GOPALPUR PORTS LIMITED
CIN. NO. : U63032OR2006PLC008831

Ref:GPL/ENV/ 2022-23/ 28

Oct. 03, 2022

To,

The Director
Ministry of Environment, Forest & Climate Change
INDIRA PARYAVARAN
JOR BAGH ROAD,
NEW DELHI – 110 003.

Subject : Development of Gopalpur Ports Ltd." : Env. Compliance.

Ref. : No.10-12/2009-IA.III dt. 30th Mar, 2011, 14th Aug.2018

Dear Sir,

With reference to the above, we are submitting herewith our compliance of the conditions as laid down in different permissions and clearances. The Compliance report till end of Sept. 2022 is being enclosed for your kind consideration.

Yours faithfully,

For Gopalpur Ports Limited,

Authorized signatory

Copy to:

1. Additional Chief Secretary, Department of Forest & Wildlife, Govt. of Odisha, Secretariat, Bhubaneswar – 751 001.
2. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-Cum-Office Complex, East Arjun Nagar, Delhi – 110 032.
3. Addl. Principal Chief Conservator of Forests (Central), Ministry of Environment, Forest and Climate Change, Regional Office (EZ), A/3, Chandersekharpur, Bhubaneswar – 751 023.
4. The Member Secretary,Odisha State Pollution Control Board, Paribesh Bhavan, A/118, Nilakantha Nagar, Unit – VIII, Bhubaneswar - 751 012.Regional Officer, Odisha State Pollution Control Board Bharampur, Ganjam

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Compliance Report for Environmental Clearance No.10-12/2009-IA-III Dated 30th March 2011

Sl. No.	Conditions	Compliance Status
6.		
(i)	"Consent for Establishment" shall be obtained from State Pollution Control Board under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.	Complied
(ii)	No construction work other than those permitted in Coastal Regulation Zone Notification, 2011 shall be carried out in Coastal Regulation Zone area.	Being complied with.
(iii)	The shore line map prepared by Institute for Ocean Management, Chennai with regard to the stretch at Gopalpur Port has been examined and it is observed that on the southern side of the port, the area is shown as high to medium accretion while, on the northern side the area is shown as low to medium erosion. This is because the net littoral drift is towards the northern side and due to the break water at the southern port there seems to be accretion at the southern breakwater and low to medium erosion on the northern side. This has to be ratified by adopting suitable sand bypass system from south break water to the northern side of the north break water.	Beach nourishment undertaken for 4 MCM in the groyne field to address the erosional aspect Environmental monitoring report (From Oct. 2021 to Mar. 2022) attached.
(iv)	Controlled and proper methods of dredging including state of the art equipment and planning the dredging operation and disposal shall be employed.	Dredging is carried out by use of controlled cutter suction. Other mitigation measures are also implemented to curtail the turbidity.
(v)	Technically qualified institution shall be engaged	Department of Marine

	to monitor the impact right from the beginning to suggest scientifically accepted mitigation measures as and when required on annual basis at least for first 3 years, shall be obtained.	Sciences, Berhampur University have been engaged since June, 2012 to carry out the environmental monitoring of Gopalpur port.
(vi)	A high level expert committee shall be constituted including the experts for Monitoring the population of benthic life during and after the construction phase and also to ensure the compliance of other conditions stipulated in the clearance.	High level expert committee has been constituted and periodically reviews the compliance conditions stipulated in the clearance.
(vii)	An additional substratum shall be provided with the breakwaters, thereby adding to the habitat of benthic community especially flora which is very low due to the present geo physical characteristics of the area.	Additional substratum provided during construction of break water and from the studies being carried out by department of Marine Science dept., Berhampur University there is increase in habitat of benthic community.
(viii)	Oil spills if any shall be properly collected and disposed as per the Rules.	Oil Spill Contingency Plan (OSCP) is in place.
(ix)	There shall be no drawl of ground water in CRZ area.	Complied with.
(x)	Environment Management Plan as suggested shall be strictly complied with.	Complied with.
(xi)	There shall be no disposal of solid and liquid wastes into the Coastal areas.	Being complied with and taken care off.
(xii)	Sewage Treatment facility should be provided in accordance with the CRZ notification, 2011. Treated sewage shall be reused for flushing of toilets and horticulture purposes.	Complied with.
(xiii)	The solid waste shall be properly collected, segregated and disposed as per the provision of solid Waste (Management and Handling) Rules, 2000.	Waste management Plan is in place.
(xiv)	Installation and operation of DG set if any shall	CPCB approved DG sets are

	comply with the guidelines of CPCB.	installed.
(xv)	The approach channel shall be properly demarcated with lighted buoys for safe navigation and adequate traffic control guidelines shall be framed. The fishermen shall be suitably educated and informed about the traffic guidelines.	Channel Marker Buoys have been installed for safe navigation. Fishermen Sensitization shall also be done regularly for harmony with port operation.
(xvi)	The project proponent shall set up separate environmental management cell for effective implementation of the stipulated environmental safeguards under the supervision of a Senior Executive.	Environment Management Cell has been created Headed by DGM Environment
(xvii)	The project proponent shall take up mangrove plantation/green belt in the project area, wherever possible. Adequate budget shall be provided in the Environment Management Plan for such mangrove development.	Green Belt development work is in progress following land shaping and plantation work.
(xviii)	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	Adequate fund is ear-marked and available.
(xix)	Under the provisions of Environment (Protection) Act, 1986, legal action shall be initiated against the project proponent if it was found that the construction of the project has been started without obtaining environmental clearance.	Construction of the project commenced after obtaining the Environmental Clearance. Date of project commencement is 10th Nov. 2011.
7.		
(I)	Adequate provision for infrastructure facilities including water supply, fuel and sanitation must be ensured for construction workers during the construction phase of the project to avoid any damage to the environment.	Being complied with.
(ii)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	Being complied with.

(iii)	Borrow sites for each quarry sites for road construction material and dump sites must be identified keeping in view the following: a) No excavation or dumping on private property is carried out without written consent of the owner. b) No excavation or dumping shall be allowed on wetlands, forest areas or other ecologically valuable or sensitive locations. c) Excavation work shall be done in close consultation with the soil Conservation and Watershed Development Agencies working in the area, and d) Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such materials must be secured so that they shall not leach into the ground water.	Being complied with.
(iv)	The construction material shall be obtained only from approved quarries. In case new quarries are to be opened, specific approvals from the competent authority shall be obtained in this regard.	Being complied with.
(v)	Adequate precautions shall be taken during transportation of the construction material so that it does not affect the environment adversely.	Being complied with.
(vi)	Full support shall be extended to the officers of this Ministry/Regional Office at Bhubaneswar by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and	GPL is committed to provide necessary support.

	other environmental protection activities.	
(vii)	A Six monthly monitoring report shall need to be submitted by the project proponents to the Regional Office of this Ministry at Bhubaneswar regarding the implementation of the stipulated conditions.	Being complied with.
(viii)	Ministry of Environment and Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	GPL is committed to comply with such condition, if any.
(ix)	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry.	Taken note of.
(x)	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment and Forests.	Will be complied, if any.
(xi)	The project proponents shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	Complied The Land development work commenced on 10th November 2011 after approval of the project.
(xii)	A copy of the clearance letter shall be marked to concern Panchayat / local NGO, if any, from whom any suggestion / representation have been made, received while processing the proposal.	Noted and complied.
(xiii)	Orissa Pollution control Board shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's Office/Tahasildar's office for 30 days.	Noted

