	5.8	0.6	0
31-08-2025	11:00:00	30.2	29.4	28.4	83.1	79.9	77.2	108.5	1005.6	242.3	17.3	5.8	1.3	0
31-08-2025	12:00:00	31.2	30.3	29.6	77.9	76.1	73.9	139.2	1005.9	240.6	19.3	5.7	1.3	0
31-08-2025	13:00:00	32.8	31.8	30.6	74.2	70	65.3	206.8	1005.9	237.2	16.6	5.5	0.6	0
31-08-2025	14:00:00	33.9	33.1	32.2	68.3	64.7	61.3	227.6	1005.2	210.8	22.6	3.8	0	0
31-08-2025	15:00:00	32.7	31	30	79.1	75.5	67.9	123.8	1003.7	196.2	28.6	8.5	3.3	0
31-08-2025	16:00:00	30.6	28.5	26	92.6	85.2	78.6	38.8	1002.3	257.6	34.6	3.1	0.6	6.5
31-08-2025	17:00:00	28.7	27.3	26.1	95.3	94.2	92.1	26.3	1001.5	218.4	8	1.3	0	0.5
31-08-2025	18:00:00	28.9	28	27	95.3	93.4	91.5	24.8	1001.5	214.4	18	6.4	0.6	0
31-08-2025	19:00:00	29.1	27.9	27.1	91.9	90.5	89.8	9.3	1001.5	233.4	18	5.4	0.6	0
31-08-2025	20:00:00	28.6	27.6	26.9	91.5	90.9	90.2	2.1	1001.7	224.9	12.6	5	0.6	0
31-08-2025	21:00:00	28.4	27.5	26.4	93.1	91.3	90.4	3.5	1002.1	228.5	14.6	5.2	1.3	0
31-08-2025	22:00:00	28.6	27.4	26.3	93.7	93.2	92.4	7.3	1002.6	230.3	16	5.5	0.6	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
31-08-2025	23:00:00	28.5	27.3	26.4	93.5	90.6	86.6	5.7	1003.1	235.7	19.3	7.3	2	0
01-09-2025	00:00:00	28.5	27.2	26.5	88.5	87.6	86.3	3.4	1002.6	237.9	10	3.9	0	0
01-09-2025	01:00:00	28.4	27.3	26.6	88.5	87.1	85.6	2.1	1002.1	237.8	18	6.5	2	0
01-09-2025	02:00:00	28.2	27.2	26.5	88	86.6	85.5	1.2	1001.6	232.2	12.6	4.9	1.3	0
01-09-2025	03:00:00	27.6	26.9	26.3	89.5	88.6	87.6	0.2	1001.2	231.3	13.3	3.6	0	0
01-09-2025	04:00:00	27.4	26.7	26.2	89.8	89.3	88.8	0	1001.2	236.6	13.3	3.5	0	0
01-09-2025	05:00:00	27.8	26.9	26.3	89	86.4	85.5	0	1000.4	237.9	15.3	5.8	1.3	0
01-09-2025	06:00:00	27.4	26.5	26	88.7	87.6	85.9	0	1000.2	233.6	11.3	4.6	0.6	0
01-09-2025	07:00:00	27.2	26.4	25.9	89.5	88.2	87.4	1.5	1000.8	227.4	10	3.6	0.6	0
01-09-2025	08:00:00	28.1	26.9	26.1	90.2	89.1	86.4	34.6	1001.6	228.9	10	3.7	0	0
01-09-2025	09:00:00	29.8	29.4	27.5	86.9	75.7	74.8	140.4	1003.7	243.8	26	6.8	0	0
01-09-2025	10:00:00	31.4	30	29.2	76.2	73.5	69.6	171.1	1003.3	238.9	23.3	8.5	2.6	0
01-09-2025	11:00:00	33	31.9	31	69.6	65.8	62.8	208.5	1003.8	247	19.3	5.5	1.3	0
01-09-2025	12:00:00	32.4	31.4	30.7	70.2	67.5	64.5	135.8	1003.1	243.4	16	5.9	1.3	0
01-09-2025	13:00:00	34	32.6	31.2	68.8	63.1	58.7	244.5	1002.9	242.2	21.3	6.1	0.6	0
01-09-2025	14:00:00	35	33.6	32.5	63.8	59	53.8	180.8	1002.2	242.9	18	4.8	1.3	0
01-09-2025	15:00:00	33.1	32	30.2	75.9	68.4	62.5	137.5	1000.6	233.3	27.3	5.5	0	0
01-09-2025	16:00:00	33.2	32	30.6	73.4	68.6	64.7	160.1	1000	233.7	23.3	8	2	0
01-09-2025	17:00:00	32	31.1	30.4	74	72.5	70.7	106.3	999.2	236.3	22.6	8.1	2	0
01-09-2025	18:00:00	31.5	30.7	30	76.2	74.4	72.5	35.7	998.9	234.7	22.6	7.8	2.6	0
01-09-2025	19:00:00	30.4	29.8	29.2	79.5	77.2	74.5	1	999	236.7	18	6.6	2	0
01-09-2025	20:00:00	29.9	29.4	29	79.8	79	78.3	0	999.5	234.2	18	6.7	2	0
01-09-2025	21:00:00	29.6	29.1	28.6	79.9	78.8	77.1	0	1000.3	236.9	25.3	6.5	1.3	0
01-09-2025	22:00:00	29.3	28.6	28	79.9	78.2	77.3	0	1001.2	238.8	22.6	7.2	1.3	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
01-09-2025	23:00:00	28.6	28.1	27.5	80.1	79	77.5	0	1001.4	240.7	19.3	5.6	1.3	0
02-09-2025	00:00:00	28	27.6	27.2	82.1	80.8	79.4	0	1001.6	239.2	16	5.1	0.6	0
02-09-2025	01:00:00	27.8	27.3	26.7	84.8	82.9	81.6	0	1001.5	233.7	12	3.7	0	0
02-09-2025	02:00:00	27.6	27.2	26.8	84.7	83.4	82.7	0	1001	235.6	16.6	4.4	0.6	0
02-09-2025	03:00:00	27.5	26.9	26.3	86.6	84.8	83.6	0	1000.5	236.7	13.3	3.5	0.6	0
02-09-2025	04:00:00	27	26.4	25.9	90.5	88.1	86.2	0	999.9	202.8	9.3	2.6	0	0
02-09-2025	05:00:00	26.6	26.2	25.8	93	91.7	90.1	0	999.9	193.5	7.3	1.3	0	0
02-09-2025	06:00:00	26.5	25.9	25.5	95	93.7	92.5	0	1000	213.8	6.6	2.4	0	0
02-09-2025	07:00:00	26.5	25.8	25.3	95.5	95	94.4	0.3	1000.5	245.3	7.3	1.4	0	0
02-09-2025	08:00:00	28.1	27	26	94.6	91.8	87.8	24.3	1001.7	254.4	10.6	2.4	0	0
02-09-2025	09:00:00	30.4	29.1	27.6	88	81.2	74.5	89.9	1002.9	244	16	5	1.3	0
02-09-2025	10:00:00	32.2	31.5	30	74.7	68.9	64.9	168.6	1004.7	271.4	20.6	3.7	0	0
02-09-2025	11:00:00	33	32.3	31.4	67.7	64.2	62.1	191.6	1004.7	283.7	21.3	4.3	1.3	0
02-09-2025	12:00:00	34.3	32.7	31.8	65.4	62.4	57.5	208.9	1004.5	268.8	16.6	3.6	0.6	0
02-09-2025	13:00:00	36.2	34.8	33.8	58.2	54.8	49.8	279.8	1004.4	271.7	15.3	3.2	0	0
02-09-2025	14:00:00	35.9	34.8	33.9	58.6	54.6	50.4	233	1003.2	240.3	23.3	4.2	0	0
02-09-2025	15:00:00	36.3	33.9	31	73.4	58.2	46.6	215.7	1002.2	169.3	21.3	5	0	0
02-09-2025	16:00:00	32.2	31.3	30.8	75.3	73	70.2	96.7	1000.4	167.3	23.3	6.9	1.3	0
02-09-2025	17:00:00	32	30.7	29.2	83.1	79.5	72.4	89.3	999.7	164.3	26	6.7	1.3	0.5
02-09-2025	19:00:00	30.4	29.6	28.6	84.9	83.5	82.5	7.1	1000.1	229.4	16.6	7.3	1.3	0
02-09-2025	20:00:00	30.2	29.3	28.6	84.2	83.4	82.4	4.6	1000.4	223.9	14.6	5.1	1.3	0
02-09-2025	21:00:00	29.9	29	28.4	84.9	84.1	83.7	2.2	1001.5	225.3	15.3	6.2	0.6	0
02-09-2025	22:00:00	29.8	29	28.4	85.4	82.7	77.8	0.5	1002.4	235	14.6	5.7	1.3	0
02-09-2025	23:00:00	29.3	28.5	27.8	78	75.9	74.7	0	1002.6	239.5	24.6	6.8	2	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
03-09-2025	00:00:00	28.4	27.9	27.4	81	79.1	76.7	0	1002.9	237.9	15.3	5.8	1.3	0
03-09-2025	01:00:00	28.2	27.5	26.9	83.6	82.2	80.6	0	1002.3	243.7	16	5	1.3	0
03-09-2025	02:00:00	27.6	27.1	26.7	85.9	84.4	83.1	0	1001.5	244.4	16	5.3	0.6	0
03-09-2025	03:00:00	27.5	27	26.7	86.1	85.4	84.8	0	1001.3	247.8	14.6	4.6	0.6	0
03-09-2025	04:00:00	27.4	26.9	26.5	86.5	85.6	85.1	0	1001.1	243.2	18	5.1	1.3	0
03-09-2025	05:00:00	27.3	26.8	26.3	88.3	86.8	85.9	0	1001.3	235.3	12	4.7	0.6	0
03-09-2025	06:00:00	27.1	26.6	26.3	90	88.9	87.8	0	1001.8	235.8	12	3.6	0	0
03-09-2025	07:00:00	27.1	26.6	26.3	90.1	89.6	89.3	0	1002.3	239.4	10.6	2.2	0	0
03-09-2025	08:00:00	27.8	26.9	26.3	90	89.1	86.7	15.6	1003.2	251.4	7.3	1.6	0	0
03-09-2025	09:00:00	30.2	29.4	27.3	87.1	76.9	74.5	122.6	1004.8	305.8	14.6	3.9	0	0
03-09-2025	10:00:00	31.6	30.8	29.8	74.6	68.7	64.8	176.4	1005.2	321.6	22.6	5.9	2	0
03-09-2025	11:00:00	32.8	32.1	30.5	67.2	62.2	59.1	242	1005.8	331.4	24	7.2	2	0
03-09-2025	12:00:00	34.2	33	31.9	61.4	57.6	54.4	275.4	1005.3	332.6	20	7.4	0.6	0
03-09-2025	13:00:00	34.2	33.2	32.4	63.5	60.2	53.6	280.9	1004.8	36.8	19.3	5.1	0.6	0
03-09-2025	14:00:00	34.5	33	31.3	67	61.6	56.8	268.2	1004.1	64.2	19.3	5.4	1.3	0
03-09-2025	15:00:00	34.2	31.8	30.6	71.5	67	57.8	139	1002.8	134.8	22	6	1.3	0
03-09-2025	16:00:00	33.5	32.8	32	66.2	63.1	60.1	249.1	1002.3	180.7	22.6	7.2	2	0
03-09-2025	17:00:00	33.4	32.1	31.2	68.7	65.9	61.6	185	1001.3	200.7	26	9.4	2.6	0
03-09-2025	18:00:00	31.8	30.7	29.7	75.5	71.2	66.7	67.9	1000.7	200.7	24.6	10.1	4	0
03-09-2025	19:00:00	30.4	29.8	29.1	78.7	76.2	74.6	10.8	1000.4	203.2	27.3	9.9	3.3	0
03-09-2025	20:00:00	29.8	29.4	29	81	79.9	78.3	0	1001.1	200.5	22	8.3	3.3	0
03-09-2025	21:00:00	29.7	29.3	28.9	81	80.4	79.9	0	1001.7	208.5	19.3	6.2	2	0
03-09-2025	22:00:00	29.6	29.1	28.7	81	80.1	79.4	0	1002.2	227	16	6.2	1.3	0
03-09-2025	23:00:00	29.7	29.1	28.6	81.6	78.5	75.1	0	1002.6	239.9	18.6	6.8	2	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
04-09-2025	00:00:00	29.8	28.7	27	82.7	78.3	75	4.2	1002.5	244.9	20	6.2	1.3	0
04-09-2025	01:00:00	28.9	27.7	25.5	88.3	82.5	79.7	7.8	1002.2	310	44	5	2	1
04-09-2025	02:00:00	27.2	25.7	24.6	94.4	92.1	88.1	8	1001.6	4.4	22.6	4.8	1.3	6.5
04-09-2025	03:00:00	27.2	26	24.9	94.6	93.8	93	7.8	1000.9	335.3	32	4	0	0.5
04-09-2025	04:00:00	26.7	25.5	24.5	96.5	95.1	93.8	8.4	1000.6	235.9	8	2.7	0	2
04-09-2025	05:00:00	26.5	25.4	24.3	98.6	97	95.9	8.3	1000.3	226.4	8	2.4	0	0
04-09-2025	06:00:00	26.5	25.3	24.1	102.7	99.2	97.5	8.3	1000.8	234.7	8.6	3.1	0	0
04-09-2025	07:00:00	26.7	25.5	24	107.6	105.2	100.8	9.3	1001.5	241.4	9.3	2.9	0	0
04-09-2025	08:00:00	27.3	26	24.6	107.3	103.9	98.6	23.3	1002.3	243.3	10	2.8	0	0
04-09-2025	09:00:00	28.3	27	25.2	99.7	96.1	91.4	61.1	1003	245.1	14	4.8	0.6	0
04-09-2025	10:00:00	28.9	28.3	27.1	91.8	85.6	84.9	33.9	1004.1	269.4	17.3	3.7	0.6	0
04-09-2025	11:00:00	29.3	28.2	27.4	86.3	85.2	83	51.3	1003.8	259.8	15.3	3.6	0	0
04-09-2025	12:00:00	31	30	28.4	83.3	77.9	74.2	147.6	1003.8	282.4	26.6	4.2	0.6	0
04-09-2025	13:00:00	31.4	30.5	29.2	79.1	75.2	72	112.3	1003.6	294.3	15.3	3.7	1.3	0
04-09-2025	15:00:00	27.5	26.5	25.3	102.3	100.7	99.1	17	1001.3	306	16.6	4.6	1.3	8.5
04-09-2025	17:00:00	27.7	26.7	25.5	107.4	106.6	105.9	10.5	1000.5	239.5	15.3	5.8	2	6.5
04-09-2025	18:00:00	27.7	26.5	25.3	107.4	106.7	106	8.5	999.4	240.7	18.6	6.4	2	1.5
04-09-2025	19:00:00	27.3	26.2	25.1	107.5	106.7	105.7	8.2	999.4	240.4	20.6	7.6	2.6	2.5
04-09-2025	20:00:00	27.1	26.2	25.1	107.6	106.6	105.6	7.5	1000.2	239.4	27.3	8.3	2.6	1.5
04-09-2025	21:00:00	27.3	26.2	25.1	107.4	106.7	105.7	6.7	1000.5	240	25.3	8.8	2.6	0
04-09-2025	22:00:00	27.3	26.3	25.2	108	106.6	104.8	6.4	1001.1	240.2	24	8.3	3.3	0
04-09-2025	23:00:00	27.7	26.7	25.7	107.6	97.4	93.5	5.7	1001.4	242.8	24	8	3.3	0
05-09-2025	00:00:00	27.7	26.5	25.2	93.9	92.2	89.5	5.7	1001.6	273.8	24	3.9	2	0
05-09-2025	01:00:00	26.9	25.9	25	90.7	89.9	89.3	5.5	1000.8	273.6	18.6	3.9	2	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
05-09-2025	02:00:00	26.5	25.7	25	90.2	89.6	89.1	3.5	999.8	314.9	17.3	5	2	0
05-09-2025	03:00:00	26.5	25.7	25	89.8	88.8	87	2.6	999.7	335	20	7.8	1.3	0
05-09-2025	04:00:00	26.4	25.2	24.1	92.2	90	86.7	6.9	1000.1	325.5	24	5	0	0
05-09-2025	05:00:00	26.2	25.1	24.2	91.8	88.5	86.2	6.9	1000.6	324.6	12.6	3.6	0	0
05-09-2025	06:00:00	26.3	25.1	24.2	90.2	89.2	87.8	6.3	1001.2	317.3	8	2.1	0	0
05-09-2025	07:00:00	25.9	25	24.1	91.7	90.2	88.7	5.5	1001.6	252.7	8	1.7	0	0
05-09-2025	08:00:00	25.8	24.9	23.9	91.9	91.4	90.9	10.5	1002.2	258.1	8	2.5	0	0
05-09-2025	09:00:00	26.7	25.3	24.1	91.9	90.7	88.5	28.8	1003.2	254.3	11.3	2.7	0	0
05-09-2025	10:00:00	28	26.5	25.3	89.1	88.4	87.6	57.4	1003.9	247.4	12	4	0	0
05-09-2025	12:00:00	29.8	29	27.8	86.2	81.9	79.6	107.4	1004.5	256.1	20	4.2	1.3	0
05-09-2025	13:00:00	30.6	29.7	28.8	80.5	78.9	76.9	105.5	1003.5	255.7	20.6	5	1.3	0
05-09-2025	15:00:00	31.2	30.4	29.8	79.6	77.7	74.5	106	1002.7	244.7	18.6	6.5	1.3	0
05-09-2025	16:00:00	32.5	31.3	30.1	78.1	74.2	70.6	179.8	1001.7	239.5	24.6	8.3	2.6	0
05-09-2025	17:00:00	30.8	30.5	29.9	79.8	78.9	78.3	58.5	1000.7	240.7	22	7.9	2	0
05-09-2025	18:00:00	30.8	30.2	29.6	81	79.6	78.2	28.1	1000.4	238.5	18.6	8	2.6	0
05-09-2025	19:00:00	30.2	29.6	28.9	82.7	81.7	80.6	1.4	1001.1	238.4	14.6	6	1.3	0
05-09-2025	20:00:00	29.6	29	28.5	84.3	83.4	82.3	0	1001.6	234.5	14.6	5.7	2	0
05-09-2025	21:00:00	29.4	28.8	28.3	84.8	83.1	81.4	0	1001.9	238.5	24	7.2	2	0
05-09-2025	22:00:00	29	28.4	27.9	83.5	82.7	81.8	0	1002.9	244	24	7.5	1.3	0
05-09-2025	23:00:00	28.8	28.2	27.8	82.6	82	81.6	0	1003	242.4	26	7.5	1.3	0
06-09-2025	00:00:00	29	27.7	26.4	88.6	84.7	82	5.5	1003.2	329.5	28	2.1	0	0.5
06-09-2025	01:00:00	28.1	26.4	25.3	94.5	91.7	87.9	8.5	1002.4	135	14.6	1.4	0	5.5
06-09-2025	02:00:00	27.3	26.2	25.1	96.7	95.3	93.9	8	1002.1	215.6	6.6	2.7	0	1
06-09-2025	03:00:00	27.6	26.3	25.2	98.7	97.3	96.1	7.9	1001.8	233.9	11.3	3.8	0	1