8.	These stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 1994, including the amendments and rules made thereafter.	Noted
9.	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.	Agreed
10.	The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environmental Clearance and copies of clearance are available with the State Pollution Control Board and may also be seen on the website of the Ministry of Environment and forests at http://www.envfor.nic.in. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional Office of this Ministry at Bhubaneswar.	Complied, Vide letter No. GPL/2011/59, dated 11/04/2011
11.	Environmental clearance is subject to final order of the Hon'ble Supreme court of India in the matter of Goa Foundation vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this Project.	Agreed
12.	Status of compliance to the various stipulated	Complied

	environmental conditions and environmental safeguards will be uploaded by the project proponent in its website.	
13.	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated EC conditions including results of monitoring data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB.	Complied
14.	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the respective Regional Offices of MoEF& CC by e-mail.	Complied
Additional Conditions of the EC Validity Extension Order dated 14th August 2018		
1.	The Project Proponent will submit a Certified Compliance Report within 03 months issued by the MoEF& CC, Regional Office or concerned Regional Office of the Central Pollution Control Board or the Member Secretary of the respective State Pollution Control Board for the conditions stipulated in the Environmental and CRZ Clearance issued earlier	Being Complied
2.	The development plan shall be implemented strictly in accordance to the Coastal Zone Management Plan as drawn up in compliance to the orders of the NGT in this regards. A copy of the compliance report shall be submitted within	Being Complied

	30 days to the MoEF& CC.	
3.	As per the Ministry's Office Memorandum F.No22-65/2017-Ia.III dated 1st May 2018, the project proponent is required to prepare and implement Corporate Environment Responsibility (CER) Plan. As per the para 6(II) of the said O.M appropriate funds shall be earmarked for the activities such as infrastructure creation for drinking water supply, sanitation, health, education, skill development, roads, cross drains, electrification including solar power, solid waste management facilities, scientific support and awareness to local farmers to increase yield of crop and fodder, rain water harvesting, soil moisture conservation works, avenue plantation, plantation in community areas etc. The activities proposed under CER shall be restricted to the affected area around the project. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half yearly compliance report, and to the District Collector. It should be posted on the website of the Project Proponent.	As per the Para 6 (IX) of the said notification which states that *the CER is not applicable in name change, transfer, amendment involving no additional project investment*; this is not applicable to us, as there is no additional project investment.

DATA REPORT

ON

ENVIRONMENTAL MONITORING OF GOPALPUR PORT

(Consultancy Project)

April 2022 to September, 2022

Prepared by

Dr. Pratap Kumar Mohanty,
Nodal Expert, GPL Env. Monitoring Project
& **Professor,** Department of Marine Sciences
Berhampur University
Bhanja Bihar, Berhampur, 760007

Team:
Dr. Shesdev Patro, Asst. Prof. & Consultant, BU
Dr. Asim Amitav Pattanayak, Project Scientist
Dr. Prabin Kumar Kar, Project Scientist
Mr. Balaji Behera, Project Scientist
Miss Bhubaneswari Panda, Project Fellow
Mr. Lochan Patra, Project Fellow

Submitted to

Gopalpur Ports Limited
Arjeepalli, Via- Chhatrapur
PIN-761020
Ganjam, Odisha, India

GOPALPUR PORT
New Era in Maritime Logistics

1. Shoreline monitoring

Table 1: Shoreline (m) analysis along Gopalpur Port South (GPLS) (Shoreline represents the distance in meter between berm line and the reference line in Fig. 1) from April, 2022 to September, 2022.

GPLS	SG 0km	0.5 km	1.0 km	2.5 km	3.0 km	3.5 km	4.0 km	4.5 km
Apr_22	710.8	680.8	837.7	1101.9	957.4	880.4	801.2	772.8
May_22	744.5	653.9	811.7	1085.9	965.0	884.0	823.8	775.2
Jun_22	662.6	658.2	784.5	1035.1	923.8	835.5	777.4	726.8
Jul_22	688.9	638.6	792.8	1056.5	944.3	881.4	798.6	740.9
Aug_22	720.4	649.2	828.8	1108.3	981.1	859.0	821.4	726.6
Sep_22	709.7	665.0	830.1	1110.2	956.9	869.8	813.6	747.1

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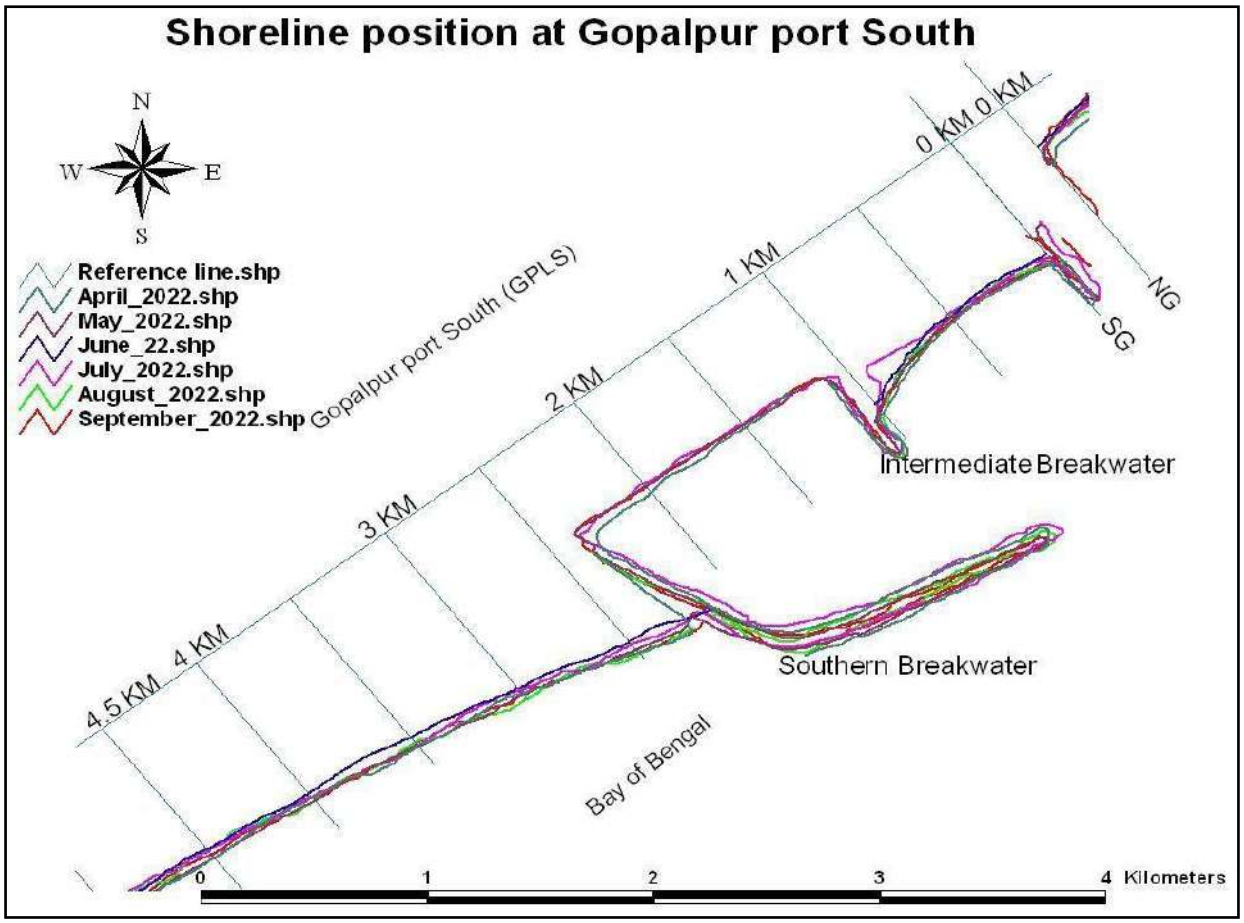

Fig. 1: Shoreline change at south of Gopalpur port from April, 2022 to September, 2022.