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
06-09-2025	04:00:00	27.3	26.1	24.9	100.4	99	97.7	7.2	1000.8	234.7	16	5.6	0.6	0
06-09-2025	05:00:00	27.4	26.2	25	100.8	99.6	98.3	6.8	1001.2	235	16.6	5.2	1.3	0
06-09-2025	06:00:00	27.4	26.2	25.1	100	97.9	96.5	6.5	1001.3	245.4	17.3	5.4	1.3	0
06-09-2025	07:00:00	27.4	26.4	25.4	97	95.8	94.6	7.3	1001.4	240.6	12.6	3.9	0	0
06-09-2025	08:00:00	28.1	26.9	25.7	95.1	93.3	90.8	28.2	1002.4	228.1	10	3.2	0	0
06-09-2025	09:00:00	29.2	28.2	26.9	91.2	87.1	84.1	69.7	1003.6	231.2	13.3	5	0	0
06-09-2025	10:00:00	31.8	30.2	28.2	84.4	78.2	72.3	162.9	1004.5	226.5	16.6	5.7	0.6	0
06-09-2025	11:00:00	32.6	31.7	30.2	75.8	70.3	66.6	182.9	1005	235.6	16.6	5.3	1.3	0
06-09-2025	12:00:00	31.8	30	28	87.2	79.5	72.1	70	1004.6	245.7	16	3.6	0	0.5
06-09-2025	13:00:00	30.7	29.6	28.3	85.1	80.2	78	79.8	1004.1	253.8	16.6	3.7	0.6	0
06-09-2025	14:00:00	31.6	30.5	29	78.3	73.9	71.1	122.7	1003.7	257.5	17.3	3.7	0	0
06-09-2025	15:00:00	30.4	29.9	29.5	75.5	74.4	73.4	116	1002.7	245.1	20.6	5.9	2	0
06-09-2025	16:00:00	30.2	29.9	29.3	73.4	73	72.6	89.9	1002	259.3	16.6	5	3.3	0
06-09-2025	17:00:00	30.4	29.6	28.5	77.2	74.8	72.3	63.1	1001.6	250.4	20	5.6	2	0
06-09-2025	18:00:00	29.1	28.5	28	81.3	78.7	77	15.6	1001.4	249.3	20.6	4.9	0	0
06-09-2025	19:00:00	28.6	27.8	26.7	87.5	84.3	81	2.7	1001.7	248.3	12	3.3	0	0
06-09-2025	20:00:00	28.1	26.9	25.8	90.8	89.1	87	7.3	1002	236.5	20.6	5.4	0.6	0
06-09-2025	21:00:00	27.7	26.5	25.7	93.5	91.9	90.2	7.3	1002.3	234.8	14	6.4	2	0
06-09-2025	22:00:00	27.6	26.6	25.7	93.8	93	92.2	7	1002.5	228.5	20.6	6.9	1.3	0
06-09-2025	23:00:00	27.6	26.6	25.7	93.4	92.7	92.3	6.2	1003.1	231.6	17.3	4.6	0.6	0
07-09-2025	00:00:00	27.9	26.9	25.9	93.1	90.7	88.6	4.6	1003	222.4	17.3	6	2	0
07-09-2025	01:00:00	27.5	26.7	26	91.7	90.6	89.1	3.5	1002.6	221.9	18.6	6.4	1.3	0
07-09-2025	02:00:00	27.5	26.7	26	92	91.5	91	2.3	1002.1	230.8	17.3	6.3	2	0
07-09-2025	03:00:00	27.5	26.7	26	91.9	90.7	87.1	1.6	1001.8	232.9	22.6	6.5	1.3	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
07-09-2025	04:00:00	28.2	27	25.5	90.7	86.4	83.6	5.3	1001.5	243.5	26	8.2	2	0.5
07-09-2025	05:00:00	27.3	26.1	25.1	95	93	90.3	7.5	1000.9	241.4	18.6	6.4	2	0.5
07-09-2025	06:00:00	27.1	26	25.1	96.1	95.4	94.6	6.9	1001.2	233.8	20.6	7.4	2	0
07-09-2025	07:00:00	26.9	26	25	96.1	95.7	95.1	7.5	1001.2	234.2	25.3	7.9	2	0
07-09-2025	08:00:00	27.1	26.1	25.1	95.7	94.7	94.1	13.3	1001.9	225.8	25.3	6.9	2	0.5
07-09-2025	17:00:00	28.6	27.4	26.3	95.9	93.1	91.9	35	1001.5	211	27.3	5.7	0.6	0
07-09-2025	18:00:00	28.3	27.4	26.6	92.3	89.2	87	21.2	1001	217.4	17.3	6.8	2	0
07-09-2025	19:00:00	28.2	27.2	26.4	88.7	87.8	86.8	7.2	1001.3	204.2	18	6.9	2.6	0
07-09-2025	20:00:00	27.8	26.9	26.3	88.9	88.4	87.8	3.3	1001.9	203.5	16.6	7.3	2.6	0
07-09-2025	21:00:00	27.8	26.9	26.1	89.3	88.2	87.4	2.7	1002.9	213.4	16	5.9	2	0
07-09-2025	22:00:00	27.7	26.7	26.1	89.7	89.3	88.6	2.5	1003.6	208.3	15.3	6.2	1.3	0
07-09-2025	23:00:00	27.5	26.7	26.1	89.1	88.4	87.6	1.8	1004.2	213.9	22.6	7.3	2	0
08-09-2025	00:00:00	27.7	26.8	26.1	88.1	87.6	87.1	1.2	1004.2	216.7	22.6	8.3	2.6	0
08-09-2025	01:00:00	27.6	26.8	26.1	89	88	87.1	1.2	1003.6	216.4	22.6	7.9	3.3	0
08-09-2025	02:00:00	27.5	26.7	26	89.5	88.9	88.3	1.3	1003.2	221.4	26	8.3	2	0
08-09-2025	03:00:00	27.4	26.5	25.7	90.2	89.1	88.2	1.4	1002.4	220.1	21.3	8	2	0
08-09-2025	04:00:00	27.2	26.3	25.5	90.5	89.7	88.8	1.7	1001.6	220.1	24.6	8.3	2	0
08-09-2025	05:00:00	27	26	25.3	91.7	91	90	2.2	1001.3	220.9	21.3	8.3	2.6	0
08-09-2025	06:00:00	26.9	25.9	25.1	92.1	91.3	90.8	2.4	1001.3	206.7	24	8.4	2.6	0
08-09-2025	07:00:00	27.1	26.2	25.3	92	90.6	89	7.9	1001.9	218.6	22.6	8.1	2	0
08-09-2025	08:00:00	28.6	27.5	26	89.4	85.8	82	66.1	1003.4	227.5	28	8.5	2	0
08-09-2025	09:00:00	29.3	28.6	27.7	82.9	80.8	78.7	111.2	1004.7	228.3	33.3	10.2	3.3	0
08-09-2025	10:00:00	27.5	26.7	26.1	89.1	88.4	87.6	1.8	1004.2	213.9	22.6	7.3	2	0
08-09-2025	11:00:00	31.5	30.7	29.5	72.8	66.8	62.7	179.9	1006.1	225.5	44	13.9	3.3	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
08-09-2025	12:00:00	32.4	31.6	30.6	66.4	61.9	57.5	310.4	1005.8	222.6	49.3	14.5	4.6	0
08-09-2025	13:00:00	33.1	32.2	31.4	59.8	57.6	54.3	321.7	1005.8	226.4	40.6	13.9	5.3	0
08-09-2025	14:00:00	33.8	33	32.1	59	55.1	51.3	324.2	1005.3	223.4	37.3	12.8	4.6	0
08-09-2025	15:00:00	33.9	32.9	31.9	60.6	55.9	52	277.9	1004.6	224.7	34	12.4	4.6	0
08-09-2025	16:00:00	33	32	31.2	65.1	60.1	56	213.8	1004	211.4	32	12.3	4	0
08-09-2025	17:00:00	32.7	31.8	30.6	68.5	64.8	61.8	173.9	1003.6	203.2	34.6	11.4	3.3	0
08-09-2025	18:00:00	31.2	30.6	29.8	70.2	68.2	66.5	84.9	1003.5	209	30	10.6	3.3	0
08-09-2025	19:00:00	30	28.9	28	78	74.6	69.4	4.4	1003.3	203.3	26	9.9	3.3	0
08-09-2025	20:00:00	28.4	27.8	27.2	81	78.7	77.4	0	1003.7	211.6	28	8.3	3.3	0
08-09-2025	21:00:00	27.6	27.3	26.9	84.1	82.5	80.6	0	1004.6	213.1	23.3	7.4	2.6	0
08-09-2025	22:00:00	27.4	26.8	26.4	87.1	85.4	83.8	0	1005.4	210.8	16	4.9	0	0
08-09-2025	23:00:00	26.9	26.4	26	89.4	88.2	86.7	0	1005.6	206.3	14	5.2	1.3	0
09-09-2025	00:00:00	26.7	26.1	25.7	91.3	90	89	0	1005.5	214.9	11.3	4	1.3	0
09-09-2025	01:00:00	26.3	25.8	25.5	92.7	91.8	90.6	0	1005.1	216.7	12	3.9	0	0
09-09-2025	02:00:00	26.3	25.7	25.3	94	92.9	92.1	0	1004.9	228.4	10	4	0.6	0
09-09-2025	03:00:00	26.1	25.5	25.1	94.8	94.2	93.6	0	1004.6	238.8	8	2.1	0	0
09-09-2025	04:00:00	25.7	25.2	24.8	96	95.2	94.4	0	1004.4	244.2	2.6	0	0	0
09-09-2025	05:00:00	25.5	25	24.6	97	96.2	95.5	0	1004.7	244.5	0.6	0	0	0
09-09-2025	06:00:00	25.4	24.9	24.5	97.9	96.9	96.4	0	1005	0	0	0	0	0
09-09-2025	07:00:00	25.3	24.7	24.2	98.5	97.7	97	1.1	1005.2	243.9	4	0	0	0
09-09-2025	08:00:00	26.7	25.5	24.4	98.4	96.9	95.4	23.8	1006.1	240.2	6.6	2.2	0	0
09-09-2025	09:00:00	29.7	28.2	26.2	95.5	87.1	77.6	104.7	1007.9	225.2	20.6	5.2	0	0
09-09-2025	10:00:00	30.6	29.7	29.1	78.5	74	69.4	131.3	1008.8	222.7	18.6	6.1	0	0
09-09-2025	11:00:00	31.4	30.7	30.2	68.5	66.8	64.5	156.5	1009.3	210	20	7	1.3	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
09-09-2025	12:00:00	31.8	31.1	30.4	69.8	66.6	64.5	174.1	1008.9	209.8	21.3	6.9	2	0
09-09-2025	13:00:00	32.6	31	30.2	69.4	66.7	62.4	178.5	1008.1	205.2	26.6	7.9	2	0
09-09-2025	14:00:00	33.3	32.7	32.2	63.6	60.4	58	365.4	1007.9	193.3	30	9.7	3.3	0
09-09-2025	15:00:00	33.3	32.7	32.2	61	59.3	57.7	334	1007.4	188.6	28.6	10.1	4	0
09-09-2025	16:00:00	32.8	32.2	31.6	63	59.5	57.4	275	1007	196.1	30	11.5	4.6	0
09-09-2025	17:00:00	32	31.4	30.8	66.4	64	61.4	190.5	1006.7	197.7	34	12	4	0
09-09-2025	18:00:00	31.4	30.7	29.9	71.1	66.6	64	90.5	1006.7	202.2	24.6	9.4	2.6	0
09-09-2025	19:00:00	30.2	29.1	28.1	76	73.8	70.7	5.7	1006.6	203.8	21.3	8.4	3.3	0
09-09-2025	20:00:00	28.6	28	27.4	80.4	77.9	75.1	0	1006.8	206.9	20.6	6.9	2	0
09-09-2025	21:00:00	28	27.2	26.7	83.4	81.8	79.6	0	1007.2	219.3	16	5.9	1.3	0
09-09-2025	22:00:00	27.3	26.9	26.5	84.1	82.7	81.7	0	1007.6	215.7	16	6.6	1.3	0
09-09-2025	23:00:00	27	26.3	25.7	88.5	86.2	83.9	0	1007.5	235.8	13.3	4.2	1.3	0
10-09-2025	01:00:00	25.8	25.4	24.9	93.3	92.6	92.1	0	1007.2	232.3	7.3	3	0	0
10-09-2025	02:00:00	25.7	25.1	24.7	93.8	93.3	92.8	0	1006.7	229.8	6.6	1.6	0	0
10-09-2025	03:00:00	25.3	24.8	24.5	94.6	94	93.4	0	1006.7	230.1	6.6	1.3	0	0
10-09-2025	04:00:00	25.1	24.6	24.2	95.9	95	94.3	0	1006.4	230.3	6	0.9	0	0
10-09-2025	05:00:00	24.8	24.3	23.9	96.9	96.2	95.5	0	1006.7	230.6	6	1.7	0	0
10-09-2025	06:00:00	24.7	24.2	23.7	98.8	97.3	96.4	0	1007.1	231.4	7.3	2.8	0	0
10-09-2025	07:00:00	24.9	24.2	23.6	100	98.8	97.8	1.5	1007.6	236.8	7.3	3.2	0	0
10-09-2025	08:00:00	27.8	26	24	99.4	94.8	88	45.4	1008.9	236.5	13.3	4.3	0.6	0
10-09-2025	09:00:00	30.3	29.9	27.4	88.2	72.4	70.6	156.3	1011	216.1	16.6	7	2	0
10-09-2025	10:00:00	31.8	30.7	29.8	71.8	66.9	61.9	204.6	1010.8	227	20	7.7	2	0
10-09-2025	11:00:00	33.2	32.2	31.2	63.3	58.1	50.9	212.8	1011.2	225.4	20.6	6.7	1.3	0
10-09-2025	12:00:00	33.6	32.6	31.4	63.2	55.9	49	243	1010.9	203.1	18	5.1	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
10-09-2025	13:00:00	33.9	33	32.2	60.4	57.3	54.5	348.5	1010.4	190.4	24.6	7.3	2	0
10-09-2025	14:00:00	33.8	33.1	32.4	59.3	56.2	52.6	361.3	1009.4	151.3	26	7.8	2	0
10-09-2025	15:00:00	33.9	32.9	32	59.4	57.4	55	297.7	1008.9	173.4	26.6	7.6	0.6	0
10-09-2025	16:00:00	33.8	32.1	30.9	63.9	60.5	54.5	187.7	1007.9	156.9	26.6	7.2	2	0
10-09-2025	17:00:00	32.5	31.4	30.6	66.1	63.2	59.7	124.3	1007.3	161.6	22.6	6.9	0.6	0
10-09-2025	18:00:00	31.2	30.2	29.6	69.4	66.6	63.6	34	1006.4	183.5	17.3	5.9	1.3	0
10-09-2025	19:00:00	30	29.2	28.5	73.6	71.2	69.3	3.2	1006	197.3	15.3	6	2	0
10-09-2025	20:00:00	29	28.4	27.9	77.4	75.6	73	0	1006.6	200.9	16.6	6.9	2	0
10-09-2025	21:00:00	28.6	28	27.4	78.8	77.2	75.9	0	1006.9	205.2	14	5.5	1.3	0
10-09-2025	22:00:00	28	27.5	27.1	81	79.9	78.5	0	1007.3	210.8	16.6	5.6	1.3	0
10-09-2025	23:00:00	27.5	27.1	26.7	83.6	82.1	80.6	0	1007.5	213.8	16	6.5	2	0
11-09-2025	00:00:00	27.2	26.6	26.1	86.1	84.6	83	0	1007.1	223.9	17.3	6.8	2.6	0
11-09-2025	01:00:00	26.7	26	25.5	90	88	85.7	0	1006.7	231.7	13.3	5.2	1.3	0
11-09-2025	02:00:00	26.1	25.6	25.3	92.1	91.1	89.7	0	1006.2	233.6	8	3.3	0	0
11-09-2025	03:00:00	26.1	25.6	25.2	91.9	91.4	90.2	0	1005.6	237.1	8.6	3.6	0	0
11-09-2025	04:00:00	26.2	25.6	25.1	91.4	90.6	89.9	0	1005.3	243.9	7.3	2.8	0	0
11-09-2025	05:00:00	25.7	25.2	24.8	93.2	92.2	91.1	0	1005.3	232.6	8	2.3	0	0
11-09-2025	06:00:00	25.8	25.2	24.7	93.6	93	92.6	0	1005.5	245.8	7.3	2.4	0	0
11-09-2025	07:00:00	25.4	24.9	24.5	94.5	93.8	93.1	0.6	1006.6	255.6	6	0.8	0	0
11-09-2025	08:00:00	27.9	26	24.8	94.2	91.6	83.3	33.4	1007.4	238.1	9.3	1.8	0	0
11-09-2025	09:00:00	31.2	30.1	28.5	75.5	69	63.8	150.3	1009.9	242.7	14	4.2	0	0
11-09-2025	10:00:00	33.2	32.3	30.6	64.1	58.6	54.3	207	1010.6	234.6	14.6	3.7	0	0
11-09-2025	11:00:00	34.4	33.5	32.5	54	50.8	45.7	164.2	1010.7	227.6	15.3	3	0	0
11-09-2025	12:00:00	33.8	32.1	31.2	67.1	62.6	51.6	282.5	1009.8	107.2	21.3	6.8	2	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
11-09-2025	13:00:00	32.7	32.1	31.4	66.7	63.9	61.1	328.5	1009.4	107.3	20	7.5	1.3	0
11-09-2025	14:00:00	33.4	32.7	32	63.4	60.4	54.6	357.5	1008.8	117.1	21.3	8.2	2.6	0
11-09-2025	15:00:00	34	33	32.3	63.5	59.8	54.9	320.3	1008.4	132.9	22	7.6	2	0
11-09-2025	16:00:00	33.8	32.9	32.2	63.6	60.9	57.4	270.4	1007.5	166.3	23.3	8	2.6	0
11-09-2025	17:00:00	33.1	32.3	31.4	65.6	62.4	60	178.4	1007	191.3	20	7.3	2	0
11-09-2025	18:00:00	32.3	30.9	30	70	66.2	60.6	69.3	1006.4	197.4	25.3	8.1	2	0
11-09-2025	19:00:00	30.4	29.4	28.7	74.5	72.1	69.6	6.7	1006.2	198.8	23.3	8.9	2.6	0
11-09-2025	20:00:00	29.2	28.7	28.4	76.7	75.9	74	0	1006.5	200.9	21.3	8	2	0
11-09-2025	21:00:00	28.7	28.1	27.6	80.6	78.4	76.2	0	1007	208.6	19.3	6.8	2	0
11-09-2025	22:00:00	28.1	27.7	27.3	83.7	82	80.1	0	1007.3	212.9	17.3	6.9	2	0
11-09-2025	23:00:00	27.7	27.2	26.8	86.9	85.4	83.4	0	1007.3	223.3	18	6	1.3	0
12-09-2025	00:00:00	27.7	27	26.7	88.1	86.4	80.2	0	1007.2	237.1	18	5.9	2	0
12-09-2025	01:00:00	27.8	27.3	26.9	80.5	78.3	76.8	0	1007	244.5	15.3	5.6	1.3	0
12-09-2025	02:00:00	27.4	26.9	26.3	83	80.6	78.7	0	1006.6	244.6	15.3	4.2	0.6	0
12-09-2025	03:00:00	26.9	26.2	25.8	86.4	84.5	82.7	0	1005.8	241.9	13.3	4	0.6	0
12-09-2025	04:00:00	26.4	25.8	25.5	87.9	87.1	85.9	0	1005.4	247	14	3.5	0.6	0
12-09-2025	05:00:00	26.1	25.5	25.1	90.4	88.9	87.5	0	1005.4	245.8	10.6	3.6	0	0
12-09-2025	06:00:00	25.6	25.2	24.9	91.6	90.9	90	0	1005.8	245	8.6	3.5	0.6	0
12-09-2025	07:00:00	25.7	25.2	24.9	91.6	91.3	91	0.7	1006.6	247.7	9.3	2.7	0	0
12-09-2025	08:00:00	29	26.8	25.1	91.6	86.9	78	39.2	1008	237.5	8	1.1	0	0
12-09-2025	09:00:00	31.6	30.2	28.5	78	70.2	64.1	119.5	1010.1	275.4	10	1.2	0	0
12-09-2025	10:00:00	32.2	31.1	30.2	67.3	64.4	60.9	203.6	1010.9	337.5	16	5.2	0	0
12-09-2025	11:00:00	33.9	32.5	31.8	61.5	59.2	54.9	202.8	1010.9	352.4	18	4.9	0	0
12-09-2025	12:00:00	34.4	33.5	32.5	59.8	53.7	47.9	305.3	1010.9	4.2	20	5.4	0.6	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
12-09-2025	13:00:00	35	33.6	33	58.5	55.1	51.1	355.3	1010.4	21.9	21.3	4.6	0	0
12-09-2025	14:00:00	34.3	32.8	31.8	64	59.5	53.8	343.9	1009.5	58	24.6	8.8	2	0
12-09-2025	16:00:00	34.3	33.8	33	53.2	51.1	48.4	225.7	1008.4	61.6	13.3	5	0.6	0
12-09-2025	17:00:00	34.6	33.9	33.2	53.8	48.9	45.6	180.2	1007.5	68.1	11.3	2.8	0	0
12-09-2025	18:00:00	33.8	33.2	32.5	54.6	52.2	50.6	38.9	1007.2	113.5	0.6	0	0	0
12-09-2025	19:00:00	33	31.4	29.6	67.5	60.2	52.7	7.2	1006.7	180.4	6.6	0.3	0	0
12-09-2025	20:00:00	30	29.1	28.4	75.9	71.8	67.3	0	1006.5	214.1	9.3	3.4	0	0
12-09-2025	21:00:00	29.1	28.4	27.8	78	76.9	75.5	0	1006.8	221	12	4.5	0.6	0
12-09-2025	22:00:00	28.4	28	27.5	81.4	79.8	77.6	0	1007.2	216.5	12.6	5.2	0.6	0
12-09-2025	23:00:00	28.1	27.5	27.1	84	82.8	81	0	1007.2	229.7	10	4.2	0	0
12-09-2025	06:00:00	27	26.6	26.3	94.6	93.1	91.9	1.5	1007.9	235.7	12.6	5	0	0
12-09-2025	07:00:00	26.7	26.4	26.2	95.4	94.5	93.9	2.2	1008.5	224.2	12.6	1.8	0	0
12-09-2025	08:00:00	28.5	27	26.3	95.5	93.4	88.4	37.1	1009.6	236.7	5.9	0.1	0	0
12-09-2025	09:00:00	29.9	29	28.1	89.1	83.5	79.1	139.1	1011.3	248.6	13.9	2.5	0	0
12-09-2025	10:00:00	30.7	30	29.6	80.2	76.4	73.3	230.3	1011.9	244.6	17.9	5.1	0	0
12-09-2025	11:00:00	31.3	30.6	30.1	76.9	72.6	69.2	185.8	1011.9	239.3	15.9	3.9	0	0
12-09-2025	12:00:00	32.4	31.5	30.4	75.5	68.8	62	311.2	1012	236	19.9	5.2	0	0
12-09-2025	13:00:00	33.4	32.7	31.6	65.6	58.9	54.1	379	1011.8	236.7	20.6	4.7	0	0
12-09-2025	14:00:00	35.8	34.1	32.5	60.4	52	45.3	373.3	1011.3	233.2	14.6	2.3	0	0
12-09-2025	15:00:00	35.5	34.7	33.8	51.4	47.5	44.6	333.3	1010.4	232.9	14.6	3.5	0	0
12-09-2025	16:00:00	35.5	34.5	33.3	51.6	47.3	43.5	243.2	1009.4	243	16.6	4	0	0
12-09-2025	17:00:00	34.6	34	33.4	51.2	48.1	45.3	170.9	1008.5	243.9	15.2	2.5	0	0
12-09-2025	18:00:00	34	32.5	31.4	60.6	54.8	48.4	75.6	1007.9	240	11.9	2.6	0	0
12-09-2025	19:00:00	32.1	30.6	29.3	75.2	66.3	56	10.5	1007.6	219.9	9.9	1.9	0	0

Ghogha station														
DATE	TIME	AT_Max	AT_Avg	AT_Min	RH_Max	RH_Avg	RH_Min	SOLAR	BP	WD	WS_Max	WS_Avg	WS_Min	RAIN
DD/MM/YY	HH:MM:SS	DegC	DegC	DegC	%	%	%	W/m2	mbar	Deg	m/s	m/s	m/s	MM
12-09-2025	20:00:00	29.4	29	28.8	80	76.9	74.9	0.6	1007.5	204.6	10.6	2.6	0	0
12-09-2025	21:00:00	29.1	28.9	28.7	82.1	81.1	79.9	0.6	1008.1	202.8	11.3	2.6	0	0
12-09-2025	22:00:00	29.2	28.9	28.7	86.4	83.5	81.3	0.6	1008.5	201.9	10.6	3.6	0	0
12-09-2025	23:00:00	29.2	28.8	28.6	90.2	87.4	85.6	1	1008.9	201.8	11.3	3.6	0	0

Annexure–D

Inception Report

On

Greenbelt Development in Deendayal Port Authority (DPA) and its surrounding areas (Phase-III) along with two years maintenance

Submitted to

Deendayal Port Authority
Administrative Office Building
Post Box No.50, Gandhidham (Kachchh)
Gujarat-370201

Prepared by

Gujarat Institute of Desert Ecology
Mundra Road, Bhuj-370 001, Kachchh, Gujarat
E-mail: desert_ecology@yahoo.com
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Inception Report

on

Greenbelt Development in Deendayal Port Authority (DPA) and its surrounding areas (Phase-III) along with two years maintenance

Co-ordinator
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Principal Investigator
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Content

Introduction

A greenbelt is a designated area of undeveloped, wild, or agricultural land surrounding urban areas, intended to limit urban sprawl, protect natural environments, improve air quality, and promote biodiversity. Greenbelt development involves creating and maintaining these areas, often through strategic planting of trees, shrubs, or other vegetation to form natural barriers between urban and rural landscapes.

Thus, greenbelt offers a number of benefits for population. Vegetation absorbs various pollutants from the environment and thus help in effective pollution control. However, economic development like industrialization, mining, infrastructural development, etc. have exerted pressure and led to reduction and fragmentation of natural vegetation cover day-by day across the globe. Industrial and infra-structural developmental activities are likely to pollute the environment with varying magnitudes. Nevertheless, the pre-eminence of resistance of each of the organisms helps themselves to overcome the hazards caused by such pollutants.

Therefore, the general concept of greenbelt has evolved to develop vegetation or green spaces alongside of industries, mines, thermal power stations, roadsides, and other developmental unit is an effective measure to rejuvenate the environment through vital vegetation cover that safeguard the health of human and other living organisms. Greenbelts in and around urban and industrial areas are important to the ecological health of any given region.

Rationale

GUIDE team visited the proposed Greenbelt development site at Kandla port with the officials from Kandla Port as part of site selection. Based on the field observation and its landscape, environment and ecology of the area, suitable plant species were identified to improve the local environment and for the Greenbelt development at the port area.

Project Site

Based on observation made by the GUIDE team and officials from Deendayal Port Authority, a site at Road Over Bridge (RoB) to oil jetty road and Gopalpuri The area proposed for green development of Deendayal Port is barren land without any vegetation. The soil of the area is black muddy and is high saline soil with saline ground water. The area is very dry and hot during the summer.

Scope of Work

The overall objective is to Development Greenbelt at Deendayal Port Area. The following activities under the Greenbelt development have been carried out:

1. Inventories the suitable sites for greenbelt development in and around the Deendayal Port at Kandla.
2. Carryout Soil and Moisture Conservation (SMC) and management of the plantation sites.
3. Identify suitable plant species as per site scenario for the greenbelt plantation and plantation of plant saplings (5000 plants-suitable to the area & 200 plants at Gopalpuri-fruit bearing/medicinal/air purifying) including maintenance of the same for 1st year, along with maintenance, management and monitoring of plantation including drip/tanker water supply for a further period of 2 years.
4. Adopting plantation technique and soil/manure amendments.
5. Regular monitoring (survival and growth) of the plantation.

Approach and Methodology for Greenbelt Development

Following steps have been adopted for greenbelt development:

1. **Planning Phase**:

- Involves site selection, environmental assessments, and choosing appropriate plant species based on local ecosystems.
- DPA officials and environmental experts collaborate to design sustainable spaces that support biodiversity and recreation.
- Selecting native trees/suitable to the condition and local environment to ensure ecological compatibility and resilience.

2. **Implementation Phase**:

- Includes land preparation (clearing and levelling), planting trees and shrubs, and constructing pathways or recreational facilities.
- Sustainable practices are prioritized to minimize environmental disruption.

3. Maintenance Phase:

- Focuses on long-term care such as watering, pruning, pest control, and replanting.
- Regular monitoring ensures the health of vegetation and ecosystems.
- Community involvement and education are key to sustaining the greenbelt

Plantation techniques:

- Site development for a plantation includes clearance for weeds and it involves, bush cutting, soil and moisture conservation works and marking of pits for planting of saplings, etc.
- After clearing the land sites for pits, plantation have been marked on ground using a measuring tape to ensure the desired spacing.
- Pits of the size 45 cm x 45 cm and 45 cm depth have been dug for tree plantation. Pits have been deep enough to ensure that the roots of the plants do not curl up once the planting material is placed in it.
- Since the soil is highly saline, a fertile soil around 06 dumpers have been added for better survival.
- Charcoal have been added for better moisture conservation and survival.
- The pit has been filled a little above the ground level so that after the earth settles the upper surface of the pit is at same level as that of ground thus avoiding any water logging.
- The plantation has been carried out in two phases (1st in Gopalpuri-200 plants & 2nd Road Over Bridge (RoB)-Oil jetty road side-5000 plants)

Selection of Plant Species for Plantation: Various indigenous tree species suitable for the area have been identified and selected for plantation areas based on soil quality, available water facility, and other environmental parameters.

Management and Monitoring of Greenbelt: The plantation within the identified site will be managed and monitored for a minimum period of two years after the plantation. The management of plantation includes watering at regular intervals, during summer and winter periods and if required even during monsoon with dry spells.

Fig. Map of Plantation Area at Gopalpuri

Fig. Map of Plantation Area RoB to Oil Jetty Road

Fig. Digging Out Trench for Plantation

Fig. Transportation of Plants to Site

Fig. Fertile Soil for Better Survival of Plants

Fig. Fertile Soil Filling to the pits

Fig. Addition of Charcoal for moisture conservation

Fig. Regular Watering of the Plants by Tanker

Annexure I
List of Plants for Plantation at site for Greenbelt Development
Site: Gopalpuri

Sr. No	Scientific name	Local name	No. of plants
Fruit Plants			
1	*Achras sapotta*	Chiku	3
2	*Citrus limonum*	Limbu	3
3	*Citrus medica*	Bijora	3
4	*Cocos nucifera*	Nariyel	3
5	*Eugenia jambolana*	Jambu	3
6	*Ficus carica*	Anjir	3
7	*Morus indica*	Shetur	5
8	*Phyllanthus emblica*	Amla	3
9	*Psidium guajava*	Jamfal	3
10	*Punica granatum*	Dadam	3
11	*Terminalia catappa*	Badam	5
12	*Pithecellobium dulce*	Gorsamli	3
13	*Tamarindus indica*	Khatiamli	5
14	*Carissa carandas*	Karmda	5
15	*Moringa oleifera*	Mitho sargavo	5
16	*Limonia acidissima*	Kothi	3
Medicinal Plant			
17	*Murraya koenigii*	Mitho limdo	5
18	*Plumbago zeylanica*	Chitrak	5
19	*Vitex negundo*	Nagod	8
20	*Nyctanthes arbor-tristis*	Parijat	8
21	*Justicia adhatoda*	Ardusi	5
22	*Butea monosperma*	Khakharo	5
23	*Hibiscus rosa-sinensis*	Jasud	5
24	*Bauhinia variegata*	Kanchnar	5
25	*Terminalia arjuna*	Arjun	5
26	*Azadirachta indica*	Limdo	5
27	*Ficus racemosa*	Umaro	5
28	*Aegle marmelos*	Bili	5
Air purifying plant			
29	*Cestrum diurnum*	Divsno raja	5
30	*Nerium odorum*	Karen	8
31	*Plumeria rubra*	Khadchampo	8
32	*Thespesia lampas*	Parspipalo	8
33	*Alstonia scholaris*	Saptaparni	8
34	*Plumeria rubra*	Kadam	5

Sr. No	Scientific name	Local name	No. of plants
35	*Ficus elastica*	Rabarplant	3
36	*Livistona chinensis*	Fenpalm	3
37	*Polyalthia longifolia*	Asopalav	8
38	*Roystonea regia*	Roayalpalm	2
39	*Pongamia glabra*	Karanj	8
40	*Delonix regia*	Gulmhor	5
41	*Ficus benjamina*	Ficus	5

Site: RoB to Oil Jetty Road

Sr. No.	Scientific Name	Local Name	No. of plants
1	*Conocarpus lancifolius*	*Conocarpus*	1700
2	*Peltophorum pterocarpum*	Peltophorum	660
3	*Millettia pinnata*	Karanj	660
4	*Delonix regia*	Gulmahor	660
5	*Tabubia rosea*	Tabubia	660
6	*Senna siamea*	*Kasid*	660

Annexure–E

Second Season Report

on

Studies on Dredged Materials for the presence of Contaminants and suggesting suitable disposal options

(As per EC & CRZ Clearance accorded by the MoEF & CC, GoI dated 19/12/2016 - Specific Condition No. vii)

DPA Work order No. EG/WK/4751/Part (EC&CRZ-1) / 84. Dt. 07.10.2024

Submitted by
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Submitted to

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Administrative Office Building
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Gujarat – 370201

2025

Dr. V. Vijay Kumar
Director

Gujarat Institute
Of Desert Ecology

CERTIFICATE

This is to state that the **Second Season Report** of the work entitled, **"Studies on Dredged Material for the presence of contaminants"** has been prepared in line with the Work order issued by DPT vide No. EG/WK/4751/Part (EC & CRZ-1). Dt.07.10.2024 as per the EC & CRZ Clearance accorded by the MoEF & CC, GoI dated 19/12/2016, Specific Condition No. vii. This work order is for a period of Three years from 2024 –2027 for the above-mentioned study.

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Authorized Signatory

Gujarat Institute of Desert Ecology Bhuj

Institute Seal

PROJECT TEAM

Project Co-Ordinator **:** Dr. V. Vijay Kumar, Director

S. No	Name and Designation	Role	Background
1.	Dr. K. Karthikeyan Assistant Director	Principal Investigator	M.Sc., Ph.D. in Environmental Science; 15 years of experience in Marine Environmental Monitoring and Pollution Assessment studies.
2.	Dr. G. Jayanthi Scientist	Co- Investigator	MSc., MPhil., PhD in Botany; 13 years of Research and teaching experience inclusive of Post-Doctoral experience for 5 years.
3.	Dr. Krushnakant. D. Baxi Scientific Officer	Co- Investigator	Ph.D in Zoology (Marine Biology) with 5 years of experience
4.	Ds. Monika Sharma Sr. Scientific Asst.	Team member	M.Sc. in Environmental Sciences; 7 years of experience in Marine water and sediment analysis
5.	Ms. Chetna Hirani Scientific Asst.	Team member	M.Sc. in Chemistry; 4 years of experience in sediment and water analysis.
6.	Ms. Bulbul Kushvah	Team Member	M. Sc in Organic Chemistry; 1 year of experience in water and sediment analysis.

CONTENTS

Chapter 1 Background

Among the twelve major ports across the nation, Deendayal Port Authority, formerly known as Deendayal Port Trust, erstwhile called as Kandla Port Trust, holds a prominent position as a significant maritime gateway in India, situated within Gujarat's Kutch district. This stands out as the largest Creek-based port, positioned at the southwestern tip of the Gulf of Kachchh, on India's north-western coastline within the state of Gujarat. Deendayal Port Authority (DPA) serves as a pivotal hub for maritime trade, facilitating the transportation needs of several hinterland states. It boasts excellent connectivity through an extensive rail and road network, functioning as a crucial gateway for the export and import activities of northern and western Indian states, including Jammu & Kashmir, Delhi, Punjab, Himachal Pradesh, Haryana, Rajasthan, Gujarat, as well as parts of Madhya Pradesh, Uttaranchal, and Uttar Pradesh. This port ranks among the largest and most essential ports in the country, playing a vital role in India's international trade and maritime infrastructure. The administration and operations of the port are overseen by the Deendayal Port Trust (DPT), an autonomous entity established under the Major Port Trusts Act of 1963.

The Deendayal Port Trust is entrusted with the comprehensive management, development, and administration of the port. The authority is comprised of a dedicated team of professionals and experts who work diligently to ensure the efficient operation of the port and all related activities. About 35% of the country's total export takes place through the ports of Gujarat in which the contribution by Deendayal port is considerable. The port handled a total cargo of 105 MMTPA during 2016-17, 110 MMTPA during 2017-18, 115 MMTPA during 2018-19, 122.5 MMTPA during 2019-2020, 117.5 MMTPA during 2020-21, 137 MMTPA during 2022-23 and 132.37 during the year 2023-24. DPA is the only major Indian port to handle more than 127 MMT cargo throughput, and it has also registered the highest cargo throughput in its history. The port has handled a total of 3151 vessels during FY 2021-22. Over the years, the port has witnessed significant growth and development, becoming a crucial gateway for India's international trade. Deendayal Port has a strategic location on the west coast of India, offering direct access to the Arabian Sea. It serves as a vital link for India's trade with countries in the Middle East, Africa, Europe, and Asia. The port handles a wide range of cargoes, including petroleum products, chemicals, coal, iron ore, fertilizers, salt, and general cargo.

Further, regular expansion of infrastructure and port facilities is under way to cater future logistic requirements. With such capacity, the Port ranks No. 1 among all the major ports in India for 12^{th} Consecutive year. Further, a regular expansion of infrastructure and port facilities is under way to cater future logistic requirements. The port has high commercial importance in the Indian maritime trade as it handled 36.1 million tons (17%) of Cargo out of total Cargo of 213.1 million tons of the maritime Cargo of India during 2015. In addition, regular expansion of infrastructure and port facilities is under way to cater future logistic requirements.

Deendayal Port Authority (DPA) has taken up Development of 7 Integrated facilities, and the Ministry of Environment, Forest and Climate Change (MoEF & CC), has put up some conditions while according Environmental and CRZ clearance. One of the conditions is to carry out the *"Study on Dredged Material for presence of contaminants"* as accorded by the MoEF & CC, GoI dated 19/12/2016 - Specific condition no. vii)" which states that ***"Dredged materials should be analyzed for presence of contaminants and also to decide the disposal options. Monitoring of dredging activities should be conducted and the findings should be shared with the Gujarat SPCB and Regional Office of the Ministry"***.

1.1 Need of the study

Considering the aforementioned condition, DPA has assigned the task of carrying out the study to Gujarat Institute of Desert Ecology (GUIDE), Bhuj. This study will be attempted three times in a year at two specified locations. Further, the study will envisage the evaluation of physico-chemical constituents in the dredged materials in the dumped locations in the study area. GUIDE has been entrusted with the project, which has duration of three years (01.11.2024 – 31.10.2027) as specified in the work order. Accordingly, the study was initiated to evaluate the dredged materials for potential contamination, employing a systematic investigation that encompasses the analysis of physical, chemical, and biological characteristics with special reference to pollutants including heavy metal, Petroleum hydrocarbon etc.

1.2. Scope of the study

a. To monitor the locations where dredged materials are dumped will be conducted.
b. Dredged materials in the area will be analyzed for the presence of contaminants in two different locations.
c. Detailed assessment of the dredged materials for physical, chemical and biological characteristics will be studied.
d. Suggesting suitable disposal options for the dredged material will be made.

1.3. Sampling locations for 2024-25

The study focused on investigating the presence of contaminants in the dredged materials during the year 2024-25. The specific locations for sampling can be found in Table 1 and Plate 1. The selection of these sampling sites was based on information supplied by the Hydraulic and Dredging Division to the Department of Port Administration (DPA), concerning the locations of dumping grounds. These location details were subsequently shared with the Gujarat Institute of Desert Ecology (GUIDE) via an email dated October 24, 2018. Three seasonal studies covering Location 1, Location 2 and Location 3 with the Second season of the study was conducted during 21.04.2025 – 23.04.2025.

Table 1: GPS Co-ordinates of sampling locations

Station	Latitude (N)	Longitude (E)
Location 1 (Offshore)	22° 51' 00" N	70° 10’ 00" E
Location 2 (Cargo jetty)	22°56' 31" N	70 13' 00" E
Location 3 (Phang Creek)	23° 04' 28" N	70°13’ 28" E

1.4. Details of work done during 2nd Quarter (May 2025 – July 2025)

During the Second season sampling conducted during this period of the project during April 2025. During the sampling, the surface and bottom marine water samples and bottom marine sediment samples were collected from the three designated locations, *i.e.,* Offshore, Cargo Jetty and Creek systems which was pre-designated locations as earmarked by CPWRS was conducted.

After the collection, the samples were preserved using standard protocols and stored in an Ice box and brought to the laboratory within 2-3 hrs of collection Comprehensive analysis was performed on all the samples, both water (36 samples) and sediment (18 samples), to determine various physical, chemical, and biological characteristics. The analysis followed the standard methods prescribed by the Integrated Coastal and Marine Area Management (ICMAM) in 2012. All samples were analysed in triplicates, and the obtained data was compared against the marine water limits specified by the Central Pollution Control Board (CPCB) and other relevant standards.

Plate 1: Map showing locations of proposed sampling (2024-2025)

Chapter 2 Physico-Chemical Characteristics of the Sediment

The sediment samples from the study area were collected for the purpose of characterization employing standard methodology and the analysis of the samples were also performed as per standard protocol and the data of sediment analysis is presented in this Chapter 1. The sediment samples were collected in pre-fixed stations using a Van-Veen type of grab sampler. After collection, the sediment samples were preserved with Rose Bengal and formalin to avoid decomposition of samples and processed for analysis and the samples after collection were brought to the laboratory on the same day of collection and air dried and used for further analysis for the test parameters (Table 2).

Table 2: Physico-chemical and biological characteristics of sediment samples

S. No.	Physico-chemical and biological parameters
1	pH (1: 10 suspension)
2	Salinity (ppt)
3	Sand (%)
	Silt (%)
	Clay (%)
4	Total organic carbon (%)
5	Phosphorus (mg/kg)
6	Sulphur (mg/kg)
7	Petroleum Hydrocarbon (µg/kg)
8	Cadmium (mg/kg)
9	Lead (mg/kg)
10	Chromium (mg/kg)
11	Copper (mg/kg)
12	Cobalt (mg/kg)
13	Nickel (mg/kg)
14	Zinc (mg/kg)
15	Magnesium (mg/kg)
16	Manganese
17	Macrobenthos

2.1. pH and Salinity (1: 10 suspension)

The pH of the sediment suspension is a measure of the activity of H+ ions within the sediment-water system. It indicates whether the sediment is acidic, neutral or alkaline in nature. Since ions are the carrier of electricity, the electrical conductivity (EC) of the sediment-water system rises according to the content of soluble salts. The EC measurement directly corresponds to the concentration of soluble salts in the sediment at any particular temperature. To conduct the analysis, ten grams of the finely sieved sediment was dissolved in 100ml of distilled water to prepare leachate. This leachate was taken for shaking using a rotator shaker for one hour to ensure proper homogenization of the suspension. Following this, the suspension was allowed to settle for two hours, and the supernatant was collected after filtration for the subsequent analysis of pH and salinity using the pH and EC meter (Make: Systronics 361) and Refractometer (Make: Atago) respectively. Each sample was analyzed in triplicates to ensure accuracy, and the mean values were considered for further evaluation.

2.2. Textural analysis (Sand/Silt/Clay)

Sediment samples were collected using Van Veen grab whereas intertidal sediments will be collected using a handheld shovel. After collection, the scooped samples are transferred to polythene bags, labelled and stored under refrigerated conditions. The sediment samples are thawed, oven dried at 40ºC and ground to a fine powder before analyses.

For texture analysis, specified unit of sediment samples were sieved using sieves of different mesh size as per Unified Sediment Classification System (USCS). Cumulative weight retained in each sieve will be calculated starting from the largest sieve size and adding subsequent sediment weights from the smaller size sieves. The percent retained will be calculated from the weight retained and the total weight of the sample. The cumulative percent will be calculated by sequentially subtracting percent retained from 100%.

2.3. Total organic carbon

Total organic carbon refers to the carbon content stored within sediment organic matter. It is derived from various sources such as the decomposition of plant and animal residues, root exudates, living and deceased microorganisms, sediment biota etc. To measure total organic carbon in sediment, a process of oxidation is employed using potassium dichromate in the presence of concentrated sulfuric acid. During the analysis, potassium dichromate generates nascent oxygen, which reacts with the carbon present in organic matter, resulting in the production of carbon dioxide (CO2). The excess volume of potassium dichromate is then titrated against a standardized solution of ferrous ammonium sulfate in the presence of phosphoric acid, using Ferroin indicator to detect the initial appearance of unoxidized ferrous iron. This titration allows the determination of the volume of potassium dichromate required to oxidize the organic carbon present in the sample.

2.3.1. Procedure

The determination of the percentage of total organic carbon in sediment involves oxidizing the organic matter within the sediment samples using chromic acid. The excess chromic acid is then estimated by titrating it against ferrous ammonium sulfate, with ferroin serving as an indicator. The step-by-step procedure is outlined as follows:

To begin, 1 gram of sediment sieved to a particle size of 0.5 mm is weighed and transferred into a 500 ml conical flask. Then, 10 ml of 1N $K_2Cr_2O_7$ is added to the flask with pipette followed by gentle swirling to ensure thorough mixing. Next, 20 ml of concentrated H2SO4 is added, and the sediment and reagents are mixed gently. This mixture is allowed to react for 30 minutes on a marble stone to avoid any damage caused by the release of intense heat from the sulfuric acid reaction. Afterward, 200 ml of distilled water is slowly added to the flask, along with 10 ml of concentrated orthophosphoric acid and approximately 0.2 grams of NaF. The sample and reagent mixture is left to stand for 1.5 hours, as the titration endpoint is better observed in a cooled solution. Just before the titration, 1 ml of ferroin indicator is added to the conical flask. The excess $K_2Cr_2O_7$ is then titrated with 0.5 N ferrous ammonium sulfate until the color changes from yellowish green to greenish, and finally to a brownish-red color indicating the endpoint. A blank test without the sediment sample is also performed simultaneously for reference. Through this procedure, the percentage of total organic carbon in the sediment can be accurately determined.

2.4. Total Phosphorus

The determination of total phosphorus in sediment is commonly conducted using Bray's extraction method. This method involves the formation of specific-colored compounds by adding appropriate reagents to the solution, with the intensity of the color being directly proportional to the concentration of phosphorus being estimated. The color intensity is measured spectrophotometrically. In the spectrophotometric analysis, a light source emitting light of a specific wavelength (usually within a band width of 0.1 to 1.0 nm) in the ultraviolet region of the spectrum is used. The photoelectric cells in spectrophotometer measure the light transmitted by the solution allowing for quantitative analysis.

2.4.1.Procedure

To perform the analysis, 50 ml of the Bray's extractant is added to a 100 ml conical flask containing 5 grams of sediment sample. The flask is shaken for 5 minutes and then filtered. Exactly 5 ml of the filtered sediment extract is transferred to a 25 ml measuring flask using a bulb pipette. Subsequently, 5 ml of the molybdate reagent is added using an automatic pipette, followed by dilution to 20 ml with distilled water and shaken well. Furthermore, 1 ml of dilute Stannous Chloride solution is added, and the volume is made up to the 25 ml mark. Thorough shaking is performed to ensure proper mixing. The mixture is then allowed to develop color, and after 10 minutes, readings are taken in the spectrophotometer at a wavelength of 660 nm. Prior to the readings, the instrument is zeroed using a blank prepared similarly but without the sediment.

2.5. Total Sulphur

Total sulphur in the sediment extract was determined using a turbidimetric method with a spectrophotometer. A series of standards containing sulphur at concentrations of 2, 4, 6, 8, and 10 ppm were prepared from a stock solution. Each flask in the series received 25 ml of the respective standard solution, and 2.5 ml of conditioning reagent solution was added. Additionally, 5 ml of extraction solution was added to the mixture. To facilitate the reaction, 0.2-0.3 grams of barium chloride were included and thoroughly mixed. The volume was adjusted to 25 ml with distilled water, and readings were taken at 340 nm using a spectrophotometer.

For the sample analysis, 5 grams of marine sediment were placed in a 100 ml conical flask. To this, 25 ml of a 0.15% $CaCl_2$ solution was added and shaken for 30 minutes. The mixture was then filtered through Whatman No. 42 filter paper. Subsequently, 5 ml of the sample aliquot was transferred into a 25 ml volumetric flask. Conditioning reagent (2.5 ml) and 0.2 to 0.3 grams of barium chloride powder were added, followed by making up the volume to 25 ml with distilled water. The flask contents were shaken for 2 minutes, and the absorbance was measured using the same procedure as the standard solutions.

2.6. Petroleum Hydrocarbons

To analyze petroleum hydrocarbons in sediment, the following procedure will be conducted. First, the sediment will undergo reflux with a mixture of KOH and methanol, allowing for the extraction of petroleum hydrocarbons. This reflux process helps release the hydrocarbons from the sediment matrix. Next, the sediment will be subjected to extraction using hexane, which selectively dissolves the hydrocarbons present in the sediment. The excess hexane will be carefully removed, leaving behind a residue containing the concentrated hydrocarbons of interest. To further purify the sample and remove any impurities, a clean-up procedure will be performed using silica gel column chromatography. This column chromatography process helps separate the hydrocarbons from other compounds present in the residue, resulting in a cleaner sample for analysis. Finally, the hydrocarbon content in the sediment will be estimated by measuring fluorescence, following the standard method for petroleum hydrocarbon analysis. This fluorescence measurement allows for quantification and determination of the hydrocarbon levels present in the sediment sample. By following this procedure, accurate analysis of petroleum hydrocarbons in sediment can be achieved.

2.7. Heavy metals

Heavy metals, such as Cadmium (Cd), Lead (Pb), Chromium (Cr), Nickel (Ni), Cobalt (Co), Copper (Cu), Zinc (Zn), Manganese (Mn), and others, are of particular concern in relation to the environment. To release mineral elements from sediment samples, wet oxidation is commonly employed, utilizing oxidizing acids, such as tri/di-acid mixtures.

In the analysis procedure, a sediment sample weighing 1.0 gram is taken in a 100 ml beaker, which is covered with a watch glass. A mixture of Aqua regia (1:3 HNO_3:HCl) in the amount of 12 ml is added to the beaker. The beaker is then subjected to digestion for 3 hours at 100°C on a hot plate using a sand bath. Afterward, the samples are evaporated to near dryness, allowed to cool for 5 minutes, and then 20 ml of 2% nitric acid is added. The beaker is placed on a hot plate for digestion for 15 minutes, after which it is removed from the hot plate and allowed to cool. The mixture is then filtered using Whatman No. 42 mm filter paper. Finally, the volume is adjusted to 50 ml with 2% nitric acid to make up the final solution. The extracted sample is then aspirated into an Atomic Absorption Spectrometer (AAS) for analysis. By following this procedure, the heavy metal content in the sediment can be accurately analyzed using wet oxidation, filtration, and AAS techniques.

2.8. Results

2.8.1. Offshore

The sediment pH values across offshore stations ranged from 7.23 to 7.57, with a mean of 7.45 ± 0.13. These values indicate a generally neutral to slightly alkaline condition in the sediments, which is typical for marine environments. The lowest pH recorded at Station 1A may indicate a slightly more acidic microenvironment, possibly due to organic matter degradation, while the highest pH at 1D suggests a more alkaline condition, potentially due to higher carbonate content. Salinity ranged widely from 6.00 to 20.00 PSU, with a mean of 12.50 ± 4.97. This variation points to different degrees of marine vs. freshwater influence across the sites. Station 1A had the highest salinity (20), indicating strong marine conditions, whereas Station 1C had the lowest salinity (6), suggesting a significant freshwater input, possibly from riverine discharge or runoff. Petroleum Hydrocarbons (PHC) concentrations varied between Below Detection Limit (BDL) and 12.21 µg/g, with a mean of 6.45 ± 5.04 µg/g. at 1A. PHC was not detected at 1B, 1C, or the control station, suggesting that contamination may be localized. Magnesium levels ranged from 437.40 to 789.75 mg/kg, with a mean of 627.75 ± 142.87 mg/kg. The highest value at Station 1E and lowest at 1B reflect variations in mineral composition and possibly input from weathered rock material or marine salts in sediments. In sediment texture, sand ranged from 13.10% to 44.80%, mean 32.53 ± 13.37%. The highest at 1E indicates coarser sediment, while the control site had the lowest. Silt varied from 7.50% to 33.10%, mean 20.75 ± 11.90%. 1D and 1E showed higher silt content, indicating low-energy depositional environments. Clay ranged between 22.10% and 78.30%, with a mean of 46.72 ± 24.96%. The control and 1B had the highest clay percentages, typical of finer sediment zones.

Total Organic Carbon (TOC) ranged from 0.21 to 0.45%, with a mean of 0.32 ± 0.09%. The highest TOC was at 1C, indicating relatively higher organic matter accumulation, potentially due to decaying biological material or sediment trapping. The control site had the lowest TOC, suggesting minimal organic input. Phosphorus levels varied between 13.51 and 33.96 mg/kg, with a mean of 20.59 ± 7.68 mg/kg. The maximum value at 1D may be attributed to anthropogenic inputs or biogenic activity, while the lowest at 1A shows a more baseline nutrient condition. Sulphur content was relatively uniform, ranging from 64.78 to 73.05 mg/kg, with a mean of 68.03 ± 2.90 mg/kg. The highest sulphur at 1C and lowest at the control indicate subtle differences in organic degradation and sulphide mineral formation. Nickel was

Below Detection Limit (BDL) at all stations, indicating absence or extremely low levels of this metal across offshore areas. Lead ranged from 9.75 to 49.90 mg/kg, with a mean of 26.38 ± 17.93 mg/kg at 1E points, while 1A had the lowest. Cadmium was BDL at all stations except 1E, which recorded 2.10 mg/kg, setting both the min and max value. This indicates localized contamination at 1E, raising environmental concerns. Chromium concentrations ranged from 20.60 to 32.70 mg/kg, with a mean of 26.62 ± 5.22 mg/kg. The highest value at 1D may indicate geological inputs or marine activity-related accumulation (Table 3).

Zinc values ranged from BDL to 17.80 mg/kg, mean 7.20 ± 9.25 mg/kg at 1A, while most other stations had very low or non-detectable levels. Copper was BDL at all stations, indicating no detectable contamination from copper-based antifouling agents or industrial discharge. Manganese ranged from 147.00 to 157.50 mg/kg, mean 151.36 ± 4.03 mg/kg. These values show consistent background levels across all sites, with slight natural variations. Cobalt showed high variability, ranging from BDL to 22.30 mg/kg, with a mean of 13.11 ± 9.37 mg/kg. The peak concentration at 1B indicates a possible localized contamination, while other stations varied in presence.

2.8.2. Cargo Jetty

The sediment pH in the cargo jetty region ranged from 7.18 to 7.55 with a mean value of 7.34 ± 0.12, indicating slightly alkaline conditions suitable for marine life. Salinity varied between 13 and 20 PSU with an average of 16.50 ± 2.88, suggesting a moderately saline environment influenced by marine waters (Table 4). Petroleum hydrocarbon levels were detected between 2.30 and 4.80 µg/g (mean 3.41 ± 1.27 µg/g), with some stations showing BDL, implying moderate but localized contamination, likely from shipping activities. Magnesium content was highly variable, ranging from 352.35 to 923.40 mg/kg, and averaging 599.93 ± 215.61 mg/kg, reflecting natural sediment composition and mineral inputs. Sediment texture showed sand content from 27.6% to 48.2% (mean 38.28 ± 8.45%), silt from 20.0% to 41.7% (mean 26.82 ± 7.95%), and clay from 25.6% to 52.3% (mean 34.90 ± 10.85%), indicating a mix of moderately coarse to fine sediments likely deposited under varying energy conditions.