Table 2: Shoreline (m) analysis along Gopalpur Port north (GPLN) (Shoreline represents the distance in meter between berm line and the reference line in Fig. 2) from April, 2022 to September, 2022.

GPLN	NG 0km	0.5 km	1.0 km	1.5 km	2.0 km	2.5 km	3.0 km	3.5 km	4.0 km	4.5 km
Apr_22	353.7	264.0	293.8	280.3	298.4	319.0	307.6	361.1	390.1	444.8
May_22	297.1	205.8	240.1	222.8	240.3	230.7	233.7	296.4	343.3	340.4
Jun_22	244.4	176.9	203.5	180.3	178.4	203.4	194.3	258.4	307.0	302.5
Jul_22	262.3	214.9	258.9	205.7	249.5	244.0	234.0	261.7	312.4	378.1
Aug_22	268.0	212.8	258.3	245.6	247.6	232.5	217.5	291.7	321.2	383.5
Sep_22	255.8	204.9	226.0	223.8	251.8	228.9	234.5	304.0	335.2	384.1

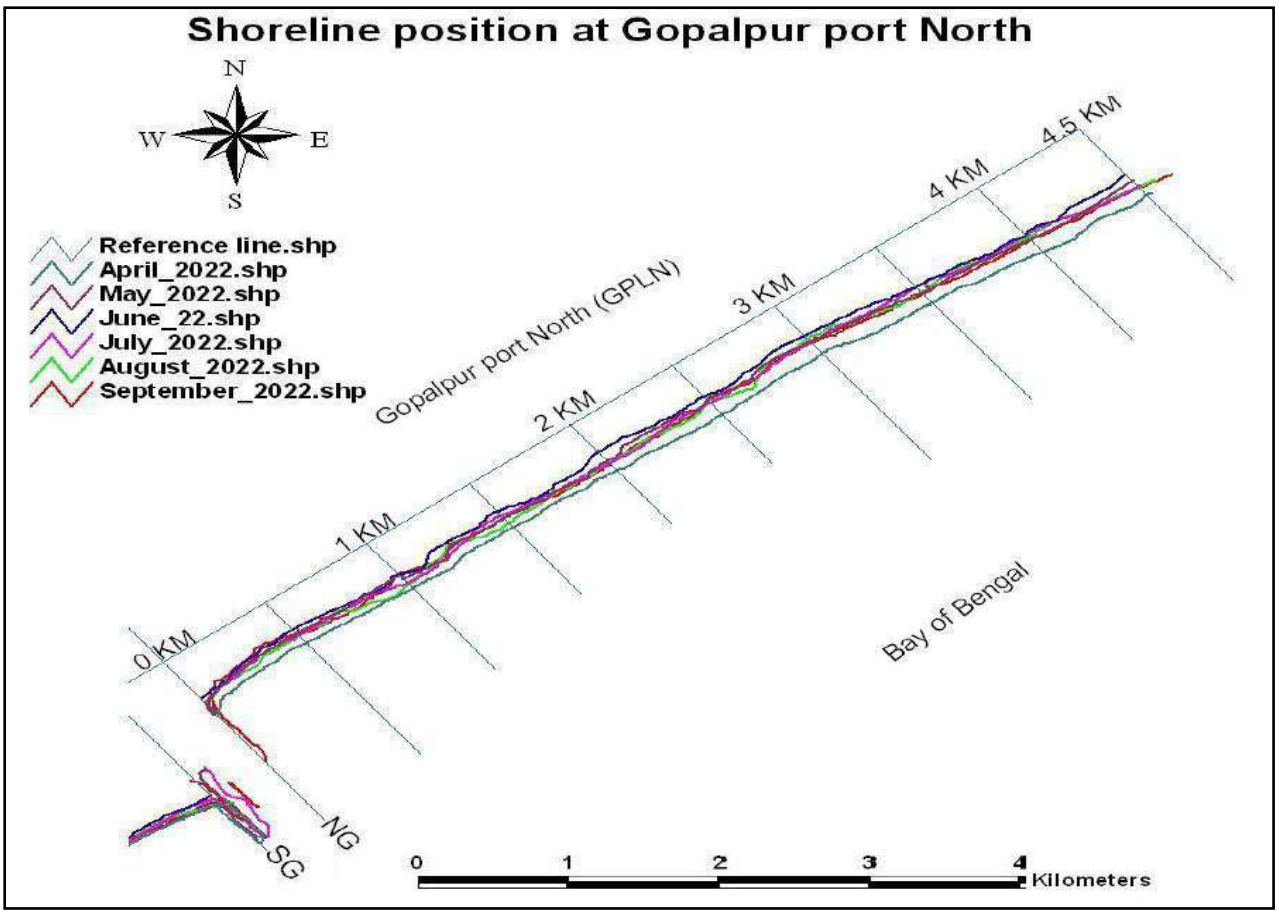

Fig. 2: Shoreline changes at north of Gopalpur port from April, 2022 to September, 2022.

Table 3: Shoreline (m) analysis along Gopalpur tourist beach (GPB) (Shoreline represents the distance in meter between berm line and the reference line in Fig. 3) from April, 2022 to September, 2022.

GPB	LH 0km	0.5 km	1.0 km	1.5 km	2.0 km	2.5 km	3.0 km
Apr_22	92.0	102.2	132.5	136.9	750.0	703.6	749.8
May_22	84.8	88.2	92.1	88.2	710.7	693.5	699.8
Jun_22	52.8	64.3	66.0	86.8	716.2	683.0	686.2
Jul_22	40.9	52.4	87.8	71.7	718.7	676.5	685.8
Aug_22	70.4	72.8	104.1	75.9	716.0	714.0	682.0
Sep_22	83.6	77.4	97.7	107.7	721.3	726.8	712.9