Total Organic Carbon (TOC) ranged from 0.54% to 0.75%, averaging 0.65 ± 0.08%, which reflects moderate organic matter content likely influenced by anthropogenic inputs and natural productivity. Phosphorus levels ranged significantly from 16.46 to 48.00 mg/kg (mean 26.05 ± 12.03 mg/kg), pointing to variable nutrient input across the area. Sulphur content exhibited an extremely wide range from 70.13 to 877.48 mg/kg (mean 213.22 ± 325.56 mg/kg), indicating possible organic matter degradation at some stations. Heavy metals showed mixed results: Nickel was BDL throughout, suggesting negligible contamination. Lead ranged from 15.85 to 23.90 mg/kg (mean 20.57 ± 2.93), showing low-level contamination. Cadmium was only detected at one station (5.25 mg/kg) and in the control (3.45 mg/kg), indicating localized enrichment (mean 4.35 ± 1.27 mg/kg). Chromium varied from 34.60 to 53.85 mg/kg (mean 42.29 ± 7.88 mg/kg), showing a moderate background level.

Zinc ranged between 37.60 and 57.05 mg/kg (mean 43.32 ± 7.57 mg/kg), while Copper showed a more pronounced variation from 2.70 to 14.50 mg/kg (mean 7.53 ± 4.19 mg/kg). Manganese values were relatively consistent, between 149.90 and 155.80 mg/kg (mean 153.99 ± 2.23 mg/kg). Finally, Cobalt concentrations ranged from BDL to 7.85 mg/kg (mean 5.53 ± 1.88 mg/kg).

2.8.3. Phang Creek

The sediment pH in Phang Creek ranged from 7.35 to 7.55 with a mean of 7.42 ± 0.08, indicating a slightly alkaline environment, typical of estuarine or marine-influenced systems. Salinity levels varied between 14 and 20 PSU (mean 17.17 ± 2.23), reflecting moderate marine influence with possible freshwater mixing. Petroleum hydrocarbons showed a wide range (2.87 to 14.52 µg/g, mean 6.51 ± 4.90 µg/g), with detection at most stations, suggesting localized hydrocarbon contamination, potentially from boat traffic or runoff. Magnesium content ranged significantly from 425.25 to 1166.40 mg/kg (mean 641.93 ± 292.15 mg/kg), indicating variable sediment mineral composition, possibly influenced by upstream inputs and sediment type.

Sediment texture revealed sand content from 14.9% to 41.3% (mean 28.48 ± 9.83%), silt from 7.9% to 54.3% (mean 33.33 ± 19.21%), and clay from 15.3% to 73.7% (mean 38.18 ± 27.43%) as shown in Table 5, suggesting a diverse depositional environment ranging from coarser to finer sediments. Total organic carbon content varied from 0.27% to 0.57%, with a mean of 0.44 ± 0.12%, indicating moderate organic matter accumulation. Phosphorus levels were between 14.03 and 21.66 mg/kg (mean 17.07 ± 2.92), pointing to consistent nutrient input, while sulphur ranged from 57.70 to 78.85 mg/kg (mean 64.40 ± 7.43), indicating active organic matter decomposition and possibly reducing conditions.

Among heavy metals, Nickel and Cadmium were Below Detection Limits (BDL) across all stations, indicating no significant contamination. Lead was detected at all sites, ranging from 16.95 to 24.15 mg/kg (mean 20.88 ± 3.12), showing moderate levels likely from anthropogenic sources. Chromium ranged between 33.80 and 54.85 mg/kg (mean 45.65 ± 8.67), suggesting natural background levels with minor inputs. Zinc and Copper were present in the range of 28.80–46.65 mg/kg (mean 38.48 ± 7.71) and 13.15–17.00 mg/kg (mean 15.19 ± 1.65), respectively, indicating trace metal presence possibly from urban runoff or boat maintenance. Manganese showed a narrow range (150.45 to 155.60 mg/kg, mean 153.28 ± 1.88), while Cobalt varied widely from 3.90 to 15.25 mg/kg (mean 8.98 ± 4.83).

Table 3: Physico-chemical characteristics of sediment samples collected from Offshore location

S. No	Parameters	1A	1B	1C	1D	1E	Control 1
1	pH (1: 10 suspension)	7.23	7.41	7.42	7.57	7.52	7.56
2	Salinity	20	16	6	10	10	13
3	Petroleum Hydrocarbon	12.21	BDL	BDL	2.87	4.28	BDL
4	Magnesium	777.6	437.4	619.65	643.95	789.75	498.15
5	Sand (%)	41.8	20	31.9	43.6	44.8	13.1
	Silt (%)	27.7	7.5	14.7	32.9	33.1	8.6
	Clay (%)	30.5	72.5	53.4	23.5	22.1	78.3
6	Total organic carbon	0.33	0.3	0.45	0.24	0.36	0.21
7	Phosphorus	13.51	14.21	17.33	33.96	24.43	20.1
8	Sulphur	65.66	67.65	73.05	68.81	68.23	64.78
9	Nickel	BDL	BDL	BDL	BDL	BDL	BDL
10	Lead	9.75	15.4	18.4	48.55	49.9	16.3
11	Cadmium	BDL	BDL	BDL	BDL	2.1	BDL
12	Chromium	20.6	22.1	29.3	32.7	31.6	23.4
13	Zinc	17.8	0.8	BDL	BDL	BDL	3
14	Copper	BDL	BDL	BDL	BDL	BDL	BDL
15	Manganese	149.85	150.15	148.65	157.5	155	147
16	Cobalt	0.5	22.3	BDL	17.45	12.2	BDL

Table 4: Physico-chemical characteristics of sediment samples collected from Cargo jetty

S. No	Parameters	2A	2B	2C	2D	2E	Control 2
1	pH (1: 10 suspension)	7.32	7.38	7.29	7.18	7.29	7.55
2	Salinity	19	15	20	18	13	14
3	Petroleum Hydrocarbon	2.3	BDL	4.8	3.12	BDL	BDL
4	Magnesium	777.6	607.5	923.4	489.15	449.55	352.35
5	Sand (%)	48.2	48.1	37.1	37.2	27.6	31.5
	Silt (%)	26.2	25.4	27.5	20	20.1	41.7
	Clay (%)	25.6	26.5	35.4	42.8	52.3	26.8
6	Total organic carbon	0.69	0.57	0.72	0.75	0.54	0.63
7	Phosphorus	22.35	16.46	16.81	48	31.36	21.31
8	Sulphur	877.48	85.27	96.15	77.88	72.39	70.13
9	Nickel	BDL	BDL	BDL	BDL	BDL	BDL
10	Lead	23.9	19.95	23.2	21.25	19.25	15.85
11	Cadmium	5.25	BDL	BDL	BDL	BDL	3.45
12	Chromium	53.85	41.95	34.95	49.5	38.9	34.6
13	Zinc	42.9	37.6	38.2	57.05	46.3	37.85
14	Copper	10.15	5.1	6.75	14.5	5.95	2.7
15	Manganese	155.6	155.8	153.1	154.5	155.05	149.9
16	Cobalt	3.35	6.45	6.15	BDL	7.85	3.85

Table 5: Physico-chemical characteristics of sediment samples collected from Phang creek

S. No	Parameters	3A	3B	3C	3D	3E	Control 3
1	pH (1: 10 suspension)	7.39	7.45	7.55	7.35	7.4	7.35
2	Salinity	20	14	16	16	18	19
3	Petroleum Hydrocarbon	3.58	2.87	14.52	BDL	3.68	7.88
4	Magnesium	1166.4	801.9	425.25	425.25	498.15	534.6
5	Sand (%)	14.9	19.8	33	34.6	41.3	27.3
	Silt (%)	11.4	7.9	36.9	46.1	43.4	54.3
	Clay (%)	73.7	72.3	30.1	19.3	15.3	18.4
6	Total organic carbon	0.42	0.57	0.33	0.27	0.54	0.51
7	Phosphorus	14.03	16.46	19.41	16.11	14.73	21.66
8	Sulphur	78.85	62.17	57.7	64.29	60.53	62.83
9	Nickel	BDL	BDL	BDL	BDL	BDL	BDL
10	Lead	17.05	16.95	23.2	21.7	22.2	24.15
11	Cadmium	BDL	BDL	BDL	BDL	BDL	BDL
12	Chromium	35.8	33.8	54.85	50.05	48.8	50.6
13	Zinc	28.8	37.5	29.85	43.85	46.65	44.2
14	Copper	BDL	BDL	17	13.15	14.7	15.9
15	Manganese	151.7	150.45	153.85	155.6	154.35	153.75
16	Cobalt	12.85	BDL	6.95	3.9	5.95	15.25

3.1. Introduction

Earth's total volume of water is estimated at 1.386 billion km³, among that, the salty water contributes almost 97.5% and the rest 2.5% contains freshwater. The existence of oceans on the Earth makes appearing it as blue planet from the space. Indian Ocean is the 3rd largest ocean in the world which (with its sub seas) surrounds to India on three sides with average depth of 3,890 meters (12,760 ft). As having at long coastline of almost 8000 km, India has vast marine resources. The Indian ocean's connection is a very large scale, including the Red Sea, East Africa, the Persian Gulf, Southern Arabia, India and Other Indian sub continental countries. This connection network connected people from all the coastal areas of the Indian Ocean and beyond, trading in aromatics, textiles, spices, precious stones, industrial productions, grain and an incredible range of other commodities and substances. Gujarat state of India shows longest coastline compare to other Indian states. Gujarat coastline is famous for various coastal ecosystems and habitats such as estuary, coral reefs, marshes, mangroves, and lagoons, rocky and sandy areas. Gujarat coasts having different coastal ecosystems like mangrove, sandy shores, muddy shores, rocky shores, mixed shores, wet sand shore, coral reefs and intertidal mudflats (Brink, 1993; Parasharya and Patel, 2014). Gujarat state is the only state in India bestowed with two gulfs, Gulf of Kachchh and Gulf of Khambhat. The Kachchh, largest district of the country with an area of 45,652 sq.km. Deendayal Port Authority is (DPT) one among the 12 major ports of the country and it is located in India's western coastal region

3.2. Benthos

Benthic animals are considered as the organism which lives in the bottom layer of all types of ecosystems including saline water as well as in freshwater. Benthos is nothing but water bottom communities or the organisms (floral and faunal) live in a benthic region regarding the sediment, rock and other substratum. They include mollusca (gastropods and bivalves), coral, sponges, worms (mostly polychaetes and nematode), crustacean crabs, other crustaceans, echinoderms, oysters etc. They play an important role in conversion of organic detritus from the sedimentary storage into the dissolved nutrients. Their distribution in water bodies can be varies and, on that basis, they can be classified into three types which are Endo-benthos, Epi-benthos (Pearson and Rosenberg, 1978) and Hyper-benthos (Mees and Jones,1997). Benthos could also recognize as one of the best indicators to assess the health and productivity of aquatic ecosystems. The benthic particularly macro benthic communities are an integral part of the coastal biotic components. They can serve as important food resource for the diverse groups of various organisms particularly bottom feeding animals. They are sensitive to wide range of environmental challenges including water movements, pollutants and living spaces (Martin et al., 2011). Their variations to tolerate changes in various environmental factors make them to be considered as an important bio-indicator for monitoring and research of marine environment.

3.3. Methodology

To study the benthic organisms, triplicate samples were collected at each station using Van-Veen grab which covered an area of $0.1m^2$. The wet sediment was sieved with varying mesh sizes (0.5 mm-macrofauna) for segregating the organisms. The organisms retained in the sieve were fixed in 5-7% formalin and stained further with Rose Bengal solution for easy spotting at the time of sorting. The number of organisms in each grab sample was expressed as number/ meter square (No/m^2). All the species were sorted, enumerated and identified to the advanced taxonomic level possible with the consultation of available literature. The works of Fauvel (1953), Day (1967) were referred for polychaetes; Barnes (1980) and Lyla *et al*. (1999) for crustaceans; Subba Rao *et al.* (1991) and Ramakrishna (2003) for molluscs.

Further, the data were treated with univariate statistical methods in PRIMER (Ver. 6.) statistical software (Clarke and Warwick, 1994)

a) Shannon – Wiener index

In the present study, the data were analyzed for diversity index (H') by following Shannon – Wiener's formula (1949):

$H' = -\sum^{S} Pi \log 2\ Pi \ldots\ldots \quad i = 1$

which can be rewritten as

$$H' = \frac{3.3219\ (N \log N - \sum ni - \log ni}{N}$$

where, H'= species diversity in bits of information per individual

ni = proportion of the samples belonging to the ith species

(number of individuals of the ith species)

N = total number of individuals in the collection and

$\sum$ = sum

b) Species richness(S) was calculated using the following formula given by Margalef (1958)

c) Margalef index (d)

d = (S-1) / log N

d) Pielou's evenness index

The equitability (J') was computed using the following formula of Pielou (1966):

$$J' = \frac{H'}{\log_2 S} \text{ or } \frac{H'}{\text{In}S}$$

Where, J' = evenness; H' = species diversity in bits of information per individual and S = total number of species.

3.4. Results on Species Composition, Population density and Biomass of Macrofauna of selected sites

3.4.1. Offshore

In Offshore region of Kandala port, total six sites were selected namely, (1A, 1B, 1C, 1D, 1E and 1- control). A total 5 groups/species (of benthic community) of benthic animals were observed in all stations at Offshore sites and they are Bivalves (Mollusca), Gastropods (Mollusca), Crustacean animals, Polychaeta worms (Annelida), *Pirenella cingulata* (gastropoda). All the data (Density and Biomass) expressed in (nos./m^2), (gm/m^2) respectively (Table 6).

Highest population density of benthic organisms was recorded in station 1D-Offshore(1500nos/m^2), whereas lowest in station 1E-Offshore(325nos/m^2). The density range of all stations varied from 325 to 1500nos./m^2. Bivalves and Gastropods were more abundant among all the benthic organisms might be sandy-muddy or rocky substratum in bottom part of Offshore region. Presence of Crustacean animals and *Pirenella cingulata that* indicated some part of substratum are muddy mix with rocky and habitat for them. The highest biomass value (expressed wet weight) of benthic fauna was observed in station 1C-Offshore (16.88gm/m^2) and lowest value was 1B-Offshore (2.29 gm/m^2) (Table 6). Lowest value of biomass is may be indication of competition between animals and predator pressure. Range of the Biomass was 2.29 to 16.88 gm/$m^{2.}$ Moderately Biomass value and also density value suggested mixing substratum, less availability of plenty food items and more predator pressure by higher animals. Intermediate association is also one responsible factor for the same. Variation in density and biomass in Offshore region because more influences by the Water Currents, Up welling - Down welling (Churning process of water) movements of water, Nutrients availability and Fluctuation in turbidity of water. Variation in substratum is also a one responsible factor for distribution of benthic organisms.

3.4.2. Cargo Jetty

In Cargo Jetty, frequently observed benthic groups were Bivalves and Gastropods less reported benthos were *Saccostrea sp* (Bivalvia), *Pirenella cingulta*, Polychaeta worms and Crustacean animals (Crabs, Barnacles etc.). The population density range noted between 75 to 525(nos/m^2) among all the stations (Cargo Jetty-2A, 2B, 2C, 2D, 2E &2-Control) during the study period. Highest and Lowest density were recorded in station 2Control- Cargo Jetty(525nos./m^2) and 2A-Cargo Jetty (75nos./m^2) respectively.

Biomass value indicated a highest value in station 2Control- Cargo Jetty (8.00gm/m^2) and lowest in 2A- Cargo Jetty (1.88gm/m^2) (Table 6). Average Biomass and Population density value of all station were 5.11gm/m^2, 325nos./m^2 respectively which indicated the low to moderate environment condition of biota, water quality as well as substratum (mostly rocky).

3.4.3. Phang creek

Six Stations of Phang creek were selected for the study namely 3A, 3B, 3C, 3D, 3E and 3-control-Phang Creek. In this Phang Creek benthic organisms were mostly represented by Polychaeta worms (annelids). Only three groups were present namely Polychaeta worms, Bivalve, Gastropods whereas *Pirenella cingulata, Crustacean animals* and *Saccostrea sp* were totally absent. Bivalve group was only noted in 3Control-Phang creek. Polychaeta worms ware more abundant because of suitable muddy environment. The population density was highest in station 3C -Phang Creek (300nos./m^2) and on the other side, lowest density was recorded in 3E-Phang Creek (25nos./m^2). Station 3D-Phang Creek comprises highest wet wt (3.13gm/m^2), whereas low value was recorded in 3A-Phang Creek(0.81 gm/m^2).

Overall result (Offshore, Cargo Jetty and Phang creek) of macrofaunal community showed highest population density in 1D-Offshore (1500nos/m^2) and high biomass was observed (16.88gm/m^2) in 1C-Offshore. Table 6 showed highest population values of Bivalves in 1D- Offshore and 2D-Cargo jetty (300nos/m^2) and same highest value of Gastropoda showed in 1Control- Offshore (750nos/m^2). The lowest value comprised by the Polychaeta worms (Annelids worms) *and Saccostrea sp (Bivalves)* including some were totally absent in some sites. Some absent or less frequently observed benthos indicated extreme weather condition (may be suddenly change temperature of running season), more stress condition and unfavourable environment condition for their survival. Bivalves and Gastropods, dominant groups were preferred rocky, sandy or mix substratum, and any other hard substrata. Polychaete worms are preferred sandy-muddy substratum or sandy habitat mostly in Phang creek.

Table 6 showed that average population density and biomass higher in Offshore and after Cargo jetty where mostly rocky, sandy or some part covered with muddy area and algal growth providing a unique habitats for benthos. Low density and biomass was observed in mostly Phang creek area (Table 6 and Figure 2) which indicated stressful environment, seasonal effect, more anthropogenic activities and also might be some chemical and biological changes in water. The population density and biomass of benthic community largely affected by the symbiotic and intermediate relation between them or with other invertebrates and suitable rocky substratum or coral reef in bottom of sea. Availability of Plankton, as a food source, also affected the benthic animals (Table 6 and Fig. 1 & 2). Extremely mix weather condition (during June and July months) also more affected in Cargo jetty and Phang creek regions of Kandla port area.

In benthic communities, recorded species at all sites were *Pirenella cingulata, Clypeomorus bifasciata, Trochus sp, Radix sp, Donax sp, Turris sp, Marcia sp, Dosinia sp, Donax sp, Anadara sp, Turris sp, Solen, Nereis sp, Saccostrea sp, Optediceros breviculum etc. The percentage of occurrence (Table 6) was revealed highest group present by Gastropoda (78%) then following are Bivalves (67%), Polychaeta worms (Annelids worms) (61%), Crustacean animals (Crabs, Barnacles etc.) (28%), Saccostrea sp and Pirenella cingulata (22%). Detail status of Population density, Group composition and biomass of the benthic community of all selected sites were depicted in (Table 6) and (Figure 2).* Among all the stations, highest percentage composition recorded by Gastropoda (35%) followed by Bivalves (28%), Pirenella cingulata (gastropoda) and others (Figure.2).

Phytoplankton abundance and their size, zooplankton body composition, patchy distribution of zooplankton, water currents, ebb and flow tides, and water churning process, changing in structure of muddy, rocky and sandy habitats are the main reasons for biomass and density fluctuation in Benthic communities. In Crustacean most commonly observed species are Crabs and attached Barnacles. Main Mollucsa families recorded Trochidae, Cerithidea, Turritellidae, Tellinidae, Donacidae and Bucciniae etc. *Nereis sp* of anneliids was mostly observed in samples. More number of the broken bivalves, debris, plant items, broken gastropods, small pebbles and soil particles are frequently observed during benthic organism's study.

3.4.4. Diversity Indices of Benthic Community

Table 7 showed various diversity indices calculation, showed that Shannon Diversity Index ranging from (0.00-1.36) indicated very low diversity. Highest diversity indices was recorded in Station 1D-Offshore (1.36) whereas Shannon indices nil (zero) observed in 3A, 3B, 3E(Phang creek). Comparatively less Shannon indices value very low in Phang creek area where number of benthos group/species present between 1 to 3 nos. The evenness values ranged between (0.49 to 1). The highest evenness value (1) is observed in stations Offshore 3A, 3B and 3E (Phang creek). Evenness value "1" indicated all organisms occurred in same area or mostly same group or very low in number. Simpson's Index value ranged between 0.00 to 0.74 indicated to lower to very less moderate diversity. The Margalef value showed range of 0.00 to 0.48 indicated high variation in species/group numbers (Table 7).

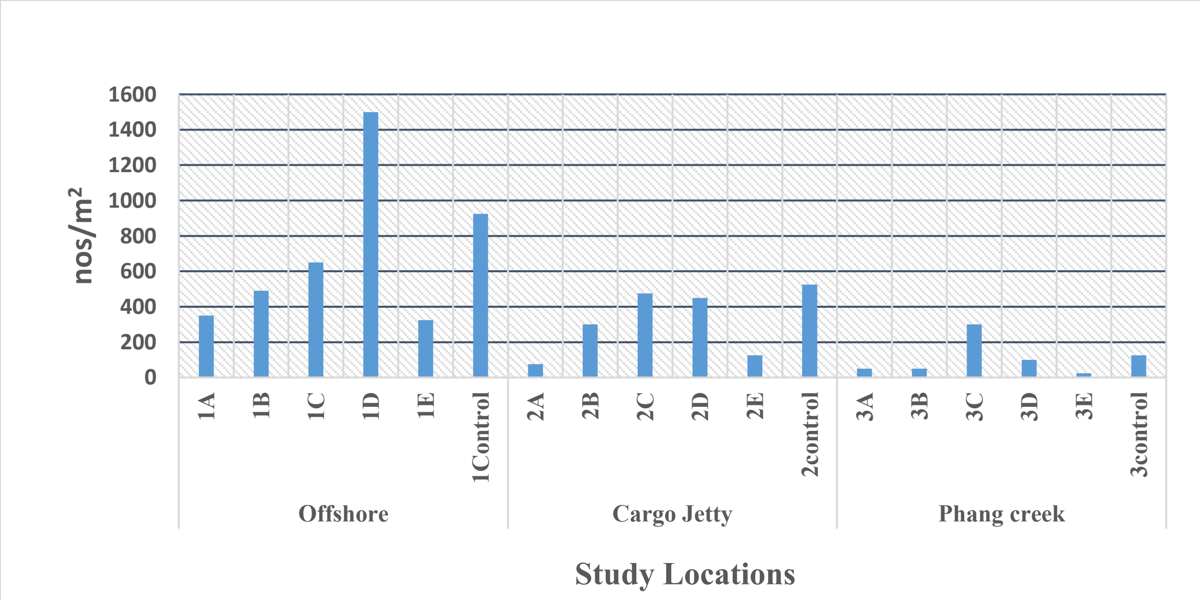

Figure 1. Population density of benthic organisms (nos/m^2) in various sites

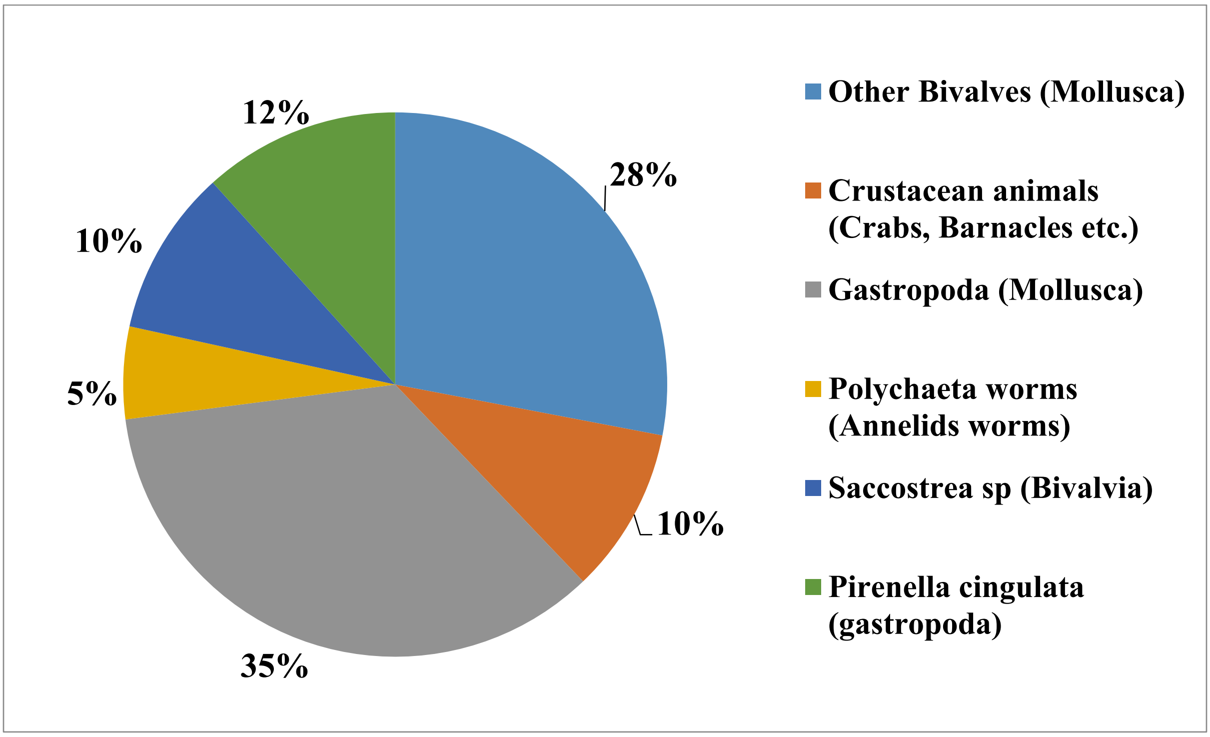

Figure 2. Percentage composition of benthic organisms in various sites

Table 6. Macrobenthos distribution in different sites of Deendayal Port

Name of Station	Offshore						Cargo Jetty						Phang creek						
	1A	1B	1C	1D	1E	1-Control	2A	2B	2C	2D	2E	2-Control	3A	3B	3C	3D	3E	3-Control	% of Occurrence
Nameof Benthic Groups																			
Other Bivalves (Mollusca)	250	165	250	300	125	100	25	0	75	300	25	250	0	0	0	0	0	50	67
Crustacean animals (Crabs, Mysis etc.)	50	125	100	375	0	25	0	0	0	0	0	0	0	0	0	0	0	0	28
Other Gastropoda (Mollusca)	50	75	0	525	75	750	50	50	125	125	50	175	0	0	250	50	0	50	78
Polychaeta wormsMarine Annelids	0	0	50	0	0	50	0	0	0	25	0	0	50	50	50	50	25	25	61
Saccostrea sp (Bivalvia)	0	0	0	0	0	0	0	250	275	0	50	100	0	0	0	0	0	0	22
Pirenella cingulata (gastropoda)	0	125	250	300	125	0	0	0	0	0	0	0	0	0	0	0	0	0	22
Total Population Density Nos/m^2	350	490	650	1500	325	925	75	300	475	450	125	525	50	50	300	100	25	125	
Biomass (wet weight) gm/m^2	2.96	2.29	16.88	9.75	3.98	8.14	1.88	4.21	5.86	6.92	3.84	8	0.81	0.88	3.06	3.13	1.06	1.72	

Table 7. Diversity indices of benthic faunal groups at various station of Deendayal Port –Kandla (Benthos)

	Offshore						Cargo Jetty						Phang Creek					
	1A	**1B**	**1C**	**1D**	**1E**	**1-control**	**2A**	**2B**	**2C**	**2D**	**2E**	**2-contrl**	**3A**	**3B**	**3C**	**3D**	**3E**	**3cont**
Variables																		
Taxa_S	3	4	4	4	3	4	2	2	3	3	3	3	1	1	2	2	1	3
Individuals (Nos./m^2)	350	490	650	1500	325	925	75	300	475	450	125	525	50	50	300	100	25	125
Dominance_D	0.55	0.27	0.33	0.27	0.35	0.67	0.56	0.72	0.43	0.52	0.36	0.37	1.00	1.00	0.72	0.50	1.00	0.36
Shannon Diversity Index (H)	0.80	1.35	1.22	1.36	1.07	0.67	0.64	0.45	0.96	0.79	1.06	1.04	0.00	0.00	0.45	0.69	0.00	1.06
Simpson_1-D	0.45	0.73	0.67	0.74	0.65	0.33	0.44	0.28	0.57	0.48	0.64	0.63	0.00	0.00	0.28	0.50	0.00	0.64
Evenness_e^H/S	0.74	0.97	0.85	0.97	0.98	0.49	0.94	0.78	0.87	0.73	0.96	0.94	1.00	1.00	0.78	1.00	1.00	0.96
Menhinick	0.16	0.18	0.16	0.10	0.17	0.13	0.23	0.12	0.14	0.14	0.27	0.13	0.14	0.14	0.12	0.20	0.20	0.27
Margalef	0.34	0.48	0.46	0.41	0.35	0.44	0.23	0.18	0.32	0.33	0.41	0.32	0.00	0.00	0.18	0.22	0.00	0.41

4.1. Introduction

In recent decades, there has been a notable deterioration in aquatic ecosystems primarily caused by the presence of a diverse array of organic and inorganic contaminants. Among these pollutants, heavy metals (HMs) and microplastics (MPs) have emerged as significant contributors to this environmental degradation (Frew et al., 2020; Saha et al., 2016). These substances are recognized for their capability to infiltrate and accumulate within the aquatic food chain, making them hazardous pollutants in aquatic environments (Olojo et al., 2005). Of particular concern are heavy metals due to their toxic nature, long-lasting presence, resistance to degradation, the potential for bioaccumulation, and the ability to magnify up the food chain, all of which have raised global alarms (Begum et al., 2013; Cai et al., 2017).

Heavy metal pollution in aquatic ecosystems can be attributed to a variety of sources, including natural factors such as atmospheric deposition and weathering (Ebrahimpour and Mushrifah, 2010; Hamidian et al., 2016) as well as human activities like mining, agricultural runoff, sewage discharge, industrial effluent release, gasoline leaks from fishing vessels, and accidental chemical waste spills (Arulkumar et al., 2017). It is essential to recognize that certain heavy metals, such as copper (Cu), iron (Fe), nickel (Ni), cobalt (Co), zinc (Zn), manganese (Mn), and chromium (Cr), play vital roles in physiological processes and are necessary for the proper biological functioning of organisms in trace amounts. However, exposure to nonessential heavy metals can lead to various health concerns, including renal, cardiovascular, nervous, and bone diseases, as well as immune-related issues (Abadi et al., 2018; Madreseh et al., 2018). It is crucial to acknowledge that all heavy metals become toxic when their concentration exceeds a certain threshold level (Makedonski et al., 2017). In light of these concerns, it is imperative to assess the various characteristics of water in order to determine the extent of pollutant presence in aquatic environments.

4.2. Materials and Methods

In this study, marine water and sediment samples were collected following standard protocols, and their analysis was conducted using established methods for marine water and sediment analysis as prescribed by APHA (2012), NIO manual (1982), and ICMAM Manual (2012). For general analysis, surface water samples were collected using a clean polyethylene bucket, while water samples from the bottom were collected using a weighted Niskin sampler. Water samples at a depth of 1 meter below the surface were collected using a 1-liter glass bottle sampler. Parameters such as pH, temperature, and salinity were measured on-site using handheld meters and verified in the laboratory.

The collected water samples were stored under refrigerated conditions until further analysis of other parameters. According to the standard protocol, fixatives and preservatives were added to the samples for specific parameters. For example, Winkler A&B solution was immediately added to measure dissolved oxygen, concentrated H2SO4 was used to bring the pH below 2 for chemical oxygen demand analysis, and nitric acid was used for the preservation of heavy metals. Formalin was added to marine water samples for planktonic analysis. In general, all water and sediment samples were stored in sterile polythene bottles and Ziplock bags and kept in an icebox to maintain suitable conditions until they were transported to the laboratory. The parameters to be analyzed (Table 8) and the methods used for the sample analysis are described below.

Table 8: Physico-chemical and biological characteristics of marine water samples

S. No	Physico-chemical and Biological parameters
1	pH
2	Temperature (°C)
3	Salinity (ppt)
4	Total Dissolved Solids (mg/L)
5	Turbidity (NTU)
6	Dissolved Oxygen (mg/L)
7	Bio-Chemical Oxygen Demand (mg/L)
8	Chemical Oxygen Demand (mg/L)
9	Phenolic compound (µg/L)

10	Petroleum Hydrocarbons (µg/L)
11	Oil and grease (mg/L)
12	Cadmium (mg/L)
13	Lead (mg/L)
14	Chromium (mg/L)
15	Copper (mg/L)
16	Cobalt (mg/L)
17	Nickel (mg/L)
18	Zinc (mg/L)
19	Manganese (mg/L)
20	Magnesium (mg/L)
21	Chlorophyll (mg/m^3)
22	Phaeophytin (mg/m^3)
23	Phytoplankton Phytoplankton cell counts (no/L) Total Genera (no.) Major Genera
24	Zooplankton Biomass ($ml/100m^3$) Population ($no/100m^3$) Total Group (no.) and Major Groups

4.2.1. pH, Temperature and Salinity

pH and temperature measurements were conducted using a Thermo Fisher pH/EC/Temperature meter. Prior to use, the instrument was calibrated with standard buffers. For pH determination, an appropriate volume of the sample was titrated against silver nitrate (20 g/l), with potassium chromate serving as an indicator. The chlorinity of the sample was estimated, and salinity values were derived using a specific formula.

4.2.2. Total Dissolved Solids (TDS)

To confirm the readings obtained from the handheld meter, the samples underwent a gravimetric procedure. Approximately 100 ml of the water sample was taken in a beaker and filtered. The filtered sample was then completely dried in a hot air oven at 105°C. The TDS values were calculated by measuring the difference between the initial and final weight of the dried sample.

4.2.3. Turbidity

For turbidity measurement, a sample tube (Nephelometric cuvette) was filled with distilled water and inserted into the sample holder. The lid of the sample compartment was closed, and the meter reading was adjusted to zero by manipulating the 'SET ZERO' knob. The sample tube containing the 40 NTU standard solution was then placed in the tube, and the meter reading was set to 100. Similar measurements were carried out for other standard solutions. To determine the turbidity of the marine water sample, the sample tube was filled with the water sample, and the corresponding reading was recorded.

4.2.4. Dissolved Oxygen (DO)

To determine the Dissolved Oxygen (DO) levels in a water sample obtained from a marine environment, the following procedure was employed. Collect sea water sample, ensuring that the sampling container is clean and free from any potential contaminants that may affect the accuracy of the results. Subsequently, transfer the water sample into a Winkler's bottle or a suitable container, taking care to eliminate any trapped air bubbles. It is crucial to completely fill the bottle to minimize any headspace that could potentially alter the DO readings. Next, add the appropriate volumes of Winkler's reagents, such as manganese sulfate and alkali-iodide-azide, to the water sample as per the specific instructions of the Winkler's method. Gently and thoroughly mix the contents of the bottle to ensure uniform distribution of the reagents without introducing any air bubbles. Allow the bottle to stand undisturbed for a designated incubation period, typically around 30 minutes, to enable the necessary reactions to occur. After the incubation period, perform a titration using a standardized sodium thiosulfate (Na2S2O3) solution until a faint yellow color appears, indicating the complete consumption of dissolved oxygen in the sample. Record the volume of sodium thiosulfate solution used for titration, which represents the amount of dissolved oxygen present in the water sample. To account for any dissolved oxygen in the reagents, it is essential to conduct the same procedure with blank samples that do not contain the water sample. This allows for an accurate calculation of the DO levels in the original water sample. Finally, employ the appropriate formula provided by Winkler's method to calculate the DO concentration in the water sample.

4.2.5. Biochemical Oxygen Demand (BOD)

To determine the Biochemical Oxygen Demand (BOD), the following procedure was employed using the direct unseeded method. Collect representative sea water sample from the desired location, ensuring the sampling container is clean and uncontaminated. Fill a BOD bottle with the water sample, leaving minimal headspace to prevent air contact that could affect BOD measurements. It's important to completely fill the bottle to minimize air bubbles. Record the initial Dissolved Oxygen (DO) level in the water sample using a dissolved oxygen meter or appropriate measurement method. Seal the BOD bottle tightly with the stopper to prevent air exchange. Incubate the sealed BOD bottle in a controlled environment, such as a BOD incubator, at a specified temperature (typically 20°C), for a designated incubation period, usually around 5 days. Throughout the incubation period, keep the BOD bottle in darkness to minimize the impact of photosynthetic activity. After the incubation period, measure the final DO level in the water sample using the same method or instrument as the initial measurement. Calculate the BOD by subtracting the final DO level from the initial DO level, accounting for any necessary dilution or blank corrections. This difference represents the amount of oxygen consumed by the organic matter in the water sample during the incubation period.

4.2.6. Chemical Oxygen Demand (COD)

The Chemical Oxygen Demand (COD) test is a widely used method for quantifying the levels of organic and inorganic pollutants in water samples. The first step involves collecting representative water samples from the target site, ensuring proper labeling and record-keeping. Subsequently, these samples are placed into digestion vials or tubes, to which digestion reagents, typically potassium dichromate and sulfuric acid, are added. This step initiates the oxidation of organic matter in the sample. The sealed vials or tubes are then subjected to high-temperature heating, typically around 150-160°C, for a predetermined period, usually around 2 hours. This heating process breaks down complex organic compounds into simpler forms. After digestion, the samples are allowed to cool to room temperature. To determine the COD concentration, a colorimetric measurement is taken. A suitable reagent is added to the digested samples, reacting with any residual potassium dichromate, and generating a color change proportional to the COD concentration. This color intensity is measured using a colorimeter or spectrophotometer, and the results are calibrated using known COD standards. The final calculations yield the COD value, typically expressed in milligrams of oxygen per liter (mg/L) of the sample.

4.2.7. Phenolic compounds

To analyze phenolic compounds in water, the following procedure was followed. A 500 ml water sample containing phenols was treated with 4-aminoantipyrine, which converted the phenols into an orange-colored antipyrine complex. This complex was then extracted using 25 ml of chloroform. The absorbance of the extracted complex was measured at 460 nm using phenol as a standard for comparison. This measurement allowed for the quantification of phenolic compounds present in the water sample.

4.2.8. Petroleum Hydrocarbons (PHc)

The analysis of Petroleum Hydrocarbons (PHc) in a water sample involved the following protocol. One liter seawater sample was extracted using organic solvent, hexane. The mixture was then separated into an organic layer and an aqueous layer. The organic layer, containing the petroleum hydrocarbons, was isolated. To remove any remaining water, the organic layer was dried using anhydrous sulphate. The volume of the organic layer was subsequently reduced to 10 ml at a temperature of 30°C under low pressure. The fluorescence of the extracted organic compound was measured at 360 nm (with excitation at 310 nm) using Saudi Arabian crude residue as a standard. This residue was obtained by evaporating the lighter fractions of crude oil at 120°C. By comparing the fluorescence intensity of the extract with that of the standard, the concentration of petroleum hydrocarbons in the water sample could be determined.

4.2.9. Oil and Grease

To determine the content of Oil and Grease in a sample, the following procedure was followed. Approximately 500 ml of the sample was transferred to a separating funnel, and the sample bottle was rinsed with 30 ml of trichlorotrifluoroethane. The rinsing solvent was then added to the separating funnel. Next, 5 ml of 1:1 hydrochloric acid (HCl) was added to the mixture, and the contents were vigorously shaken for about 2 minutes. If a soluble emulsion was formed, the sample container was shaken for an additional 5 to 10 minutes. After shaking, the layers in the separating funnel were allowed to separate, and the lower layer (organic layer) was discarded.

The solvent layer was drained through a funnel containing a filter paper moistened with solvent, and it was collected in a clean distillation flask that had been pre-weighed. The solvent was then distilled from the flask using a water bath set at 70°C. The resulting residue was carefully transferred into a clean, pre-weighed, and dried beaker, using the minimum amount of solvent necessary. The beaker was placed on a water bath at 70°C for 15 minutes to evaporate off all the solvent. After the evaporation process, the beaker was cooled in a desiccator for 30 minutes to reach a consistent temperature, and its weight was then measured.

4.2.10. Heavy metals

Heavy metals are a significant concern, especially in coastal environments, since it is biomagnifying from lower organisms to higher organisms through water and sediment. Common heavy metals of concern include Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Cobalt (Co), Nickel (Ni), Zinc (Zn), Magnesium (Mg) and Manganese (Mn). To release mineral elements from sediment and analyze them, a wet oxidation process is typically employed using oxidizing acids, such as a mixture of Tri / Di-acids.

The procedure begins by weighing 0.5 grams of the sediment sample and placing it in a 100 ml beaker, which is covered with a watch glass. Then, 12 ml of Aqua regia (a mixture of 1 part HNO3 and 3 parts HCl) is added to the beaker. The beaker is placed in a digestion apparatus and heated at 100°C for 3 hours on a hot plate using a sand bath. The sample is evaporated until it is nearly dry, and then allowed to cool for 5 minutes. Next, 20 ml of 2% nitric acid is added to the cooled sample in the beaker, and the mixture is further digested on the hot plate for 15 minutes. After digestion, the beaker is removed from the hot plate and allowed to cool. The sample is then filtered using a Whatman No. 42 mm filter paper to remove any solid particles. To make up the final volume, the filtrate is diluted with 2% nitric acid to a total volume of 50 ml. The resulting extracted sample is then aspirated into an Atomic Absorption Spectrometer (AAS) for analysis of the heavy metal concentrations.

4.3. Results

In this First season study conducted in the present year, we closely monitored three distinct locations: Offshore, Cargo Jetty, and Phang Creek. A comprehensive analysis of physico-chemical characteristics in marine water samples was conducted at each of these sites. The collected data is thoughtfully presented in Tables 9-11. These findings serve as a significant source of information regarding the precise physico-chemical conditions prevailing at each of these locations. Consequently, they play a pivotal role in enhancing the comprehension of the environmental factors that exert influence on the quality of marine water in these specific areas. The description of the data in each station is detailed as below.

4.3.1. Offshore

Temperature ranged from 24.70°C at Station 1D (BW) to 25.40°C at Station 1C (SW), with a mean of 25.01 ± 0.22°C, showing stable offshore thermal conditions. pH varied between 7.53 at Control 1 (BW) and 7.83 at Stations 1D (SW) and 1E (SW), with a mean of 7.77 ± 0.08, indicating slightly alkaline conditions. Salinity ranged from 35

PSU at Station 1A (BW) to 39 PSU at Stations 1B (SW) and 1C (SW), mean 36.83 ± 1.40 PSU, reflecting strong marine influence.

Total Dissolved Solids (TDS) were lowest at 38.44 ppt at Station 1C (BW) and highest at 42.34 ppt at Station 1A (SW), with a mean of 39.88 ± 1.07 ppt, consistent with high-salinity seawater. Turbidity showed high variability, ranging from 111 NTU at Station 1C (SW) to 486 NTU at Control 1 (BW), mean 237.17 ± 112.37 NTU, indicating fluctuations in suspended matter. Dissolved Oxygen (DO) was lowest at 5.80 mg/L at Station 1B (BW) and highest at 6.80 mg/L at Station 1C (SW), mean 6.35 ± 0.28 mg/L, showing generally good oxygenation. Biochemical Oxygen Demand (BOD) ranged from 2.10 mg/L at Control 1 (BW) to 2.90 mg/L at Station 1E (BW), mean 2.38 ± 0.22 mg/L, indicating low organic load. Chemical Oxygen Demand (COD) was lowest at 24.00 mg/L at Stations 1B (BW) and 1D (BW) and highest at 40.00 mg/L at Control 1 (SW), mean 31.33 ± 5.00 mg/L, suggesting moderate oxidizable material.

Phenolic compounds were lowest at 10.04 µg/L at Station 1E (BW) and highest at 59.29 µg/L at Station 1B (SW), mean 25.64 ± 13.77 µg/L. Petroleum hydrocarbons ranged from 2.48 µg/L at Control 1 (BW) to 24.58 µg/L at Station 1C (BW), mean 14.84 ± 5.90 µg/L, indicating localized oil contamination. Oil and grease varied between 1.60 mg/L at Station 1A (SW) and 16.00 mg/L at Control 1 (BW), mean 9.10 ± 4.47 mg/L. Magnesium was lowest at 1215.00 mg/L at Station 1B (SW) and highest at 2430.00 mg/L at Station 1E (BW), mean 1741.50 ± 324.92 mg/L, reflecting natural mineral variability.

For metals, Nickel, Zinc, Copper, and Cobalt were below detection limits at all stations. Lead was detected only at 0.54 mg/L in Station 1A (SW) and 0.56 mg/L in Station 1A (BW), mean 0.55 ± 0.01 mg/L. Cadmium ranged from 0.19 mg/L at Station 1C (BW) to 0.45 mg/L at Station 1A (BW), mean 0.32 ± 0.18 mg/L, present in few sites. Chromium varied from 0.24 mg/L at Station 1C (SW) to 0.60 mg/L at Station 1C (BW), mean 0.41 ± 0.16 mg/L, showing trace presence. Manganese was lowest at 0.01 mg/L at Station 1B (SW) and highest at 0.70 mg/L at Station 1C (BW), mean 0.26 ± 0.19 mg/L, influenced by sediment interaction (Table 9)

4.3.2. Cargo Jetty

Temperature ranged from 25.1°C at Station 2A (BW) to 26.8°C at Station 2D (SW), with a mean of 25.99 ± 0.51°C (Table 10), showing stable but slightly warmer water at some sites, possibly due to shallow depth or localized heating. pH varied slightly between 7.67 at Control 2 (BW) and 7.80 at Station 2A (SW), mean 7.76 ± 0.046, indicating a healthy alkaline balance for marine waters. Salinity ranged from 35.0 PSU at Station 2C (BW) to 39.0 PSU at Station 2B (SW), mean 36.71 ± 1.32 PSU, consistent with marine influence.

Total Dissolved Solids (TDS) were lowest at 39.51 ppt at Control 2 (BW) and highest at 46.44 ppt at Station 2D (SW), mean 42.60 ± 2.24 ppt, reflecting normal seawater conditions with some variability. Turbidity showed wide variation from 192 NTU at Station 2A (SW) to 533 NTU at Control 2 (BW), mean 303.42 ± 117.97 NTU. Dissolved Oxygen (DO) ranged from 5.2 mg/L at Station 2D (BW) to 6.9 mg/L at Station 2B (SW), mean 6.18 ± 0.49 mg/L, with lower levels near the berth possibly due to organic matter decay. Biochemical Oxygen Demand (BOD) varied from 2.1 mg/L at Stations 2B (BW) and 2E (BW) to 3.1 mg/L at Station 2A (SW), mean 2.49 ± 0.34 mg/L, suggesting generally low organic pollution. Chemical Oxygen Demand (COD) was lowest at 22 mg/L at Control 2 (SW) and highest at 34 mg/L at Station 2B (SW), mean 28.50 ± 3.43 mg/L, indicating moderate oxidizable organic matter.

Phenolic compounds ranged widely from 4.61 µg/L at Station 2B (SW) to 58.07 µg/L at Control 2 (BW), mean 28.34 ± 17.28 µg/L. Petroleum hydrocarbons were lowest at 1.85 µg/L at Station 2E (SW) and highest at 21.52 µg/L at Station 2D (SW), mean 11.32 ± 7.79 µg/L, showing localized oil contamination. Oil and grease varied from 3.2 mg/L at Control 2 (SW) to 19.6 mg/L at Station 2D (SW), mean 10.97 ± 5.97 mg/L, with elevated levels near operational areas. Magnesium ranged between 1215 mg/L at Stations 2A (SW), 2C (SW), and Control 2 (SW) to 1944 mg/L at Station 2C

(BW) and 2E (SW), mean 1559.25 ± 282.97 mg/L, reflecting natural seawater mineral composition.

For metals, Nickel and Zinc were below detection limits at all stations. Lead ranged from 0.06 mg/L at Station 2B (BW) to 3.2 mg/L at Station 2A (BW), mean 1.78 ± 1.03 mg/L, indicating localized contamination. Cadmium varied between BDL and 0.90 mg/L at Station 2E (SW), mean 0.51 ± 0.34 mg/L, showing occasional detection. Chromium ranged from 0.40 mg/L at Station 2A (SW) to 2.00 mg/L at Control 2 (BW), mean 1.14 ± 0.47 mg/L, indicating moderate presence. Manganese was lowest at 0.05 mg/L at Control 2 (BW) and highest at 0.50 mg/L at Station 2E (SW), mean 0.20 ± 0.14 mg/L. Cobalt ranged from 0.80 mg/L at Control 2 (BW) to 2.12 mg/L at Station 2D (SW), mean 1.48 ± 0.57 mg/L.

4.3.3. Phang Creek

Temperature ranged from 24.2°C at Station 3E (BW) to 25.8°C at Stations 3E (SW) and Control-3 (SW), with a mean of 25.10 ± 0.47°C, reflecting stable conditions with slight spatial variation. pH varied between 7.70 at Station 3E (BW) and 7.80 at Stations 3B (BW), 3C (SW), and 3E (SW), mean 7.763 ± 0.037, indicating slightly alkaline water suitable for aquatic life. Salinity ranged from 36 PSU at Station 3B (SW) to 40 PSU at Stations 3D (BW), 3E (BW), and Control-3 (BW), mean 38.75 ± 1.22 PSU, reflecting strong marine influence (Table 11).

Total Dissolved Solids (TDS) were lowest at 39.32 ppt at Station 3B (BW) and highest at 49.54 ppt at Station 3E (BW), mean 44.12 ± 3.50 ppt, indicating variability in mineral content. Turbidity ranged from 216 NTU at Station 3A (SW) to 557 NTU at Station 3D (BW), mean 379.00 ± 99.31 NTU, suggesting higher suspended solids near berthing areas. Dissolved Oxygen (DO) was lowest at 5.2 mg/L at Control-3 (BW) and highest at 5.9 mg/L at Stations 3B (SW) and 3C (SW), mean 5.64 ± 0.21 mg/L, showing generally moderate oxygenation. Biochemical Oxygen Demand (BOD) varied between 2.2 mg/L at Station 3C (BW) and 3.0 mg/L at Station 3B (SW), mean 2.54 ± 0.26 mg/L, indicating low organic load. Chemical Oxygen Demand (COD) was lowest at 26 mg/L at Station 3D (SW) and highest at 44 mg/L at

Station 3E (BW), mean 34.67 ± 5.55 mg/L, suggesting moderate oxidizable organic matter.

Phenolic compounds ranged from 17.64 µg/L at Station 3C (SW) to 59.97 µg/L at Station 3C (BW), mean 33.66 ± 10.37 µg/L. Petroleum hydrocarbons were lowest at 2.63 µg/L at Station 3B (BW) and highest at 24.52 µg/L at Station 3C (BW), mean 15.20 ± 6.43 µg/L, indicating localized oil contamination. Oil and grease ranged from 2.4 mg/L at Control-3 (SW) to 13.2 mg/L at Station 3D (SW), mean 8.37 ± 3.54 mg/L, suggesting moderate hydrocarbon residues. Magnesium was lowest at 1215 mg/L at Station 3C (SW) and highest at 1944 mg/L at Stations 3A (SW), 3C (BW), and 3E (BW), mean 1620.00 ± 299.11 mg/L, reflecting seawater mineral content.