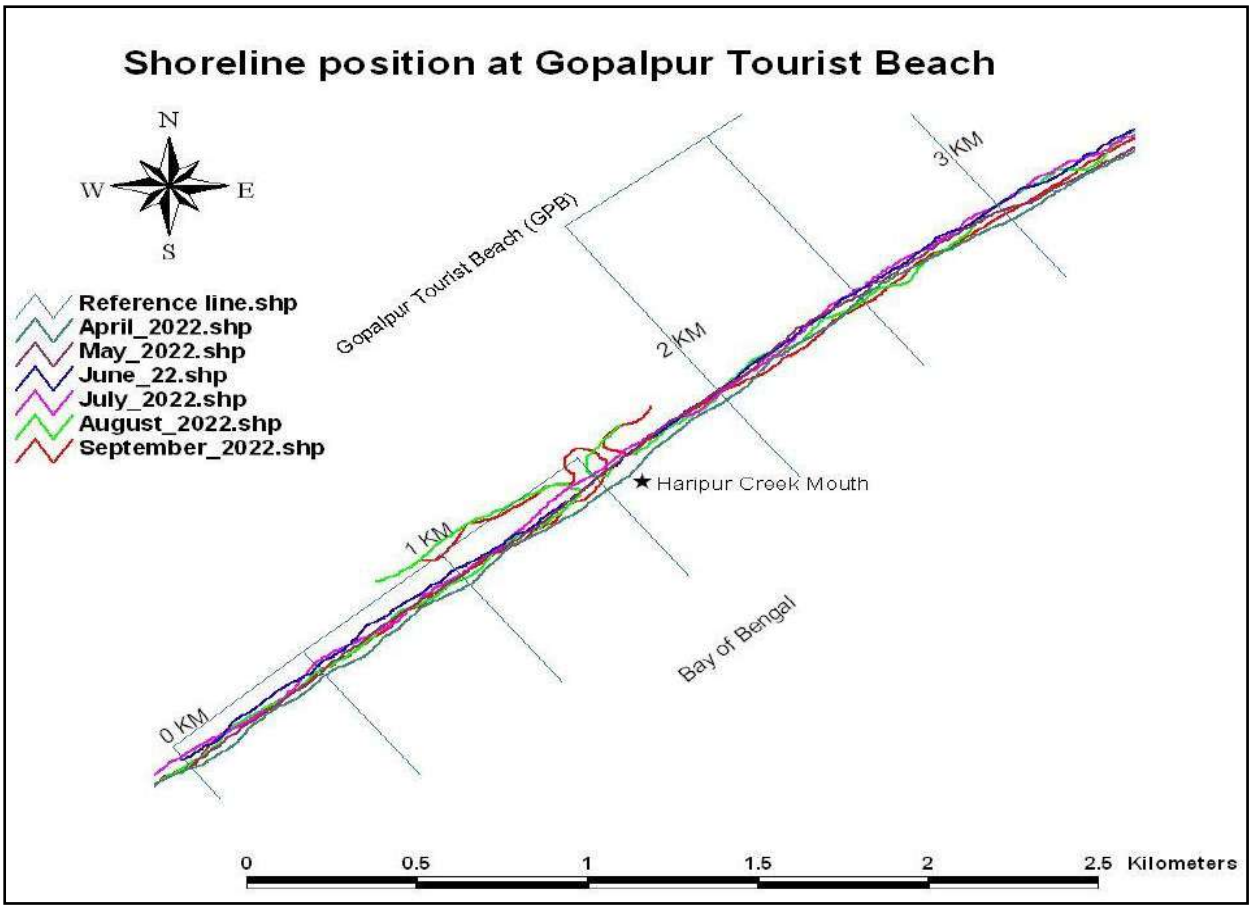

Fig. 3: Shoreline change at tourist beach of Gopalpur beach from April, 2022 to September, 2022

Table 4: Area, perimeter and length of sand spit near Rushikulya Spit during April, 2022 to September, 2022.

Sand Spit			
Month	**Area (Km^2)**	**Perimeter (Km)**	**Length (Km)**
Apr_22	1.27	13.18	6.12
May_22	0.5	7.36	3.25
Jun_22	0.33	5.56	2.5
Jul_22	0.49	6.52	2.86
Aug_22	0.56	7.06	3.06
Sep_22	0.52	7.52	3.28

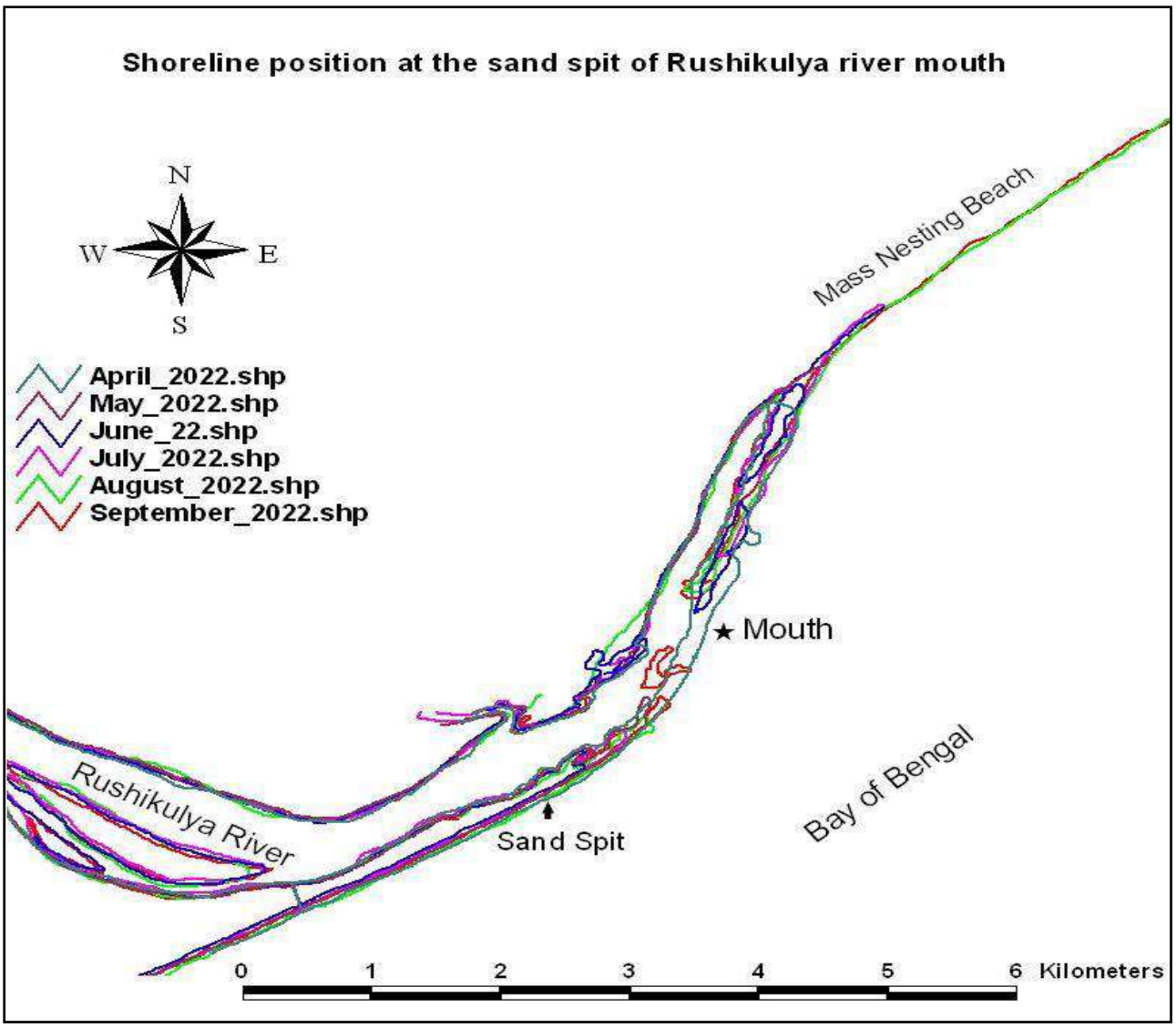

Fig. 4: Shoreline changes at Rushikulya sand spit from April, 2022 to September, 2022.

Table 5: Beach width and volume along Gopalpur port South during April, 2022 to September, 2022.

Month	GPLS_1	GPLS_2	GPLS_3	GPLS_6	GPLS_7	GPLS_8	GPLS_9	GPLS_10
Beach Width (m)								
Apr_22	364.2	230.0	326.8	638.0	549.0	496.3	295.8	225.4
May_22	344.2	229.1	313.5	441.4	539.1	481.7	301.3	219.1
Jun_22	353.1	222.7	306.5	457.2	532.9	473.3	283.5	209.1
Jul_22	349.7	222.7	299.9	450.0	525.1	458.9	283.9	205.9
Aug_22	333.2	204.4	286.8	441.1	510.2	437.9	273.0	198.8
Sep_22	322.4	194.4	264.2	431.6	493.8	418.0	262.5	195.3
Beach Volume (m^3/m)								
Apr_22	1257.8	658.0	765.4	1776.1	1483.9	2103.6	887.4	571.5
May_22	1178.2	632.2	742.0	969.8	1450.1	1992.2	840.7	568.7
Jun_22	1224	649.8	751.3	983.5	1465.8	1958.7	875.0	573.2
Jul_22	1152.7	630.3	704.3	970.2	1384.1	1911.6	850.3	531.7
Aug_22	1069.5	559.1	657.3	928.0	1322.3	1837.9	826.5	512.5
Sep_22	1073.3	548.6	640.0	914.9	1298.1	1761.5	753.3	507.6