For metals, Nickel, Zinc, Copper, and Cobalt were below detection limits at all stations. Lead was detected between 0.415 mg/L at Station 3A (SW) and 0.965 mg/L at Station 3B (BW), mean 0.665 ± 0.259 mg/L, indicating low-level contamination. Cadmium ranged from 0.045 mg/L at Station 3C (BW) to 1.265 mg/L at Station 3B (BW), mean 0.551 ± 0.469 mg/L, showing localized presence. Chromium varied between 1.39 mg/L at Station 3C (BW) and 4.125 mg/L at Station 3E (BW), mean 2.453 ± 0.821 mg/L, indicating trace metal inputs. Manganese ranged from 0.065 mg/L at Station 3A (SW) to 0.880 mg/L at Station 3E (SW), mean 0.492 ± 0.306 mg/L, with higher values possibly from sediment resuspension.

Table 9: Physico-chemical characteristics of the marine water from sampling location 1 (Offshore)

S. No	Parameters	1A		1B		1C		1D		1E		Control 1	
		SW	BW	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW
1	Temperature (^{0}C)	25.3	25	25.2	24.9	25.4	24.8	25	24.7	25	25.1	25	24.7
2	pH	7.72	7.72	7.80	7.79	7.82	7.81	7.83	7.82	7.83	7.81	7.77	7.53
3	Salinity (ppt)	37	35	39	39	39	36	36	36	36	37	36	36
4	Total Dissolved Solids (mg/L)	42.34	39.72	40.38	40.03	40.55	38.44	38.93	38.49	40.30	39.66	40.47	39.26
5	Turbidity (NTU)	149	189	119	223	111	211	140	239	288	328	363	486
6	Dissolved Oxygen(mg/L)	6.6	6.2	6	5.8	6.8	6.7	6.2	6.3	6.3	6.4	6.5	6.4
7	Bio-Chemical Oxygen Demand (mg/L)	2.3	2.2	2.6	2.3	2.4	2.5	2.4	2.2	2.4	2.9	2.2	2.1
8	Chemical Oxygen Demand (mg/L)	32.00	28.00	30.00	24.00	36.00	32.00	28.00	24.00	32.00	38.00	40.00	32.00
9	Phenolic Compounds (µg/L)	38.81	10.85	59.29	19.94	19.4	24.29	14.38	20.62	34.87	10.04	28.36	26.86
10	Petroleum Hydrocarbons (µg/L)	15.24	10.86	22.45	12.84	11.85	24.58	12.84	20.84	16.85	14.57	12.63	2.48
11	Oil and grease (mg/L)	1.6	3.2	4.0	7.6	8.4	13.2	10.8	11.2	14.4	9.6	9.2	16.0
12	Magnesium (mg/L)	1458	2187	1215	1701	1701	1944	1458	1701	1701	2430	1701	1701
13	Nickel (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
14	Lead (mg/L)	0.54	0.56	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Cadmium (mg/L)	BDL	0.445	BDL	BDL	BDL	0.19	BDL	BDL	BDL	BDL	BDL	BDL
16	Chromium (mg/L)	BDL	BDL	BDL	BDL	BDL	0.6	0.275	BDL	BDL	0.405	0.52	0.235
17	Zinc (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Copper (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Manganese (mg/L)	0.25	0.23	0.01	BDL	BDL	0.7	0.15	BDL	0.16	0.365	0.26	0.21
20	Cobalt (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Note: BDL denotes Below Detection Limit.

Table 10: Physico-chemical characteristics of the marine water from sampling location 2 (Cargo Jetty)

S. No	Parameters	2A		2B		2C		2D		2E		Control 2	
		SW	BW	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW
1	Temperature (^{0}C)	25.2	25.1	26.4	25.8	26.4	25.7	26.8	25.8	26.2	25.9	26.4	26.2
2	pH	7.8	7.74	7.81	7.79	7.82	7.77	7.78	7.76	7.76	7.73	7.69	7.67
3	Salinity (ppt)	38.00	36.00	39.00	38.00	38.00	35.00	36.00	35.50	37.00	36.00	37.00	35.00
4	Total Dissolved Solids (mg/L)	42.61	41.53	44.87	44.16	40.88	39.79	46.44	45.57	41.35	41.64	42.87	39.51
5	Turbidity (NTU)	192	228	258	206	196	226	264	266	358	463	451	533
6	Dissolved Oxygen(mg/L)	.6.6	6.5	6.9	6.2	6.6	6.5	6.5	5.2	6.1	5.9	6	5.6
7	Bio-Chemical Oxygen Demand (mg/L)	3.1	2.5	2.8	2.1	2.4	2.5	2.3	2.2	2.2	2.1	2.9	2.8
8	Chemical Oxygen Demand (mg/L)	32	28	34	30	28	28	24	32	30	26	22	28
9	Phenolic Compounds (µg/L)	55.22	14.79	4.61	10.72	9.91	26.59	24.56	24.42	38.13	33.38	39.62	58.07
10	Petroleum Hydrocarbons (µg/L)	13.57	20.25	10.87	14.58	13.54	20.48	21.52	BDL	1.85	2.16	3.45	2.21
11	Oil and grease (mg/L)	10.8	16.4	6	10	15.6	3.6	19.6	17.2	16.4	3.6	3.2	9.2
12	Magnesium (mg/L)	1215	1701	1701	1458	1215	1944	1701	1215	1944	1701	1215	1701
13	Nickel (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
14	Lead (mg/L)	1.165	3.2	1.62	0.06	BDL	0.065	2.405	1.565	2	2.79	2.035	2.62
15	Cadmium (mg/L)	0.045	0.86	0.715	BDL	BDL	BDL	0.11	BDL	0.885	0.41	BDL	0.515
16	Chromium (mg/L)	0.4	0.85	1.095	0.975	0.775	0.685	0.95	1.78	1.155	1.96	1.455	1.58
17	Zinc (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Copper (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Manganese (mg/L)	BDL	0.175	0.18	0.105	0.215	BDL	0.11	BDL	0.475	0.085	0.365	0.05
20	Cobalt (mg/L)	BDL	1.79	2.045	BDL	BDL	BDL	2.12	BDL	1.055	1.085	BDL	0.8

Note: BDL denotes Below Detection Limit

Table 11. Physico-chemical characteristics of the marine water from sampling location 3 (Phang Creek)

S. No	Parameters	3A		3B		3C		3D		3E		Control 3	
		SW	BW	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW
1	Temperature (^{0}C)	25.2	25	24.9	24.7	24.9	24.7	25.4	25.1	25.8	24.2	25.8	25.5
2	pH	7.74	7.72	7.79	7.8	7.8	7.78	7.79	7.78	7.8	7.7	7.75	7.71
3	Salinity (ppt)	39	37	36	39	39	39	39	40	39	40	38	40
4	Total Dissolved Solids (mg/L)	40.78	39.32	40.01	40.09	48.52	47.48	45.16	45.11	45.66	49.54	45.08	42.74
5	Turbidity (NTU)	216	392	300	372	388	434	258	557	446	510	316	359
6	Dissolved Oxygen(mg/L)	5.8	5.7	5.9	5.6	5.9	5.7	5.8	5.5	5.7	5.4	5.5	5.2
7	Bio-Chemical Oxygen Demand (mg/L)	2.5	2.3	3	2.8	2.3	2.2	2.3	2.6	2.9	2.7	2.5	2.4
8	Chemical Oxygen Demand (mg/L)	42	38	36	34	32	28	26	34	28	44	36	38
9	Phenolic Compounds (µg/L)	32.97	30.26	30.12	39.48	17.64	59.97	22.79	40.03	31.61	33.78	35.01	30.26
10	Petroleum Hydrocarbons (µg/L)	BDL	2.63	12.48	10.87	20.05	24.52	12.87	23.57	12.78	20.48	14.87	12.085
11	Oil and grease (mg/L)	10.4	12.0	11.6	7.6	5.2	11.2	13.2	8.4	2.8	7.2	2.4	8.4
12	Magnesium (mg/L)	1944	1701	1215	1944	1944	1701	1458	1458	1215	1944	1701	1215
13	Nickel (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
14	Lead (mg/L)	0.415	0.795	BDL	0.965	BDL	BDL	BDL	BDL	BDL	0.485	BDL	BDL
15	Cadmium (mg/L)	BDL	0.685	BDL	1.265	0.245	0.045	BDL	BDL	0.515	BDL	BDL	BDL
16	Chromium (mg/L)	3.245	2.405	1.61	1.925	3.22	1.39	1.43	2.565	2.575	4.125	2.785	2.155
17	Zinc (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Copper (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Manganese (mg/L)	0.065	0.875	0.665	0.205	0.42	0.605	BDL	BDL	0.365	0.74	0.88	0.1
20	Cobalt (mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Note: BDL denotes Below Detection Limit

5.1. Introduction for Plankton

Plankton is defined as all those living organisms which are suspended and drifting in water. Phytoplanktons are the primary producers in marine ecosystems and form the basis of the food web. The animal portion of plankton is known as Zooplankton, which are pelagic animals and unable to maintain their position by swimming against the physical movement of water. Size is very important to understanding about the classification of both zooplankton and phytoplankton. Based on size, various categories of plankton are smallest one Picoplankton (0.2-2 µm), Nanoplankton (2-20 µm), Microplankton (20-200 µm), Mesoplankton (200 µm-2 mm), Macroplankton (2-20 mm) and Megaplakton(> 20 mm) . The planktonic communities encompass of aquatic organisms which drift passively and also have limited mobility to move contrary of the water mass. Plankton are divided in two parts which are phytoplankton and zooplankton (Brink. 1993). The tiny flora or plants are called as Phytoplankton, and weak swimming tiny fauna or animals are called as Zooplankton. Phytoplankton are the primary producers in marine ecosystems and form the basis of the food web. Zooplankton are pelagic animals play a role in the food chain in aquatic ecosystem to provide a food resource to various organisms. Major phytoplankton in sea water is Diatoms (Tiwari and Nair, 1998; Thakur et al, 2015), Cocolithophores, Sillicoflagellates, Blue green algae (Cyanobacteria) and Dinoflagellates. Zooplankton comprises the second level in the food chain and includes Tintinnids, Foramonifers, Radiolarians, Amphipoda, Copepoda, Calanoida, Chaetognaths, larvae of benthic invertebrates and fish larvae etc. (Gajbhiye and Abidi, 1993; Thirunavukkarosu, 2013; Chakrabarty et al. 2017). Interspecific competition among the Zooplankton; Inter-relationship for prey and predator between zooplankton and their mostly predator animals; Grazing ratio of primary-secondary consumers; Suspension of sediment; Fluctuation in Phytoplankton abundance; Waves, Currents and Tidal turbulence effect; Fluctuation in Chlorophyll a and Nutrients; Input of Organic and other Pollution creating sources; Fish potential ratio; Monsoon effect; Suddenly changes in atmosphere; Peak time of every seasons and it’s effect; Vertical migration of Zooplankton; Food selection pattern of predator; Collection time and number of collected samples, mixing of water column, high surface action, Seasonal up welling and down welling process in water column

5.1.1. Phytoplankton

Phytoplankton are single celled marine algae with great difference in shape, size and form, either use flagella for movement in water or just drift with currents (Zohari et al, 2014). These photosynthetic organisms need sunlight for photosynthesis. Diatoms dominate the phytoplankton biomass in highly productive areas of the ocean. The diatoms are one of the most important phytoplankton as a primary producer of marine ecosystem. They are estimated to produce 20-25 % of the world total net primary production (Werner, 1977).

With trapping carbon in the process of photosynthesis, they can control the atmospheric carbon dioxide and help in combating the global climate change. With this, they have significant role in the management of nutrients cycles in the ocean systems. Their role as primary producers in aquatic ecosystem, in the process of nutrients cycling in the ocean systems, also in calcification, silicification, nitrogen-fixing, etc. made them important marine component for marine life study. Their sensitiveness for various anthropogenic activities in the marine environment such as Eutrophication, introduction of invasive species, overfishing etc, make them one of the best indicators to analyse these activities.

5.1.2. **Zooplankton**

The faunal species particularly microscopic fauna, living inside the water bodies are known as zooplankton. Zooplankton is tiny-small animals found in all water bodies particularly the pelagic and littoral zone in the ocean. They are classified by size and or by development stages. Zooplankton community is composed of both primary consumers (which eat phytoplankton) and secodanry (which feed on the other zooplankton). Crustaceans zooplankton are Arthropods whose body is covered with chitinous exoskeleton for protection. Nearly all fish depend on zooplankton for food in both larval stages and entire life period (Madin et al., 2001). They are attractive, various and plentiful group of faunal species which can swim or generally drift with water currents but have no potential to swim against water currents (Alcaraz and Calbet, 2003). The important role of them is to be a major link in the marine life in between marine microalgae or phytoplankton and fish. Although they can be classified according to their habitat and depth, distribution, size and duration of planktonic life period (Omori and lkeda, 1984), generally, it is considered as there are two types of zooplanktons. Holoplanktons are those which live permanently in the planktonic form, while meroplanktons are the temporary members in this form. The potential of zooplankton to respond quickly to environment changes and short generation life span, make them important bioindicator of water pollution and all variation occurred in their living environment. Their study is the important part for getting knowledge of the functioning of marine ecosystems (Mees and Jones, 1997).

5.2. Methodology

5.2.1 Estimation of Chlorophyll and Phaeophytin

Estimating Chlorophyll and Phaeophytin was done using known volume of water (500 ml) was filtered through a 0.45μm Millipore membrane filter paper and the pigments retained on the filter paper were extracted in 90% acetone overnight at 50°C. The extinction of the acetone extract was measured using fluorimeter before and after treatment with dilute acid (0.1N HCI).

5.2.2. Phytoplankton sampling and analysis

Phytoplankton samples were collected in the ten prefixed sampling sites using a standard plankton net with a mesh size of 51 μm. Plankton nets are with a square mouth covering an area of 0.900 cm^2 (30 cm square mouth) fitted with a flow meter (Hydrobios). Nets were towed from a moving boat for 10 minutes and the plankton adhering to the net was concentrated in the net bucket. Plankton soup from the net bucket was transferred to a pre-cleaned and rinsed container and preserved with 5% neutralized formaldehyde. The containers were appropriately labelled. The initial and final flow meter reading was noted down for calculating the amount of water filtered to estimate plankton density. As per flow meter reading, a total amount of $165m^3$ of water was filtered by the net. One liter of water was separately collected for density estimation to counter check density estimation obtained by the flow meter reading. Quantitative analysis of phytoplankton (cell count) was carried out using a sedge wick-Rafter counting chamber. One ml of soup added to a Sedgwick counting chamber was observed under an inverted compound microscope. The number of cells present in individual cells of the counting chambers (1/1000) was noted and identified up to a generic level. Several observations were fixed to represent the entire quantity of the soup (generally more than30 times) and the recorded data were used to calculate the density (No/l) using the formula, $N = n \times v/V$ (where N is the total no/l; n is an average number of cells in 1 ml; v is the volume of concentrate; V is the total volume of water filtered). The phytoplankton diversity richness and evenness were past software.

5.3. Results of Chlorophyll and Phaeophytin in three locations

The concentration of phytopigments is inversely proportional to the turbidity of the waters and in general, waters owing to the high turbidity restricts sunlight penetration essential for nutrient uptake by phytoplankton and thus inhibiting primary production.

5.3.1. Offshore

Chlorophyll-a ranged from 0.43 mg/m^3 at Station 1C (SW) to 0.84 mg/m^3 at Station 1A (BW), mean 0.56 ± 0.10 mg/m^3, suggesting low to moderate phytoplankton biomass. Phaeophytin ranged between 0.20 mg/m^3 at Station 1C (BW) and 0.88 mg/m^3 at Station 1C (SW), mean 0.43 ± 0.18 mg/m^3, with higher levels indicating older phytoplankton communities or post-bloom phases as shown in Table 12.

5.3.2. Cargo jetty

The Table 13 shows the Chlorophyll-a ranged from 0.30 mg/m^3 at Control 2 (SW) to 0.70 mg/m^3 at Station 2B (BW), mean 0.52 ± 0.12 mg/m^3, indicating low to moderate phytoplankton biomass. Phaeophytin varied widely from 0.30 mg/m^3 at Station 2A (SW) to 2.50 mg/m^3 at Station 2D (SW), mean 0.65 ± 0.60 mg/m^3, with higher values suggesting older phytoplankton populations or degraded organic matter.

5.3.4. Phang Creek

Chlorophyll-a ranged from 0.117 mg/m³ at Control-3 (SW) to 0.571 mg/m³ at Station 3A (BW), mean 0.330 ± 0.149 mg/m³, indicating low phytoplankton biomass (Table 14) Phaeophytin was lowest at 0.140 mg/m³ at Station 3E (BW) and highest at 0.428 mg/m³ at Station 3A (SW), mean 0.240 ± 0.088 mg/m³, suggesting relatively young phytoplankton populations.

Table 12: Chlorophyll and Phaeophytin concentration observed in the Offshore site

Parameters	1A		1B		1C		1D		1E		1 Control	
	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW
Chlorophyll	0.517	0.835	0.523	0.611	0.428	0.523	0.564	0.482	0.523	0.517	0.612	0.571
Phaeophytin	0.341	0.323	0.284	0.202	0.410	0.881	0.424	0.641	0.442	0.364	0.329	0.480

Table 13: Chlorophyll and Phaeophytin concentration observed in the Cargo Jetty site

Parameters	2A		2B		2C		2D		2E		2 Control	
	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW
Chlorophyll	0.523	0.659	0.646	0.687	0.394	0.577	0.551	0.441	0.435	0.618	0.305	0.434
Phaeophytin	0.320	0.810	0.370	0.390	0.496	0.392	2.483	0.338	0.472	0.512	0.731	0.464

Table 14: Chlorophyll and Phaeophytin concentration observed in the Phang Creek site

Parameters	3A		3B		3C		3D		3E		3 Control	
	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW	SW	BW
Chlorophyll	0.469	0.571	0.306	0.529	0.435	0.211	0.353	0.353	0.246	0.224	0.117	0.142
Phaeophytin	0.428	0.352	0.168	0.252	0.269	0.308	0.192	0.146	0.245	0.140	0.207	0.178

5.4. Phytoplankton

The study was conducted at 3 sites (or regions) at Kandla Port and near area where dredging activities is going on Creek and the stations are Offshore, Cargo Jetty and Phang Greek.

5.4.1. Offshore

In this site, frequently observed species were *Actinocyclus sp, Coscinodiscus centralis, Coscinodiscus wailesii, Coscinodiscus rediatus, Coscinodiscus granii, Thalassionema frauenfeldii colony, Thalassionema nitzschioides colonies, Odontella sinensis, etc.* whereas less observed species were *Biddulphia sp*, *Entomoneis sp*, *Gyrosigma sp, Navicula sp, Nitzschia sp, Protoperidinium sp* and *Triceratium sp etc.* Total 32 (out of 42) Phytoplankton were recorded in this Offshore area. Highest population density was recorded at site 1A-Offshore (100480nos./m^3) and lowest density was recorded at site 1B-Offshore (62400nos./m^3). The maximum number of species observed in site 1B-Offshore (20 nos.) followed by 1control (19nos.), 1A, 1D, 1E and 1C (14nos.). The population density greatly varied between (62400nos./m^3 to 100480nos./m^3). *Synedra ulna, Navicula sp, Nitzschia sp Entomoneis sp, Thalassiosira sp.* were recorded which are sometimes considering for pollution indicator species in water. Green algae were also recorded in some location of Offshore which may be indication of freshwater or polluted water mixing with seawater. . The Dinoflagellates like *Protoperidinium sp* was also observed during microscopic analysis that may be indication of water circulation from deep water to upper surface. Highest population density contributor species was *Coscinodiscus wailesii* (range 5120 to 12000nos./m^3).

5.4.2. Cargo jetty

Total 26 Phytoplankton were recorded in this Cargo Jetty area. The population density greatly varied between 35040 nos/m^3 to 117120 nos/m^3. Highest density recorded at 2D-Cargo Jetty (117120nos./ m^3) and lowest value was at 2C-Cargo Jetty (35040nos./m^3). The lowest number of species noted in the site 2E-Cargo Jetty(13 nos.) whereas highest in 2control-CargoJetty (19nos.). In this Cargo Jetty station commonly or frequently observed species were *Actinocyclus sp, Coscinodiscus centralis, Coscinodiscus radiatus, Coscinodiscus wailesii, Coscinodiscus granii, Odontella sinensis, Ditylum brightwelli, Synedra ulna, Thalassionema frauenfeldii colonies Thalassiosira sp* etc. The rarely found species were Blue Green algae, Green algae, *Odontella sp*, *Rhizosolenia imbricata, Synura alga Colonies Triceratium favus etc*. *Synura alga Colonies* (Chrysomonad algae) were also recorded.

5.4.3. Phang Creek

The population density of phytoplankton ranged from 28800nos./m^3 to 56320nos./m^3 same way species availability ranged from 09 to 20 nos. Maximum and Minimum value of population density were recorded in site 3A-Phang Creek (56320nos./m^3) and 3C-Phang Creek (28800 nos./m^3) respectively. Highest number of species recorded in site 3control-Phang Creek (20nos.) and lowest in site 3C-Phang Creek (09nos.). Total recorded phytoplankton was 28 in this creek area. *Actinocyclus sp, Coscinodiscus centralis, Coscinodiscus wailesii, Coscinodiscus radiatus, Coscinodiscus granii, Pleurosigma sp, Synedra ulna, Thalassionema frauenfeldii colonies etc.* were frequently noticed during microscopic work whereas less observed species were *Biddulphia sp*, *Coscinodiscus asteromphalus*, *Cylindrotheca sp*, *Planktoniella blanda*, *Thalassionema nitzschioides colonies*, *Trieres mobiliensis, Trachyneis aspera* and some unidentified phytoplanktons. Green algae *were also recorded*, which are generally found in fresh water and estuarine area.

Overall view of Phytoplankton showed that a total 42 species of Marine phytoplankton were identified during summer season (June month) of the year 2025. Among them,21-Centric diatoms, 15-Pennate diatoms, 2-Dinoflagellates, 1-Green algae, 1-Blue green algae, 1-Chrysomonad algae and 1-silicoflagellates and some are not identified phytoplanktons were included in unidentified group. Some species like *Actinoptychus sp*, *Biddulphia sp*, Coscinodiscus asteromphalus, Cyclotella sp, *Dinophysis sp* (Dinoflagellate cysts), *Grammatophora sp* chain, *Navicula lyra*, *Planktoniella blanda*, *Planktoniella sol*, *Protoperidinium sp*, *Pseudo-nitzschia sp*, *Trachyneis aspera* were rarely recorded during sample analysis. Input of the fresh water indicated by the presence of some common fresh water species like *Green algae* and *Blue green algae.* Presence of *Dinoflagellates (Dinophysis sp and Protoperidinium sp)* indication of bottom water circulation up to surface water layer in some level. *Synura alga Colonies* (Chrysomonad algae) were also recorded in Phang creek region. Highest phytoplankton density was observed at the site 2D-Cargo Jetty (117120nos./m^3) and lowest was observed at site 3C-Phang creek (28800 nos./m^3) (Table 15). Total number of highest species observed at site 1B-Offshore and 3control-Phang creek (20nos.) and lowest in site 3control-Phang creek (09nos).

The high population density composed by species like Actinocyclus sp, *Coscinodiscus centralis, Coscinodiscus radiates, Coscinodiscus wailesii, Coscinodiscus granii Thalassionema frauenfeldii colonies, Thalassionema nitzschioides colonies, Odontella sinensis, Thalassionema frauenfeldii colonies, Thalassiosira sp, Trieres mobiliensis (*Table 15). This result indicated that genus *Coscinodiscus sp. Actinocyclus sp, Thalassionama sp, Trieres sp.* were very common with good numbers in all sites. In some sites, least number of species and low density of phytoplankton might be responsible due to some factors like extreme cool or hot weather because of rainy season, mixing of water, high pre-predation ratio, marine pollution (anthropogenic pressure), high turbidity, total suspended solids, water current and suddenly changes in environment conditions etc. Diatoms, type of phytoplankton, constitute major part in total phytoplankton composition The individual density of species of sites viz. has been depicted in Table 3. All values of phytoplankton density, list of phytoplankton and others shown in (Table 15).

Diversity Indices of Phytoplankton

According to Table 16, diversity indices calculation for phytoplankton showed that the Shannon Index ranged from (1.50 to 2.39) indicated low level to moderate level of diversity range. High Shannon Index was recorded at 3B, 3D and 3E-Phang creek (2.39) where species numbers were recorded nearly sixteen and low at 3C-Phang creek (1.50) where 09 species were recorded. Lowest evenness recorded at site 1E-

Offshre (0.36) whereas highest was in at 2C-Cargo Jetty (0.77). Dominance_D index ranged from 0.11 to 0.31 where higher value in 3C-Phang creek (0.31) and lowest was at in 2C-Cargo jetty (0.11). Value of Margalef D (0.78 to 1.77) showed more to moderate variation in species numbers. (Table 16.).

Table 15. Density of Phytoplankton at different sites of Deendayal Port

Name of Sites	Offshore						Cargo Jetty						Phang Creek					
	1A	1B	1C	1D	1E	1 control	2A	2B	2C	2D	2E	2 control	3A	3B	3C	3D	3E	3 control
Genus of Phytoplankton																		
Actinocyclus sp	3200	2400	3680	2400	5600	2880	5600	8000	6400	800	2400	3680	2560	4000	1600	1920	1440	1920
Actinoptychus sp	0	0	1600	0	0	0	3200	0	0	0	0	0	0	0	0	0	0	0
Biddulphia sp	0	320	0	0	640	0	0	0	0	0	0	0	0	0	0	320	0	0
Biddulphia sp chain	0	0	0	0	0	160	0	0	0	0	0	0	0	0	0	0	0	0
Blue green algae (unidentified)	0	0	0	0	0	0	0	0	0	0	320	0	0	0	0	0	0	0
Coscindiscus radiatus	24000	9600	24000	16000	16000	12800	20000	19200	4800	20000	8000	16000	8000	4800	5600	8000	4800	8000
Coscinodiscus asteromphalus	0	0	0	0	0	1600	0	0	0	0	0	0	1600	0	0	0	0	
Coscinodiscus centralis	1600	3200	1440	2560	3520	2080	3200	3200	2080	1920	2080	1920	3360	1280	1440	1920	1120	3360
Coscinodiscus granii	9600	8000	16800	11200	9600	8800	8000	9600	4320	24000	3200	8000	8000	7200	4000	3840	6400	7200
Coscinodiscus wailesii	32000	21600	23200	12800	21600	25600	16800	5760	3520	43520	16000	16000	17600	12000	14400	6400	8640	12000
Cyclotella sp	0	0	0	0	0	0	800	0	0	0	0	0	0	0	0	0	0	0
Cylindrotheca sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1600	0	0	0	0
Dinophysis sp (Dinoflagellate cysts)	0	0	0	0	0	320	0	0	0	0	0	0	0	0	0	0	0	0
Ditylum	12000	4000	0	0	0	0	1600	4800	0	3200	0	2400	0	1600	0	640	1600	1600

brightwelli																		
Entomoneis sp	0	0	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grammatophora sp chain	0	0	0	0	0	160	0	0	0	0	0	0	0	0	0	0	0	0
Green algae (unidentified)	800	640	0	0	0	0	0	320	160	0	0	0	1600	0	0	0	1600	320
Gyrosigma sp	0	0	0	640	320	320	0	960	2400	0	1600	320	0	0	0	320	480	320
Navicula lyra	480	0	480	0	0	0	0	0	0	0	0	480	0	0	0	0	0	0
Navicula sp	0	1600	0	0	0	0	800	0	0	480	0	1600	320	0	0	0	320	320
Nitzschia sp	0	1600	0	0	320	0	160	800	2400	0	320	0	2400	0	0	480	0	320
Odontella sinensis	4800	3200	4800	4800	0	2400	1600	0	800	6400	0	640	1600	2400	0	2400	0	480
Odontella sp	0	0	0	0	0	0	0	0	0	5600	0	0	0	0	0	0	0	0
Planktoniella blanda	0	640	0	3200	0	0	0	0	0	0	0	0	0	1600	0	0	0	0
Planktoniella sol	0	800	0	0	0	0	0	0	0	0	0	0	0	0	0	640	0	800
Planktoniella sp	0	0	0	0	0	0	0	0	0	0	0	0	160	0	0	0	0	0
Pleurosigma sp	0	0	320	800	0	320	1600	1600	320	0	0	0	0	1600	640	640	640	320
Protoperidinium sp	0	320	0	0	0	320	0	0	0	0	0	0	0	0	0	0	0	0
Pseudo-nitzschia sp chain	0	0	0	0	0	320	0	0	0	0	0	0	0	0	0	0	0	0
Rhizosolenia imbricata	0	0	0	0	0	0	0	0	0	640	0	0	0	0	0	0	0	0
Surirella sp.	0	0	0	0	0	0	2400	1760	0	0	0	160	320	0	320	0	480	0
Synedra ulna	3200	800	0	2400	800	640	800	1600	2400	1600	640	2400	3200	4000	480	2400	2400	3200
Synura alga Colonies	0	320	1600	0	4800	0	0	0	0	0	0	640	0	0	0	0	0	0
Thalassionema frauenfeldii colonies	4000	0	7200	4800	8000	4000	5600	4800	3200	4800	8000	4800	4000	4000	320	800	5600	1600
Thalassionema nitzschioides colonies	0	800	0	0	0	0	0	0	0	0	0	160	0	0	0	640	0	640
Thalassiosira	800	1600	1600	640	800	800	5600	800	1600	960	1120	2400	0	800	0	800	2400	800

sp																		
Thalassiosira aculeata	0	0	0	0	0	0	1600	2400	0	0	2400	320	800	320	0	2400	800	0
Trachyneis aspera	0	0	0	0	0	0	0	0	0	0	0	0	800	0	0	0	0	1600
Triceratium favus	1600	480	0	800	480	320	0	0	640	0	0	320	0	480	0	0	0	480
Triceratium sp	0	480	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trieres mobiliensis	2400	0	800	640	320	640	5600	3200	0	3200	640	320	0	0	0	0	2400	640
Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	800	0	0	0	0
Density of Phytoplankton (diff. sites wise.)(no/m^3)	100480	62400	87680	63680	72800	644480	84960	68800	35040	117120	46720	62560	56320	48480	28800	34560	41120	45920
Total= 1121920 no/m^3																		
Total No Of Genus/Species=**42**																		

Table 16. Diversity Indices of Phytoplankton at different sites at Kandla Port

	Offshore						Cargo jetty						Phang Creek					
	1A	1B	1C	1D	1E	1-control	2A	2B	2C	2D	2E	2-contrl	3A	3B	3C	3D	3E	3-control
Variables																		
Taxa_S	14	20	14	14	14	19	18	16	14	14	13	19	16	16	9	17	16	20
Individuals (Nos/m^2)	100480	62400	87680	63680	72800	64480	84960	68800	35040	117120	46720	62560	56320	48480	28800	34560	41120	45920
Dominance_D	0.19	0.17	0.19	0.15	0.18	0.23	0.13	0.14	0.11	0.22	0.19	0.16	0.16	0.12	0.31	0.12	0.12	0.14
Shannon Diversity Index (H)	2.00	2.22	1.91	2.14	1.97	1.93	2.39	2.32	2.38	1.88	1.99	2.17	2.21	2.39	1.50	2.39	2.39	2.34
Simpson_1-D	0.81	0.83	0.81	0.85	0.82	0.77	0.87	0.86	0.89	0.78	0.81	0.84	0.84	0.88	0.69	0.88	0.88	0.86
Evenness_e^H/S	0.53	0.46	0.48	0.61	0.51	0.36	0.61	0.64	0.77	0.47	0.56	0.46	0.57	0.68	0.50	0.64	0.68	0.52
Menhinick	0.04	0.08	0.05	0.06	0.05	0.07	0.06	0.06	0.07	0.04	0.06	0.08	0.07	0.07	0.05	0.09	0.08	0.09
Margalef	1.13	1.72	1.14	1.18	1.16	1.63	1.50	1.35	1.24	1.11	1.12	1.63	1.37	1.39	0.78	1.53	1.41	1.77

5.4. Zooplankton

The study was conducted at 3 sites in Kandla Port and nearby areas where dredging activities are going on. The three selected study stations are Offshore, Cargo Jetty and Phang Greek.

5.4.1. Offshore

Acartia sp, Ammonia beccarii (Foraminifera), Calanoida (unidentified), Clausocalanus sp (Calanoida), Cyclops sp (Cyclopoida), Foraminifera(unidentified), Nauplius larvae of Crustacea, Parvocalanus sp (Calanoida), Subeucalanus sp (Calanoida), Tintinnopsis orientalis (Tintinnida), Tintinnopsis sp (Tintinnida), Veliger larvae of Bivalve etc. were the mostly common zooplankton and throughout observed in all sites of Offshore area. Highest population density was recorded at site 1C-Offshore (138240nos./100m^3) where number of species was (39nos.) and lowest density in 1Control-Offshore (60000nos./100m^3) where number of species was recorded (33nos.). High biomass was observed in the site 1Control-Offshore (15.31 ml/100m^3) and low biomass was recorded in site 1B-Offshore (8.77 ml/100m^3). The range of the population density, biomass and number of species were (60000 to 138240 nos./100m^3), (8.77 to 15.31 ml/100m^3) and (29 to 43 nos.) respectively in all sites.

Less observed species were Bryozoan*, Arcella sp (Amoebozoa), Bulimina sp (Foraminifera), Calcarina sp (Foraminifera), Cibicides sp (Foraminifera), Embryonic stage (Crustacea),* Gastrula larva of Echinodermata, *Harpacticus sp (Harpacticoida), Spiroloculina sp (Foraminifera) etc.* Total 68 zooplankton was recorded in Offshore area adding that more composition of zooplankton by the Phylum Arthropoda(Crustacea), Foraminifera and Sponge Spicules (Porifera) and Tintinnida.

5.4.2. Cargo Jetty

The population density of zooplankton varied from 55200 nos./100m^3 to 106240 nos./100m^3. Maximum density was noticed in site 2D-Cargo Jetty (106240nos./100m^3) and minimum was at site 2Control-Cargo Jetty (55200nos./100m^3). Maximum number of species (35nos.) found 2E - Cargo Jetty minimum number of species was observed in site 2A, 2B-Cargo Jetty (27nos.). Biomass ranged between 13.89 to 65.79 ml/100m^3 where highest biomass noted in site2C-Cargo Jetty and lowest in 2D-Cargo Jetty.

Frequently observed species were Ammonia beccarii (Foraminifera), *Calanoida (Unidetified), Cyclops sp (Cyclopoida) Bolivina sp (Foraminifera), Globigerina sp (Foraminifera), Microsetella sp (Harpacticoida), Ostracoda, Sponge Spicules, Tintinnopsis orientalis (Tintinnida), Veliger larvae of Bivalve etc.* whereas less observed species were *Acartia ohtsukai (Calanoida), Amphipoda (Crustacea), Calcarina sp (Foraminifera), Cyphonautes larva (Bryozoan), Egg capsules of Littorinids (animal), Heteropoda shells (gastropods), Leprotintinnus nordqvistii (Tintinnida), Nodosaria sp (Foraminifera), Quinqueloculina sp (Foraminifera)* etc. Total (60) zooplanktons were recorded in Cargo Jetty.

5.4.3. Phang Creek

This Creek area was represented by the zooplankton fauna majority of them were Ammonia beccarii (Foraminifera) Calanoida (unidentified), Cyclops sp (Cyclopoida) Copepoda eggs sacs, Foraminifera (unidentified), Globigerina sp (Foraminifera) Gastrula larva of Echinodermata, Globigerina sp (Foraminifera), Leprotintinnus pellucidus (Tintinnida) Ostracoda , Sponge spicules, *Leprotintinnus sp* (Tintinnida)*, Tintinnopsis orientalis (Tintinnida).*Very less time or rarely recorded species were Calcarina sp (Foraminifera), Centropages sp (Calanoida), Cyclopoida (unidentified), Cyphonautes larva (Bryozoan), Egg (unidentified), Euterpina sp (Harpacticoida), Gastropoda shells (empty), Harpacticoida (unidentified), Lagena sp (Foraminifera), Microsetella sp (Harpacticoida), Textularia sp (Foraminifera) etc.

The range of zooplankton biomass was between 9.38 to 38.46 ml/100m^3. Highest Biomass was recorded in site 3A-Phang creek (38.46 ml/100m^3) and lowest in site 3C-Phang creek (9.38 ml/100m^3). Maximum and Minimum species count was at in site 1E-Offshore (43nos.) and 2B and 2C-Cargo Jetty (27nos.) respectively. Population density was maximum recorded in site 3A-Phang Creek (87840 nos./100m^3) and minimum in site 3E-Phang Creek (53600 nos./100m^3). In site 3E-Phang creek comparatively low density according to other sites may be because of high predator pressure or some environment changes.

Overall assessment of zooplankton showed that the total number of 84 Zooplankton recorded during this season. Out of these (64) zooplankton, 68 zooplankton recorded in Offshore region, 60 zooplankton at Cargo Jetty and 67 zooplankton in Phang Creek region. The recorded zooplankton of all 3 stations mainly representing Phylum Arthropoda (Crustacea), Protozoa (mainly foraminifera and tintinnids), Porifera (sponge spicules). Crustacean zooplankton was the dominant due to the dominance of different larval stages and Copepods which mainly feed phytoplankton. More larval stage of crustacean and other animals observed in samples that indicated reproduction and development season of animals from larval to mature animal. Generally, zooplankton population dynamics and studies emphasize is given up to group level rather than to species level because of microscopic size of zooplankton so to the difficulty in identifying the zooplankton as some species are considered as a groupor genus level. The most dominant or frequently observed species(all 3 station) were *Acartia sp* (Calanoida), *Ammonia beccarii* (Foraminifera) Calanoida (unidentified), *Canthocalanus sp* (Calanoida), *Cyclops sp* (Cyclopoida), *Clausocalanus sp* (Calanoida), *Tintinnopsis orientalis* (Tintinnida), Foraminifera (unidentified), *Leprotintinnus sp* (Tintinnida), Ostracoda, *Globigerina sp* (Foraminifera), Ostracoda, Sponge Spicules, Zoea larva of Crab etc. Foraminifera and Ostracoda belonging to the meroplankton were present at all three stations.

Overall range of all three sites Population density, Biomass and Number of species were (53600 to 138240no/100 m^3), (8.77 to 65.79 ml/100m^3) and (27 to 43nos) respectively. Average high biomass noted at Cargo Jetty (161.66 ml/100m^3) followed by Phang creek (93.45 ml/100m^3) than Offshore (52.25 ml/100m^3) (Table 17, 18, 19). Highest population density was recorded in site 1C-Offshore (138240nos/100m^3) and lowest was recorded in site 3E- Phang creek(53600nos/100m^3). Among all recorded zooplankton, majority dominance occurrence was by the Copepoda, Crustacean larvae, Spong Spicules, Foraminifera (Protozoa), Ostracoda, Tintinnids (Protozoa), Zoea larva of Crab. The small Fish was also recorded in Offshore and Cargo Jetty region.

Maximum zooplankton faunal composition was dominated by the Phylum Arthropoda, Mollusca, Protozoa, Porifera, Foraminifera. The Fish (Ichthyoplankton) was also recorded in some sites of Offshore and Cargo jetty. The Zooplankton of Chaetognatha,, Amoebozoa were only represented by the species namely *Sagitta sp (arrow worm), Arcella sp.* respectively. Veliger larva of Bivalve and Heteropods shells include in Phylum Mollusca. The Echinodermata phylum represented by the Ophiopluteus larva and Gastrula larva of Sea star. The Bryozoan represented by the Cyphonautes larva and some bryozoan.

In Offshore**,** maximum Occurrence (%) was by the *Tintinnopsis orientalis (Tintinnida)* (12.62%) and minimum by some unidentified species (0.05%). In Cargo Jetty, maximum Percentage of Occurrence (%) by the *Tintinnopsis orientalis (Tintinnida)* (8.62%) and minimum by the Nodosaria sp (Foraminifera) and small Fish (0.07%). In Phang Creek maximum Occurrence by the *Tintinnopsis orientalis* (Tintinnida) (8.12%) and minimum (0.08%) by the Mysida (Malacostraca, Crustacea), *Textularia sp* (Foraminifera), *Quinqueloculina sp* (Foraminifera), Protozoea larva (Decapoda), *Centropages sp* (Calanoida) and some unidentified zooplankton (Tables 17 - 19).

During microscopic sample analysis more number of species varieties of Foraminifera, Sponge spicules, Crustacean larva, Copepoda and Tintinnids were observed. These all three are very important for paleontological study aspects and also for evolutionary, ecological and environmental rebuilding. Some species of Ostracoda, Foraminifera and Sponge spicules are considered in microfossils materials. Some deep-sea species also recorded that is indication of water circulation pattern. Data on zooplankton density, list of zooplankton is shown in Tables 17 -19.

Plankton identification, both zooplankton and phytoplankton, were done by using relevant identification and taxonomic keys and with standard literatures, monographs and research articles.(Kasturirangan, 1963; APHA, 1992; Mitra et al., 2003;Goswami, 2005; Carling et al.,2004; Mandal, 2004; Hussain & Kalaiyarasi, 2013; Guglielmo et al., 2015; Hussain et al., 2016; Sreenivasulu et al., 2017; NIO,1998; NIO,2002) and others.

5.4.4. Diversity Indices of Zooplankton

Table 20 shows diversity indices of zooplankton. The Shannon-wiener diversity index (H’) fluctuated between 2.62 to 3.29 indicated moderate to quite high range of diversity added indication of healthy body of water with a maximum value in site 2C-Cargo Jetty (3.29) where number of species noted (33nos.) and minimum value in site 1A-Offshore (2.62) where species number was (29nos). Range of the evenness was 0.47 to 0.81 where lowest and highest recorded in site 1A- Offshore and 2C-Cargo Jetty (0.81) respectively. Range of Simpson index was 0.88 to 0.96. The range value of Margalef indices was 2.34 to 3.58 that means high species number variations (Table 20)..

Table 17. Density of Zooplankton at Offshore site of Deendayal Port

Name of Genera/Group	1A	1B	1C	1D	1E	1 Control	Individual total density (no/100m^3)	% of Occurrence (Site-wise)
Acartia sp (Calanoida)	2400	2400	800	320	800	480	7200	1.14
Ammonia beccarii (Foraminifera)	800	640	480	480	640	480	3520	0.56
Arcella sp (Amoebozoa)	0	0	640	4000	0	0	4640	0.74
Bolivina sp (Forminifera)	320	0	1600	800	0	640	3360	0.53
Bryozoan	0	0	0	0	0	640	640	0.10
Bulimina sp (Foraminifera)	0	0	0	0	640	0	640	0.10
Calanoida (Unidetified)	8000	4000	8000	4000	4000	3200	31200	4.95
Calcarina sp (Foraminifera)	0	0	0	0	0	480	480	0.08
Canthocalanus sp (Calanoida)	1440	0	1760	800	1440	800	6240	0.99
Cibicides sp (Foraminifera)	0		0	0	0	1600	1600	0.25
Clausocalanus sp (Calanoida)	1280	1280	3200	1920	1280	2080	11040	1.75
Copepoda eggs sacs	2400	0	8000	4000	8000	3200	25600	4.06
Cyclops sp (Cyclopoida)	3840	6400	4800	11200	8000	0	34240	5.44
Discorbis sp (Foraminifera)	0	0	0	0	800	0	800	0.13
Egg (unidentified)	0	0	0	0	480	0	480	0.08
Egg capsules of Littorinids (animal)	0	0	4000	0	2400	0	6400	1.02
Embryonic stage (Crustacea)	0	0	0	0	320	0	320	0.05
Euterpina sp (Harpacticoida)	480	0	2400	480	0	0	3360	0.53
Favella sp (Tintinnida)	0	0	0	0	0	800	800	0.13
Fish (small)	800	0	0	0	0	0	800	0.13
Foraminifera(unidentified)	8000	4000	3200	8000	5600	4000	32800	5.21
Gallitella sp (Foraminifera)	0	0	800	0	0	0	800	0.13
Gastrula larva of Echinodermata	0	0	0	480	0	0	480	0.08
Globigerina sp (Foraminifera)	0	2240	1440	1600	2080	2400	9760	1.55
Harpacticoida (unidentified)	0	1600	0	0	320	0	1920	0.30
Harpacticus sp (Harpacticoida)	0	640	0	0	0	0	640	0.10
Heteropoda shells (gastropods)	320	1600	1600	0	0	2400	5920	0.94
Labidocera sp (Calanoida)	800	0	0	0	0	0	800	0.13
Lagena sp (Foraminifera)	0	0	800	640	0	0	1440	0.23
Leprotintinnus pellucidus (Tintinnida)	0	0	0	320	800	0	1120	0.18
Leprotintinnus sp (Tintinnida)	800	1600	0	3200	2240	0	7840	1.24
Leprotintinnus simplex	1440	1600	0	480	1600	0	5120	0.81

(Tintinnida)								
Megacyclops sp (Cyclopoida)	4800	0	3200	0	800	0	8800	1.40
Mesocyclops sp (cyclopoida)	0	0	0	0	2560	0	2560	0.41
Microsetella sp (Harpacticoida)	2400	1600	1600	0	480	1600	7680	1.22
Mysida (Malacostraca, Crustacea)	0	0	0	480	800	0	1280	0.20
Nauplius larva of Copepoda	0	0	12000	8000	6400	3200	29600	4.70
Nauplius larvae of Barnacles	0	0	800	800	0	640	2240	0.36
Nauplius larvae of Crustacea	12000	10400	17600	11200	8000	4800	64000	10.16
Nonion sp (Foraminifera)	0	0	0	1600	0	800	2400	0.38
Oithona nana (Cyclopoida)	1600	2400	2400	0	1920	0	8320	1.32
Oithona similis (Cyclopoida)	0	3200	2400	960	2240	0	8800	1.40
Oithona sp (Cyclopoida)	1600	11200	1920	1600	3200	0	19520	3.10
Ophiopluteus Larva (Echinodermata)	0	2560	0	0	480	320	3360	0.53
Ostracoda	0	0	2400	7200	960	3200	13760	2.18
Paracalanus parvus (Calanoida)	0	0	1920	2400	3200	0	7520	1.19
Paracalanus sp (Calanoida)	0	2560	0	0	0	1920	4480	0.71
Parvocalanus sp (Calanoida)	1120	3200	2400	3200	4000	4000	17920	2.84
Polychaete larvae (Annelids)	800	640	640	800	640	960	4480	0.71
Protozoea larva (Decapoda)	0	800	0	0	640	0	1440	0.23
Quinqueloculina sp (Foraminifera)	0	0	480	800	0	800	2080	0.33
Rosalina sp (Foraminifera)	0	0	960	0	0	0	960	0.15
Rotaliida (foraminifera)	0	0	0	0	1600	0	1600	0.25
Sagitta sp (arrow worm)	640	800	1600	1600	0	1600	6240	0.99
Spirillina sp (Foraminifera)	320	320	800	1280	640	800	4160	0.66
Spiroloculina sp (Foraminifera)	0	1120	0	0	0	1920	3040	0.48
Sponge Spicules	0	6400	4000	3360	5600	1920	21280	3.38
Subeucalanus sp (Calanoida)	2400	1600	1600	0	1600	1600	8800	1.40
Temora sp (Calanoida)	0	0	0	2400	0	800	3200	0.51
Thermocyclops sp (Cyclopoida)	0	0	2400	0	3360	0	5760	0.91
Tintinnopsis cylindrica (Tintinnida)	0	0	1600	0	800	0	2400	0.38
Tintinnopsis orientalis (Tintinnida)	8000	8000	28000	16000	17600	1920	79520	12.62
Tintinnopsis sp (Tintinnida)	27200	4800	1600	9600	14400	0	57600	9.14
Tintinnopsis tubulosa	0	0	0	0	640	0	640	0.10

(Tintinnida)								
Triloculina sp (Foraminifera)	0	0	0	800	0	0	800	0.13
Veliger larvae of Bivalve	480	800	2400	1440	800	4000	9920	1.57
Zoea larva of Crab	800	0	0	640	0	0	1440	0.23
Unidentified	0	0	0	320	0	0	320	0.05
Total No. Of Genera/Groups=68								
Site-wise Total Density (no/100m^3)	97280	90400	138240	119200	124800	60000	**Total Density =629920**	**100%**
Biomass (ml/100m^3)	**10.71**	**8.77**	**9.09**	**9.23**	**11.90**	**15.31**		

Table 18. Density of Zooplankton at Cargo Jetty site of Deendayal Port

Name of Genera/Group	2A	2B	2C	2D	2E	2 Control	Individual total density (no/100m^3))	% of Occurrence (Site-wise)
Acartia ohtsukai (Calanoida)	0	0	0	0	800	0	800	0.19
Acartia sp (Calanoida)	0	1600	1600	480	0	320	4000	0.93
Ammonia beccarii (Foraminifera)	800	1280	800	480	800	1120	5280	1.23
Amphipoda (Crustacea)	0	0	0	0	480	0	480	0.11
Arcella sp (Amoebozoa)	800	0	480	0	0	800	2080	0.48
Bolivina sp (Forminifera)	2400	800	0	320	2400	320	6240	1.45
Bulimina sp (Foraminifera)	0	320	480	0	480	480	1760	0.41
Calanoida (Unidetified)	3200	3200	3200	20000	6400	0	36000	8.36
Calcarina sp (Foraminifera)	0	0	0	1280	0	0	1280	0.30
Canthocalanus sp (Calanoida)	2400	1600	1440	0	0	960	6400	1.49
Clausocalanus sp (Calanoida)	1600	0	0	1600	0	0	3200	0.74
Copepoda eggs sacs	0	0	4000	4800	0	2400	11200	2.60
Cyclopoida (unidentified)	1600	4000	0	0	0	0	5600	1.30
Cyclops sp (Cyclopoida)	0	2400	3200	3520	3200	2400	14720	3.42
Cyphonautes larva (Bryozoan)	0	0	0	1600	0	0	1600	0.37
Egg capsules of Littorinids (animal)	0	0	0	800	800	800	2400	0.56
Euterpina sp (Harpacticoida)	1600	0	0	1600	0	0	3200	0.74
Fish (small)	0	0	320	0	0	0	320	0.07
Foraminifera(unidentified)	1600	4800	4800	1600	12000	3200	28000	6.50
Gastrula larva of Echinodermata	0	0	0	0	800	0	800	0.19
Globigerina sp (Foraminifera)	2560	3200	2400	2080	4800	2400	17440	4.05
Globigerinoides sp (Foraminifera)	0	0	0	0	0	3200	3200	0.74
Heteropoda shells (gastropods)	0	0	0	0	320	320	640	0.15
Hydrozoa (Cnidaria)	0	0	0	640	0	0	640	0.15
Labidocera sp (Calanoida)	1600	0	0	640	0	800	3040	0.71
Lagena sp (Foraminifera)	1600	0	0	0	0	0	1600	0.37
Leprotintinnus nordqvistii (Tintinnida)	0	0	0	0	640	0	640	0.15
Leprotintinnus pellucidus (Tintinnida)	0	0	1920	0	480	800	3200	0.74
Leprotintinnus sp (Tintinnida)	2400	0	2400	1600	1600	2400	10400	2.42
Leprotintinnus simplex (Tintinnida)	0	0	1600	960	1920	1920	6400	1.49
Microsetella sp (Harpacticoida)	0	800	1600	1600	1600	800	6400	1.49
Mysida (Malacostraca,	1600	1600	0	0	0	1600	4800	1.11