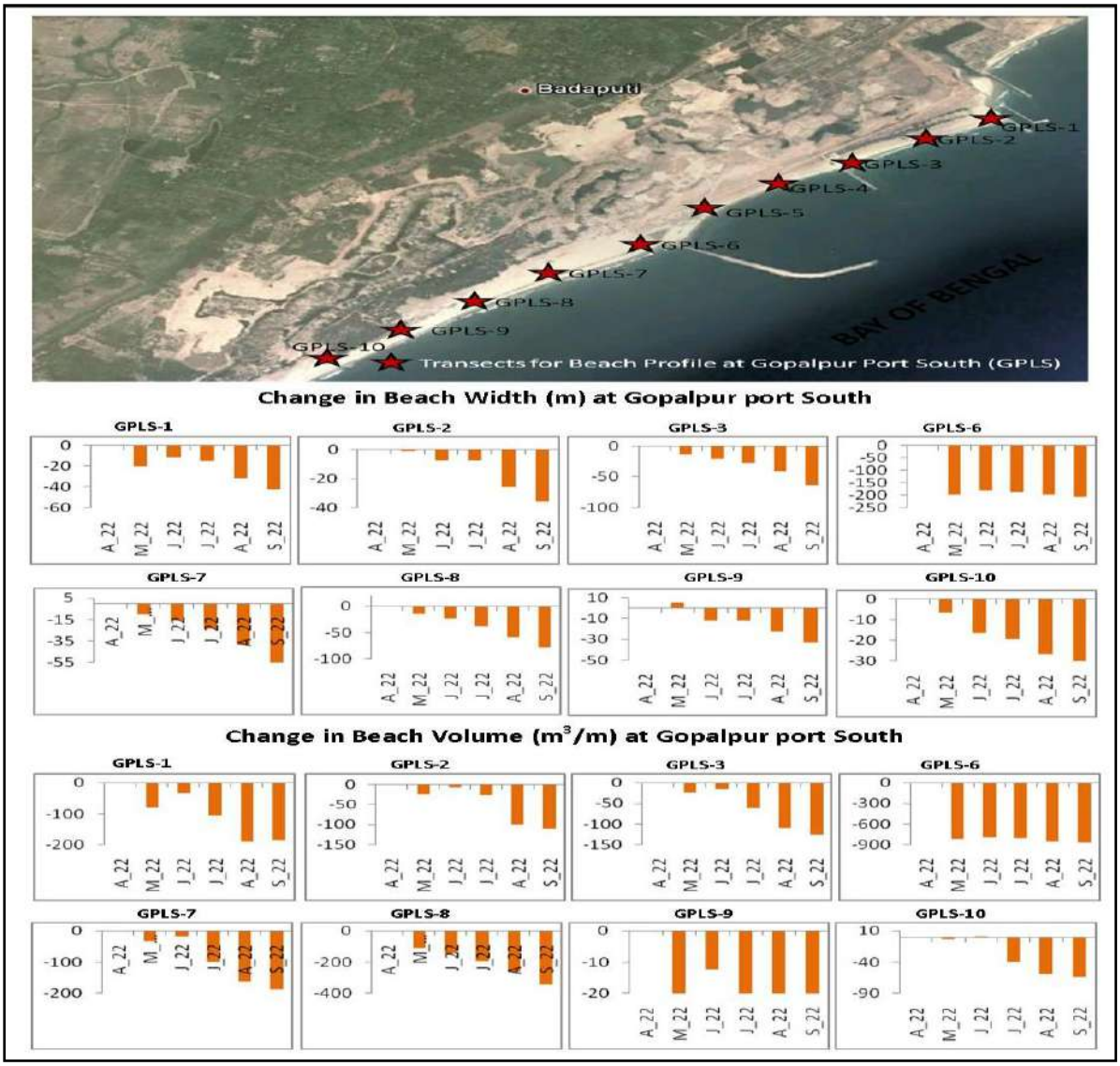

Fig. 5: Beach width and volume changes with respect to April, 2022 at south of Gopalpur port

Table 6: Beach width and volume during April, 2022 to September, 2022 along Gopalpur port north.

Month	GPLN_1	GPLN_2	GPLN_3	GPLN_4	GPLN_5	GPLN_6	GPLN_7	GPLN_8	GPLN_9	GPLN_10
	Beach Width (m)									
Apr_22	86.1	156.2	165.3	132.2	217.4	93.2	166.2	99.8	95.4	90.6
May_22	79.8	148.4	163.9	133.0	207.7	88.8	169.3	96.2	87.2	83.5
jun_22	74.8	140.1	156.7	127.5	200.8	91.2	163.0	96.1	85.4	79.4
Jul_22	70.2	136.5	152.4	118.1	196.4	84.9	151.2	86.9	78.4	81.9
Aug_22	71.2	129.5	147.9	106.2	189.6	78.0	146.2	76.1	72.6	77.9
Sep_22	68.7	125.0	143.8	101.9	193.0	72.0	143.6	73.9	66.4	72.5
	Beach Volume (m3/m)									
Apr_22	393.1	1309.8	1205.1	740.7	1297.3	413.0	1147.6	514.2	384.7	456.2
May_22	394.4	1350.9	1224.6	760.5	1250.9	421.8	1172.0	507.6	381.3	455.6
jun_22	378.9	1300.9	1183.4	715.9	1229.0	408.7	1148.2	521.2	382.8	435.6
Jul_22	375.5	1235.9	1108.7	691.7	1184.1	364.6	1116.5	482.7	342.7	445.7
Aug_22	341.3	1180.1	1061.5	628.4	1167.3	345.1	1063.0	455.0	322.1	413.7
Sep_22	325.3	1123.4	1064.7	606.2	1133.3	323.8	1049.5	439.4	316.5	421.2

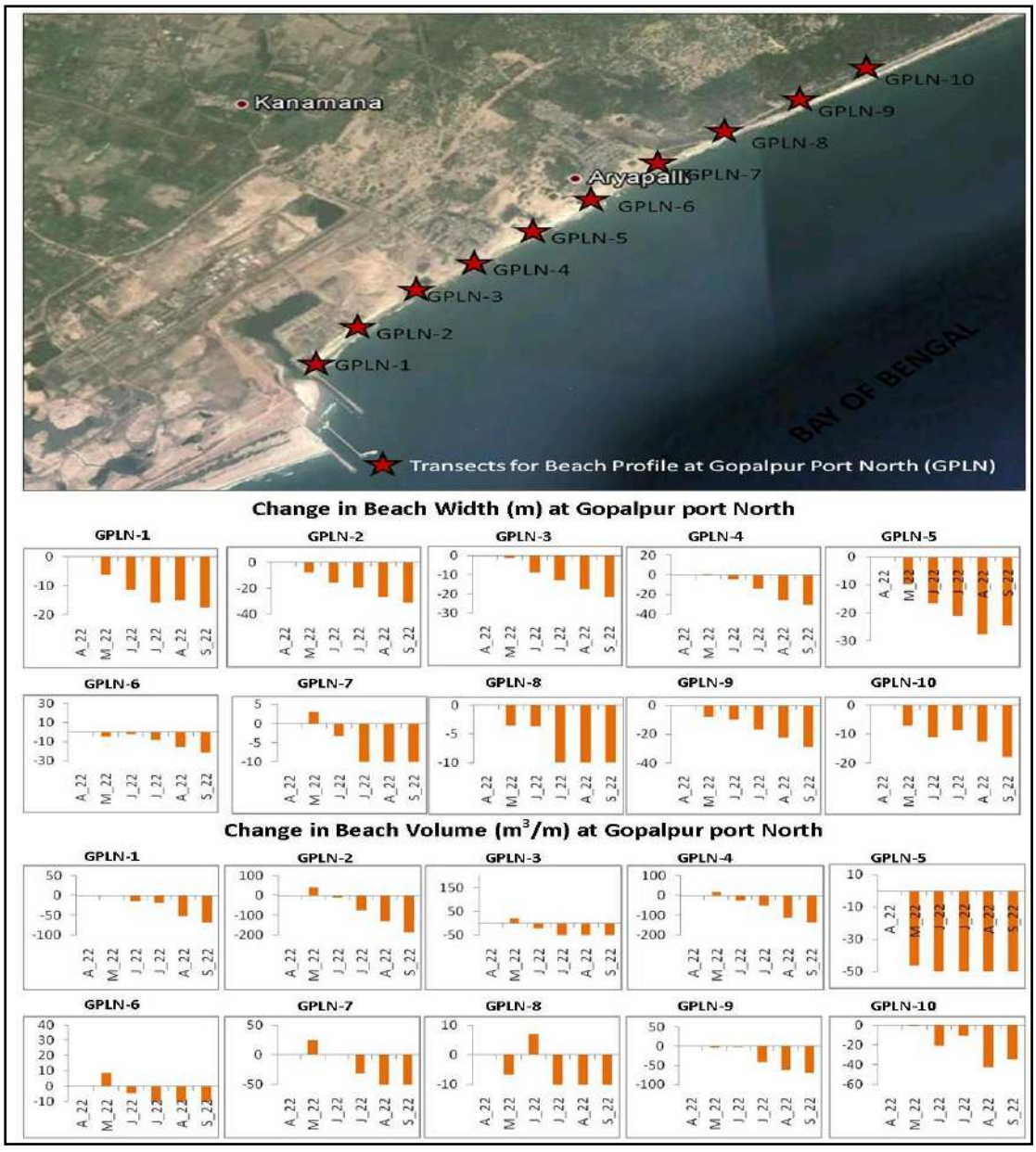

Fig. 6: Beach width and volume changes with respect to April, 2022 at north of Gopalpur port

Table 7: Beach width and volume along Gopalpur tourist beach during April, 2022 to September, 2022.

Month	GPB_1	GPB_2	GPB_3	GPB_4	GPB_5	GPB_6	GPB_7
Beach Width (m)							
Apr_22	44.4	50.7	104.3	104.6	138.7	198.8	196.5
May_22	48.7	54.1	103.1	105.2	133.2	190.6	205.5
Jun_22	43.7	54.0	107.7	104.0	126.3	198.7	286.7
Jul_22	45.3	52.2	100.5	109.9	129.6	193.0	193.6
Aug_22	40.3	49.6	94.9	100.2	119.4	184.9	187.5
Sep_22	32.3	42.6	81.6	92.7	108.9	155.0	170.8
Beach Volume (m3/m)							
Apr_22	90.0	108.6	214.5	97.8	321.6	897.6	517.6
May_22	95.5	116.4	226.1	95.1	316.6	881.6	520.6
Jun_22	90.4	116.6	237.3	95.3	317.5	907.2	542.7
Jul_22	90.0	113.5	224.6	101.3	300.8	899.3	512.4
Aug_22	82.0	110.9	198.5	86.7	284.5	840.2	480.1
Sep_22	77.8	102.1	191.4	78.1	257.7	822.3	467.4

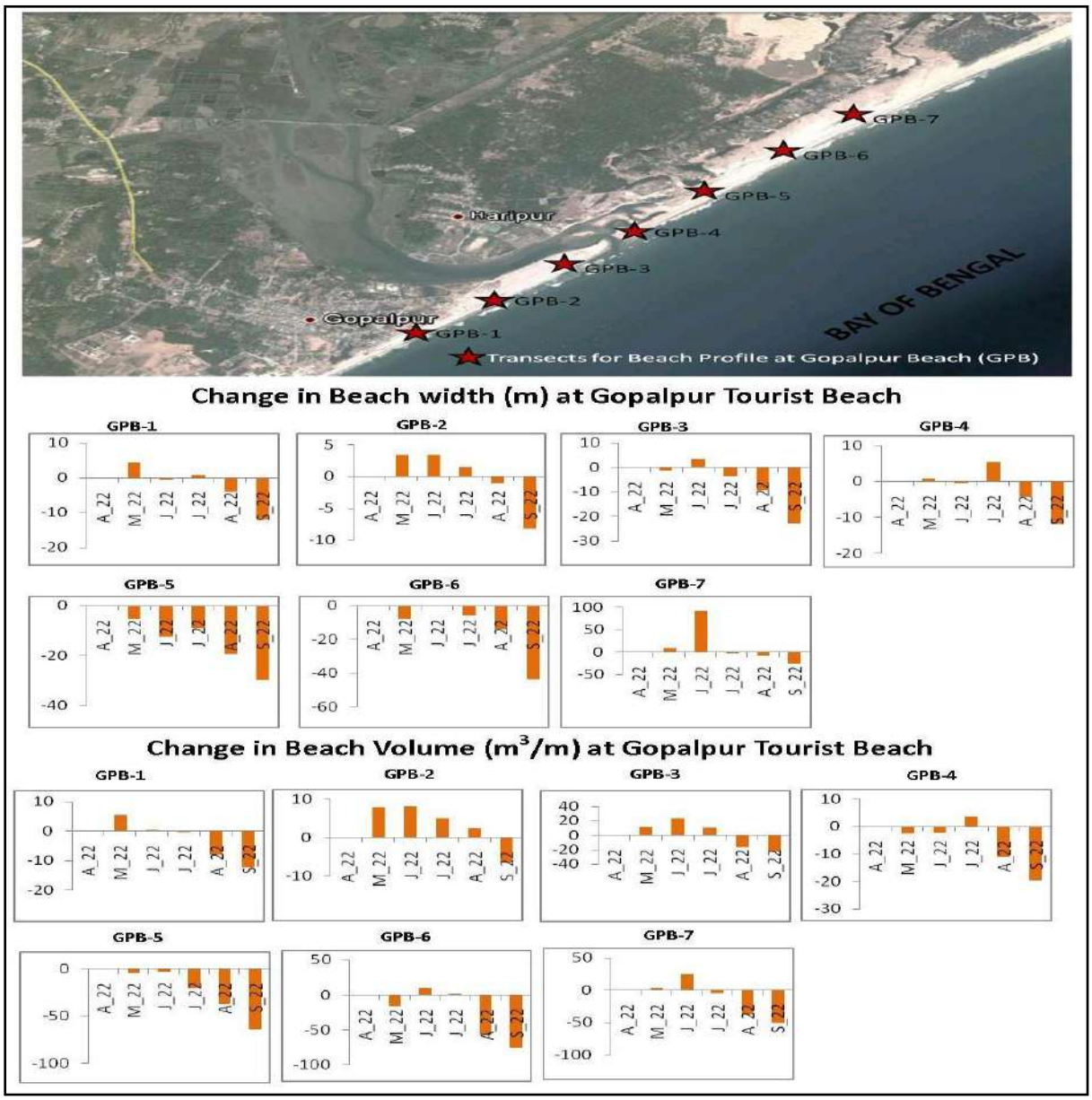

Fig. 7: Beach width and volume changes with respect to April, 2022 at Gopalpur tourist beach.