Crustacea)								
Nauplius larva of Copepoda	5600	5600	3200	0	0	1280	15680	3.64
Nauplius larvae of Barnacles	0	800	1600	0	2400	0	4800	1.11
Nauplius larvae of Crustacea	800	800	4000	0	2400	3200	11200	2.60
Nodosaria sp (Foraminifera)	0	0	0	320	0	0	320	0.07
Nonion sp (Foraminifera)	0	1600	640	0	1600	2400	6240	1.45
Oithona brevicornis (Cyclopoida)	0	0	0	1600	0	0	1600	0.37
Oithona nana (Cyclopoida)	0	1600	1600	2400	0	0	5600	1.30
Oithona similis (Cyclopoida)	0	1600	0	0	0	0	1600	0.37
Oithona sp (Cyclopoida)	4000	0	1600	4800	1600	0	12000	2.79
Ophiopluteus Larva (Echinodermata)	0	0	480	1600	0	0	2080	0.48
Ostracoda	4000	4800	4000	2560	3200	4000	22560	5.24
Paracalanus parvus (Calanoida)	0	0	0	1600	1600	0	3200	0.74
Parvocalanus sp (Calanoida)	0	0	800	8000	1920	0	10720	2.49
Polychaete larvae (Annelids)	800	0	0	0	0	0	800	0.19
Quinqueloculina sp (Foraminifera)	0	0	0	0	800	800	1600	0.37
Rotaliida (foraminifera)	0	0	1280	0	960	2400	4640	1.08
Sagitta sp (arrow worm)	2400	0	0	1600	1600	800	6400	1.49
Spirillina sp (Foraminifera)	320	640	480	960	480	320	3200	0.74
Spiroloculina sp (Foraminifera)	480	0	640	0	0	640	1760	0.41
Sponge Spicules	7200	5600	4000	4800	4000	2400	28000	6.50
Subeucalanus sp (Calanoida)	0	1600	1600	0	1600	1600	6400	1.49
Temora sp (Calanoida)	0	0	0	0	1600	0	1600	0.37
Tintinnopsis cylindrica (Tintinnida)	0	0	2400	0	480	0	2880	0.67
Tintinnopsis orientalis (Tintinnida)	5600	2560	2240	16000	5600	5120	37120	8.62
Tintinnopsis sp (Tintinnida)	5600	3840	0	9600	4800	1600	25440	5.91
Triloculina sp (Foraminifera)	1600	800	0	480	0	0	2880	0.67
Veliger larvae of Bivalve	1600	320	2400	4000	0	0	8320	1.93
Zoea larva of Crab	0	4000	640	320	1600	1600	8160	1.90
Total No. Of Genera/Groups=60								
Site-wise Total Density (no/100m^3)	65760	61760	63840	106240	77760	55200	**Total Density =430560**	**100%**
Biomass (ml/100m^3)	**27.27**	**35.00**	**65.79**	**13.89**	**15.22**	**26.92**		

Table 19. Density of Zooplankton at Phang Creek site of Deendayal Port

Name of Genera/Group	3A	3B	3C	3D	3E	3 Control	Total density (no/100m3)	% of Occurrence (Site-wise)
Acartia sp (Calanoida)	0	800	1600	0	640	320	3360	0.85
Ammonia beccarii (Foraminifera)	800	480	800	320	960	1600	4960	1.26
Arcella sp (Amoebozoa)	800	0	4000	960	1600	4000	11360	2.88
Bolivina sp (Forminifera)	640	480	1600	0	0	960	3680	0.93
Bolivinita sp (Foraminifera)	800	0	0	0	0	0	800	0.20
Calanoida (Unidetified)	2400	3200	4800	3200	2560	3200	19360	4.91
Calcarina sp (Foraminifera)	0	0	0	320	0	0	320	0.08
Canthocalanus sp (Calanoida)	960	640	0	640	1600	0	3840	0.97
Centropages sp (Calanoida)	0	0	0	320	0	0	320	0.08
Clausocalanus sp (Calanoida)	0	0	0	0	800	2240	3040	0.77
Copepoda eggs sacs	4800	3520	0	4000	2400	0	14720	3.73
Cyclopoida (unidentified)	0	0	0	4000	800	0	4800	1.22
Cyclops sp (Cyclopoida)	3200	1920	640	1600	1600	0	8960	2.27
Cyphonautes larva (Bryozoan)	320	0	320	0	0	0	640	0.16
Discorbis sp (Foraminifera)	0	0	0	0	0	640	640	0.16
Egg (unidentified)	480	0	0	0	0	0	480	0.12
Egg capsules of Littorinids (animal)	0	0	0	0	0	640	640	0.16
Euterpina sp (Harpacticoida)	0	800	0	0	0	0	800	0.20
Favella sp (Tintinnida)	0	3200	0	0	0	0	3200	0.81
Foraminifera(unidentified)	4800	2400	12000	5600	4000	4800	33600	8.52
Gastropoda shells (empty)	0	0	4000	0	0	0	4000	1.01
Gastrula larva of Echinodermata	800	0	480	320	0	480	2080	0.53
Globigerina sp (Foraminifera)	3200	1440	2400	0	1920	3520	12480	3.17
Globigerinoides sp (Foraminifera)	0	0	0	0	0	1440	1440	0.37
Harpacticoida (unidentified)	800	0	0	320	0	0	1120	0.28
Heterolaophonte (Harpacticoida)	0	0	0	480	0	0	480	0.12
Heteropoda shells (gastropods)	0	0	0	800	0	0	800	0.20
Labidocera sp (Calanoida)	0	0	0	2400	0	0	2400	0.61
Lagena sp (Foraminifera)	320	0	1600	0	0	0	1920	0.49
Leprotintinnus nordqvistii (Tintinnida)	0	1600	0	0	0	0	1600	0.41
Leprotintinnus pellucidus (Tintinnida)	2720	1440	2240	3200	2240	3360	15200	3.86
Leprotintinnus sp (Tintinnida)	3200	1600	5600	2240	4800	4800	22240	5.64
Leprotintinnus simplex (Tintinnida)	2400	960	3360	2400	1600	1600	12320	3.13

Lucifer sp (Decapoda)	0	1600	0	320	0	0	1920	0.49
Megacyclops sp (Cyclopoida)	0	0	0	0	800	0	800	0.20
Mesocyclops sp (cyclopoida)	1600	1920	0	0	0	0	3520	0.89
Microsetella sp (Harpacticoida)	0	0	800	0	0	480	1280	0.32
Mysida (Malacostraca, Crustacea)	0	0	320	0	0	0	320	0.08
Nauplius larva of Copepoda	3200	2400	800	0	0	0	6400	1.62
Nauplius larvae of Barnacles	1600	800	480	640	1600	0	5120	1.30
Nauplius larvae of Crustacea	8000	4000	800	1600	1600	2560	18560	4.71
Nonion sp (Foraminifera)	800	0	0	480	0	640	1920	0.49
Oithona sp (Cyclopoida)	0	1600	800	0	0	0	2400	0.61
Ophiopluteus Larva (Echinodermata)	0	0	0	320	320	0	640	0.16
Ostracoda	3200	800	9600	1600	1440	1920	18560	4.71
Paracalanus sp (Calanoida)	2400	960	0	1920	1600	0	6880	1.75
Parvocalanus sp (Calanoida)	0	960	1920	2560	2400	1600	9440	2.39
Polychaete larvae (Annelids)	0	800	0	800	640	800	3040	0.77
Protozoea larva (Decapoda)	0	0	0	0	320	0	320	0.08
Pseudodiaptomus sp (Calanoida)	0	2400	0	800	0	0	3200	0.81
Quinqueloculina sp (Foraminifera)	0	0	320	0	0	0	320	0.08
Rotaliida (foraminifera)	3200	1600	1920	0	1600	2400	10720	2.72
Sagitta sp (arrow worm)	1600	0	0	0	0	1600	3200	0.81
Spirillina sp (Foraminifera)	800	640	480	480	960	640	4000	1.01
Spiroloculina sp (Foraminifera)	1120	320	0	640	960	0	3040	0.77
Sponge Spicules	4800	8000	5600	960	3200	4800	27360	6.94
Subeucalanus sp (Calanoida)	0	0	0	0	160	0	160	0.04
Textularia sp (Foraminifera)	0	0	320	0	0	0	320	0.08
Thermocyclops sp (Cyclopoida)	0	1440	0	0	0	0	1440	0.37
Tintinnopsis cylindrica (Tintinnida)	800	0	0	1600	0	0	2400	0.61
Tintinnopsis orientalis (Tintinnida)	9600	4000	4000	1600	7200	5600	32000	8.12
Tintinnopsis sp (Tintinnida)	9600	0	800	4000	0	2880	17280	4.38
Tintinnopsis tubulosa (Tintinnida)	480	0	0	0	0	0	480	0.12
Triloculina sp (Foraminifera)	0	1600	800	0	0	0	2400	0.61
Veliger larvae of Bivalve	1600	800	480	480	960	1920	6240	1.58
Zoea larva of Crab	0	0	0	0	320	320	640	0.16
Unidentified	0	0	0	320	0	0	320	0.08
Total No. Of Genera/Groups=67								

Site-wise Total Density (no/100m^3)	87840	61120	75680	5424 0	53600	61760	**Total density =394240**	**100%**
Biomass (ml/100m^3)	**9.38**	**10.00**	**38.46**	**17.14**	**15.00**	**20.83**		

Table 20. Diversity indices of Zooplankton at different sites of Deendayal Port

	Offshore						Cargo jetty						Phang Creek					
	1A	1B	1C	1D	1E	1-control	2A	2B	2C	2D	2E	2-contrl	3A	3B	3C	3D	3E	3-control
Variables																		
Taxa_S	29	30	39	39	43	33	27	27	33	34	35	33	35	34	32	36	31	29
Individuals (nos. /m^2)	97280	90400	138240	119200	124800	60000	65760	61760	63840	106240	77760	55200	87840	61120	75680	54240	53600	61760
Dominance_D	0.12	0.06	0.08	0.06	0.06	0.04	0.06	0.06	0.04	0.08	0.06	0.04	0.05	0.05	0.07	0.05	0.05	0.05
Shannon Diversity Index(H)	2.62	3.05	3.06	3.10	3.21	3.27	3.06	3.05	3.29	2.91	3.18	3.27	3.18	3.27	2.96	3.23	3.15	3.11
Simpson_1-D	0.88	0.94	0.92	0.94	0.94	0.96	0.94	0.94	0.96	0.92	0.94	0.96	0.95	0.95	0.93	0.95	0.95	0.95
Evenness	0.47	0.70	0.55	0.57	0.58	0.80	0.79	0.78	0.81	0.54	0.68	0.79	0.69	0.77	0.60	0.70	0.75	0.77
Menhinick	0.09	0.10	0.10	0.11	0.12	0.13	0.11	0.11	0.13	0.10	0.13	0.14	0.12	0.14	0.12	0.15	0.13	0.12
Margalef	2.44	2.54	3.21	3.25	3.58	2.91	2.34	2.36	2.89	2.85	3.02	2.93	2.99	2.99	2.76	3.21	2.76	2.54

6.0. References

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Annexure–F

List of CSR Works for the year 2025(April to Till November-2025)		
Sr.No	**Name of work**	**Approved cost (Rs in Lakhs)**
1	Request for construction of relocatable of sports arena at Gandhidham Military Station,HQ 98 Artillery Brigade Military Station Gandhidham	₹ 28.00
2	Proposal for construction of Police Community Hall at Police Headquarters Shinay.Office of the Superintendent of Police, East – Kutch Gandhidham.	₹ 100.00
3	Proposal for providing AWG system at their check posts located in the Runn of Kutch,Commandant BSF Station Gandhidham	₹ 82.70
4	Proposal for providing 4000 pieces of Tripal/Tarpaulin,Matri Sena Charitable Trust	₹ 32.00
5	Proposal for Upgrading Satellite Eye Hospital at Bhuj.1.Request for financial support for the addition of cornea and retina outpatient departments (OPD), a spectacle dispensing unit, and a medicine counter as part of our OPD activities, & equipment purchase.	₹ 35.08
6	Proposal for financial assistance for purchase of C Arm and OT table to start Orthopedic at St. Joseph's Hospital Gandhidham,ST. Joseph's Hospital Trust, Gandhidham.	₹ 28.78
7	Proposed to establish a women empowerment center, through Ujjas Mahila Sangh,Gandhidham	₹ 119.48
8	CSR Grant for 'Strengthening of School Ecosystem at Primary School Level in Kachchh District,Ladies Environment Action Foundation (LEAF), Gandhinagar	₹ 50.00
9	Proposal for recharge Ponds and Solar based initiatives.Providing solar street lights, home lighting and solar lights for boats, specially targets sea farming families in the Tuna & Vandi village within Gandhidham block of Kutch district,Baif Institute for sustainable livelihoods and development, (BISLAD)Pune- Maharashtra.	₹ 30.00
10	Proposal for the Financial assistance for Ramakrishna Mission Centre for Human Excellance and Social Sciences also called 'Viveka Thirtha', New Town Kolkata. Human Excellence building ,Ramakrishna Mission, West Bengal	₹ 150.00
11	Funding for Distribute Biomass Green Cook Stove free of cost across Gujarat state.,Ramdas Athawale Foundation Ahemdabad	₹ 27.00
12	Request to Allotment of Fund for Development of School premises and providing furniture etc from CSR Fund.,Shree J.H Shukla Madhyamik Shala	₹ 25.92
13	Re-accreditation of sport academy under Khelo India Scheme.Request for Infrastructure for the proposals i) seating gallery & amenities ii) up gradation of existing hostel for elite athletes iii) surrounding road & infrastructure, etc.,Usha School Athletics, Kerala.	₹ 69.00
14	Proposal for Skill Development Training Program for Unemployed and Underprivileged Youth under CSR Initiative of Deendayal Port Authority (DPA) through Centre of Excellence in Maritime and Shipbuilding (CEMS),Mumbai	₹ 124.00
15	Submission of application along with requisite documents for construction of Kabrastan and fund for basic amenities under CSR,Etihadul Muslemin E Hind Trust, Anjar	₹ 50.00
16	Request Letter for the purchase of stainless steel Water Cooler with filter and dispenser for the school,Sunflower School, Gandhidham	₹ 3.19
17	Proposal for Placement Linked Skill and Capacity Building Training on Tourism and Hospitality Request for funding under Corporate social Responsibility (CSR) initiative,Pragati Edutech, Guwahati	₹ 50.00
18	Fund for establishment of New Facilities and upgradation of existing facilities at 'Adhar Sankul (Excluding cost of Building Construction.),'Adhar Sankul' Manav Seva Trust, Gandhidham.	₹ 75.00
19	Earnest Appeal to Contribute under CSR Activities for the construction of sainik school at silvassa in the name of NETAJI CHANDRA BOSE MILITARY ACEDEMY,VidhyaBharti Gujarat Pradesh, Ahemdabad.	₹ 445.23
20	Construction of an educational and social purpose building having 28 rooms & 2 halls.Shree Akhil Kutch Samasta Meghvanshi Gurjar Meghwal Charitable Trust, Bhuj.	₹ 75.00
21	Request to allotment of fund for development of school premises and providing furniture from CSR fund.Sunrise Global School, Gandhidham	₹ 12.60
22	Financial assistance to construction of Building Mind Power development centre for specially visually impaired children. With Equipments, Furniture CCTV, Airconditioner etc.,Shri Navchetan Adhjan Mandal, Madhapar	₹ 107.00

23	Proposal for DPA support Kutch Muslim Shifa Hospital,Muslim Shifa Medical Trust-Bhuj	₹	200.00
24	Request for help from CSR for providing Kits to the Children . List of government schools in khambhaliya taluka,for school Bags/Kits etc. They have requested for 1000 kits ,District Primary Education Officer, Devbhumi Dwarka-Khambhaliya	₹	4.00
25	Project proposal is for Education,Health and Livelihood project in kutch area Electric vehicle project for migrant community school,mobile health van project proposal, school structure project,tailoring training project, computer class for bhadreshwar centre, school-toilet-project, vermin compose unit, fisherman livelihood project.Yusuf Meherally Centre, Bhadreshwar-Kutch	₹	97.67
26	Request for renovation and construction of the shed work above G.F. slab, both side jali for shed, repairing work, painting.Missionaries of Charity, Bhachau (Mother Teresa's distitudi's home)	₹	55.00
27	River Reincarnation Project of the Bhukhi River.Krushi Research Innovation and Development Association, Mumbai (KRIDA)	₹	400.00
28	Providing Financial Assistance to R.D.S Kalavad Taluka Meghwar Seva samaj Education and Charitable Trust, Kalavad,SWA Ramji Daya Somaiya Shri Kalavad Taluka Meghwar Seva Samaj Education and Charitable trust, Kalavad	₹	75.00
29	CSR funding towards cure of Baby Aasmika Das diagnosed with Spinal Muscular Atrophy (SMA Type-1).	₹	20.00
30	CSR Funding for Providing Nutrition Kit to T.B. Patients under TB Mukat Bharat Abhiyan as Nishyray Mitra.	₹	14.02
31	Financial assistance under the CSR initiative to facilitate the urgent upgradation of the training and parade ground at the 176 BN BSF campus, Bhuj, Frontier Headquarters, Border Security Force (BSF)	₹	171.90
32	Financial assistance under the CSR initiative for Construction of a Martyr’s Column at the 176 BN BSF campus, Bhuj, Frontier Headquarters, Border Security Force (BSF)	₹	32.20

Annexure – G

दीनदयाल पोर्ट प्राधिकरण
DEENDAYAL PORT AUTHORITY

Office of the Dy. Chief Engineer
(EMC & I/c), Ground Floor,
Administrative Office Building
Post Box No. 50, Gandhidham–Kachchh
Email: scplkpt@gmail.com,
www.deendayalport.gov.in

No: EG/WK/4783/VII/ 143 **Date: 04/10/2024**

To,
M/s. Precitech Laboratories Pvt. Ltd.
1st floor, Bhanujyot Complex,
Plot no. C5/27, B/h. Pachratna Complex,
Near GIDC Char Rasta,
VAPI-396195
Mail – vapi@precitechlab.com

WORK ORDER

Sub: "Strengthening of Existing Environmental Management Cell of Deendayal Port Authority: Appointment of Environment Expert for two years and further extendable for one years."

Ref: 1) Tender dated 28/12/20223 submitted by M/s Precitech Laboratories Pvt. Ltd., Vapi.
2) LOA No. EG/WK/5375/171 dated 19/09/2024.
3) Performance Guarantee submitted by M/s. Precitech Laboratories Pvt Ltd in the form of Bank Guarantee of Rs. 9,45,000.00 vide Bank Guarantee no. 1102924BG0B00238 dated 30.09.2024 issued by State Bank India, Commercial Branch, Vapi.

Sir,

Kindly refer above cited Letter of Acceptance dated 19/09/2024.
1) You shall have to provide Key Experts as per tender requirement during the entire contract period. Accordingly, you shall have to submit the qualification and experience certificates of the Key experts to be appointed at DPT, as per tender conditions for verification & approval.
2) Please submit the agreement of contract as per Tender Conditions.
3) Kindly commence the work on or before 07/10/2024.

Please note that the time period for providing Consultancy service for the subject work will be Initially for Two years and further extendable for one year on mutual consent as per tender condition.

Accordingly, a copy of Form-III is enclosed herewith for information and necessary action please.

Encl: Form – III

04/10/24
Dy. Chief Engineer (PL) & EMC (I/c),
Deendayal Port Authority

CC: 1. TPA to CE - For kind information to Chief Engineer, please.
2. RAO, DPA
3. Sr. DD (EDP) with a request to hoist this work order in website of DPA.

4. A.M.(W/A)

दीनदयाल पोर्ट प्राधिकरण
DEENDAYAL PORT AUTHORITY

Office of the Dy. Chief Engineer
(EMC & I/c), Ground Floor,
Administrative Office Building
Post Box No. 50, Gandhidham-Kachchh
Email: seplkpt@gmail.com,
www.deendayalport.gov.in

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No: EG/WK/4783/VII/ **Date: 4 /~~09~~/2024**
10

FORM – III
(Under rule 21(2) of the Contract Labour (Regulation and Abolition) Central Rules,1970; and Rules 7(3) of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Central Rules, 1980)

CERTIFICATE BY PRINCIPAL EMPLOYER FOR OBTAINING LICENCE FROM ASSISTANT LABOUR COMMISSIONER (C), GOPALPURI.

Certified that:

I have engaged the applicant "Precitech Laboratories Pvt Ltd. 177, 1st floor, Bhanujyot Complex, Plot no. C5/27, B/h. Pachratna Complex,Near GIDC Char Rasta,VAPI-396195. as a contractor in my establishment for the work **"Strengthening of Existing Environmental Management Cell of Deendayal Port Authority: Appointment of Environment Expert for two years and further extendable for one years."** to be carried out for **24 months** (as per tender) and the work will be commenced on or before **07/10/2024**.

1) I undertake to be bound by all the provisions of the Contract Labour (Regulations and Abolition) Act, 1970 (37 of 1970) and the Contract Labour (Regulations and Abolition) Central Rules, 1971 The inter-State Migrant Workman (Regulation of Employment and Conditions of Service) Act, 1979 (30 of 1979) and the Inter State Migrant Workmen (Regulation of Employment and Conditions of Service) Central Rules, 1980* in so far as the provisions are applicable to me in respect of the employment of Contract Labour/inter-state migrant workmen by the applicant in my establishment.

2) The engagement of contract labour in the said work is not prohibited under sub-section (1) of section 10 of the Contract Labour (Regulation and Abolition) Act, 1970 (37 of 1970) or an award or a settlement.

04/10/24

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

Annexure–H

CE
May posted in Civil Engineering Deptt/ Chairman's office, after observance & due formalities there.
25/8/2025

Date: 25th August

To,

The Secretary,
Deendayal Port Authority,
Gandhidham, Kutch

Subject: Duty Report for the post of Chief-Manager (Environment & Safety) on contractual basis at DPA – reg.

Sir,

I Dr. Utkarsh S. Mukkannawar, have been selected and offered the position of Chief Manager (Environment & Safety) on contractual basis under professional functionaries category vide Letter No. GA/PS/4292(PF)/2025/1347 with effective from 12th August'2025.

As per terms clause no 19, I "have to report for medical examination before the Chief Medical Officer, DPA at Gopalpuri Hospital......"

Accordingly, I hereby submit and enclose my medical examination Report as clinically healthy and "FIT to Join".

Further, I hereby submit my duty report today i.e., 25th August 2025 (FN) along with duly signed acceptance copy of Offer Letter, the original copy of the medical report enclosing clinical documents and two passport size photos for your kind perusal.

Thanking you,

Yours faithfully,

25/08/25

Dr. Utkarsh Mukkannawar
Mob: 9822077507

CE

May be posted in Civil Engineering Department, after due observance of formalities as per T&C of engagement, under intimation to GAD please.

10/9/2025

Secretary.

Date: 10th September 2025

To,

The Secretary,

Deendayal Port Authority,

Gandhidham, Kutch

Subject: Duty Report for the Port of Manager (Environment & Safety) on contractual basis at DPA – reg.

Sir,

I Ms. Neha Chandrashekhar Dekate, have been selected and offered the position of Manager (Environment & Safety) on contractual basis under professional functionaries' category vide letter no. GA/PS/4292 (PF)/2025/1349 with effective from 12th August'2025.

As per clause no. 19, "I have to report for medical examination before the Chief Medical Officer, DPA at Gopalpuri Hospital……. "

Accordingly, I hereby submit and enclose my medical examination report as clinically healthy and "FIT to Join".

Further, I hereby submit my duty report today i,e. 10th September 2025 (FN) along with duly signed acceptance copy of Offer letter, the original copy of the medical report enclosing clinical documents and two passport size photos for your kind perusal.

Thanking you,

Yours faithfully,

Ms. Neha Dekate

Mob: 9096069665

CG/Sr AS

May be posted in Environment Cell of Civil Engineering Depart, subject to observance of due formalities as per terms & conditions of engagement in DPA on contract, Above.

3/9/2025
Secretary

To,

The Secretary

Administrative Building

Deendayal Port Authority

Date: 03/09/2025

SUBJECT: **Duty Report for Contractual Engagement as Manager – Environment & Safety in Deendayal Port Authority (DPA)**

Ref.: DPA letter GA/PS/4292(PF)/2025/1348 dated 12/08/2025

Sir,

With reference to the above referred letter dated 12/08/2025 I am hereby pleased to submit my Duty Report and I confirm to join the organization with effect from today i.e.03/09/2025.

Thanking You

Yours Faithfully

Rajeshwari Sharma