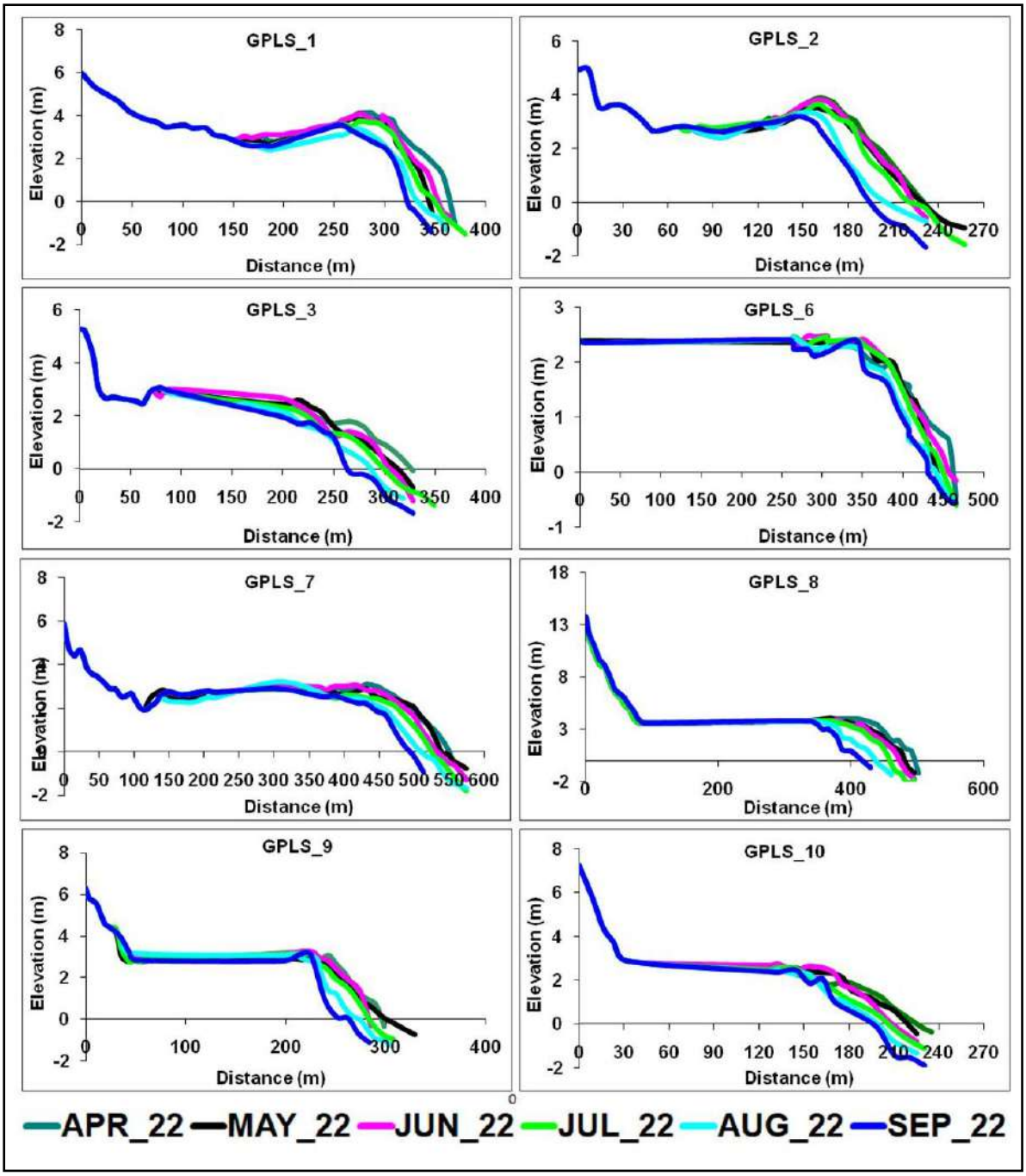

Fig.8: Beach profile at south of Gopalpur port from April, 2022 to September, 2022.

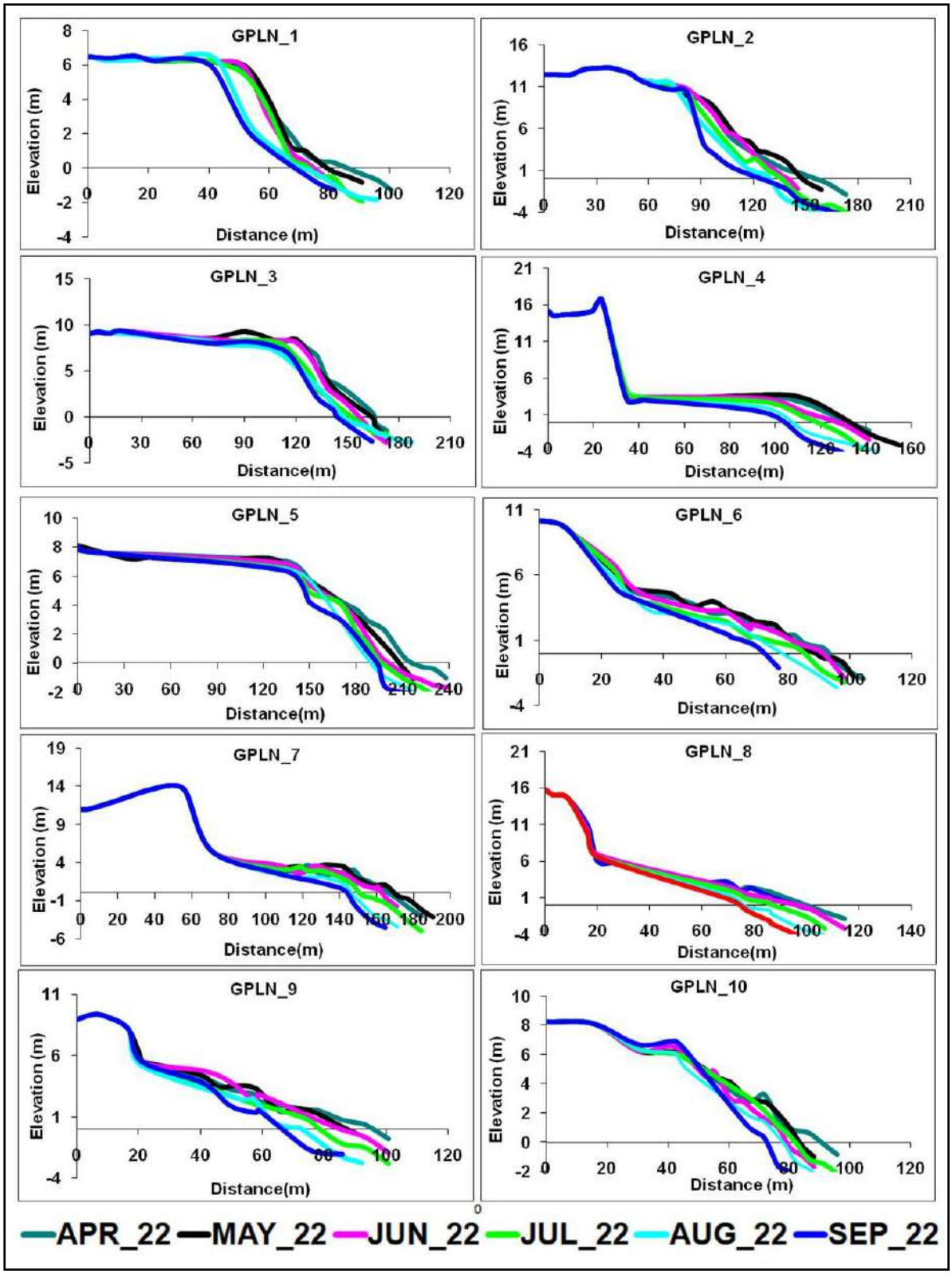

Fig. 9: Beach profile at north of Gopalpur port from April, 2022 to September, 2022

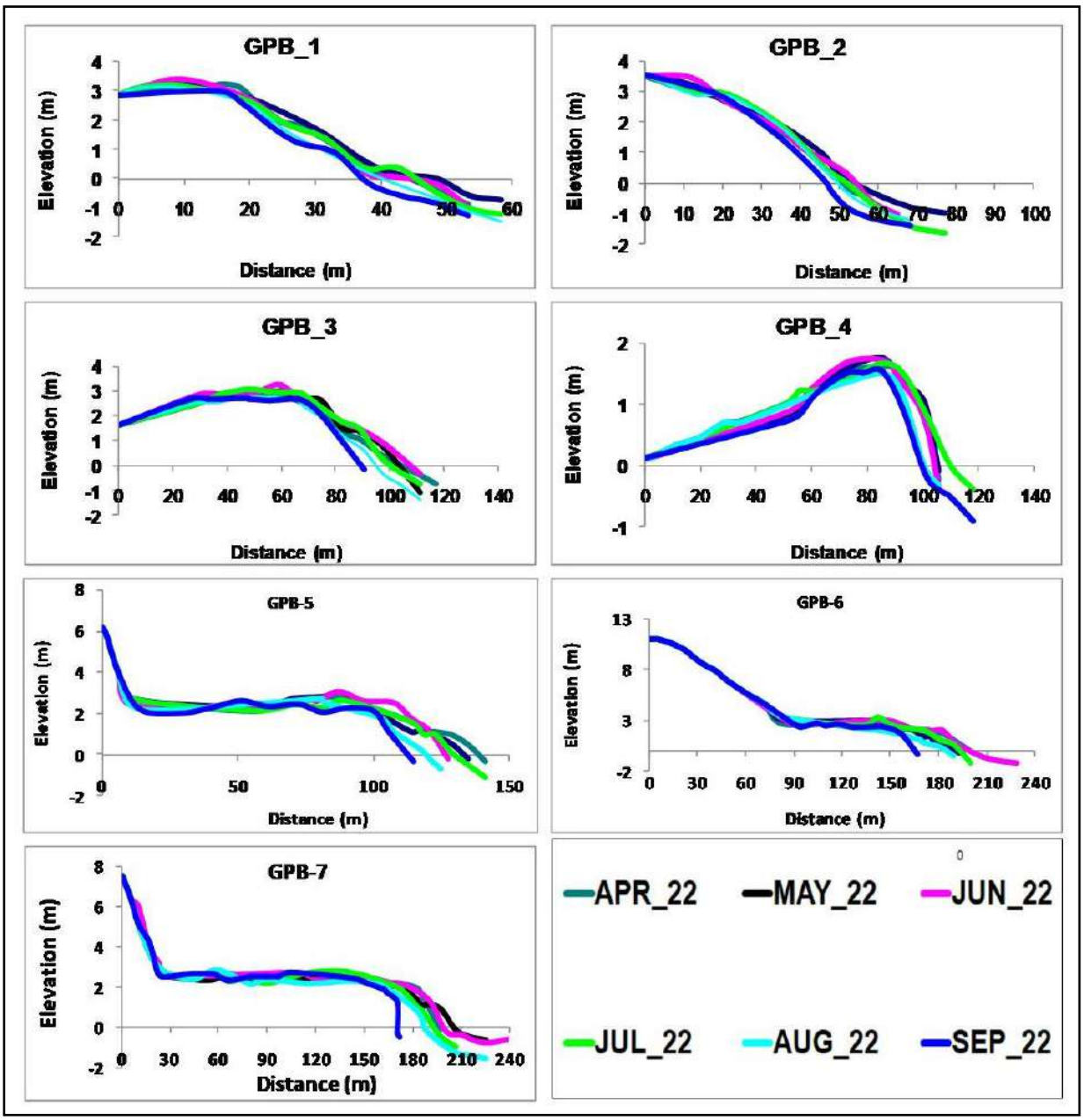

Fig.10: Beach profile at tourist beach of Gopalpur from April, 2022 to September, 2022

2. Sediment Grain size

Table 8: Sediment grain size (Mean, Sorting, Skewness and Kurtosis) at Gopalpur port south, port north, tourist beach and Rushikulya spit from April, 2022 to September, 2022.

	Gopalpur Port South											
	GPLS_1 (0 km)			GPLS_3 (1 km)			GPLS_7 (3 km)			GPLS_9 (4 km)		
	BS	MS	FS	BS	MS	FS	BS	MS	FS	BS	MS	FS
Apr_22	M	M	C	M	M	M	M	M	M	M	M	M
	MDS	MDS	MDS	MDS	MWS	MWS	MWS	MWS	MWS	MDS	MDS	MDS
	CSK	SYM	CSK	SYM	CSK	CSK	SYM	CSK	CSK	SYM	SYM	SYM
	MSK	LPK	MSK	MSK	MSK	LPK	LPK	LPK	MSK	LPK	MSK	PLK
May_22	M	M	M	M	M	M	M	M	M	M	M	M
	PS	MDS	MDS	MDS	MDS	PS	MDS	MDS	MDS	PS	MDS	MDS
	SYM	CSK	CSK	SYM	SYM	SYM	CSK	SYM	CSK	SYM	CSK	CSK
	PLK	LPK	PLK	MSK	PLK	MSK	MSK	MSK	LPK	PLK	LPK	PLK
Jun_22	F	M	M	C	C	M	C	F	M	M	M	M
	WS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS
	CSK	SYM	SYM	CSK	FSK	SYM	CSK	SYM	CSK	FSK	SYM	CSK
	LPK	MSK	LPK	PLK	PLK	MSK	MSK	MSK	MSK	LPK	MSK	MSK
Jul_22	M	C	M	C	M	M	M	M	F	M	F	M
	MWS	MWS	MWS	MDS	MDS	MWS	MWS	MDS	MWS	MDS	MWS	MDS
	SYM	SYM	SYM	FSK	SYM	FSK	SYM	CSK	CSK	SYM	CSK	SYM
	MSK	MSK	MSK	MSK	MSK	MSK	LPK	MSK	MSK	PLK	MSK	LPK
Aug_22	M	M	M	M	M	M	M	M	F	M	M	M
	MWS	MWS	MDS	MDS	MDS	MDS	MWS	MWS	MWS	MWS	MWS	MDS
	SYM	SYM	SYM	FSK	SYM	CSK	SYM	SYM	SYM	SYM	SYM	SYM
	MSK	LPK	MSK	MSK	MSK	LPK	LPK	LPK	MSK	MSK	MSK	MSK
Sep_22	M	M	F	F	F	F	M	F	M	M	M	M
	MWS	MWS	MWS	MWS	MDS	MWS	PS	MWS	MWS	MWS	MWS	MWS
	SYM	SYM	CSK	SYM	SYM	SYM	VSK	SYM	FSK	SYM	SYM	SYM
	MSK	LPK	MSK	LPK	LPK	MSK	LPK	MSK	LPK	LPK	MSK	LPK

	Gopalpur Port North														
	GPLN_1 (0 km)			GPLN_3 (1 km)			GPLN_5 (2 km)			GPLN_7 (3 km)			GPLN_9 (4 km)		
Apr_22	M	M	C	F	M	M	M	M	C	C	F	M	M	M	M
	MDS	MDS	MWS	MWS	MWS	MDS	MDS	MWS	MWS	MWS	MDS	PS	MDS	MDS	MDS
	CSK	SYM	SYM	CSK	SYM	SYM	SYM	SYM	FSK	FSK	CSK	SYM	SYM	CSK	SYM
	MSK	LPK	PLK	LPK	LPK	MSK	PLK	LPK	PLK	MSK	MSK	PLK	MSK	MSK	LPK
May_22	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS	MDS
	SYM	SYM	SYM	CSK	SYM	SYM	CSK	SYM	CSK	SYM	SYM	SYM	CSK	SYM	SYM
	LPK	MSK	MSK	PLK	LPK	MSK	MSK	PLK	MSK	LPK	MSK	MSK	PLK	LPK	MSK
Jun_22	M	M	M	F	M	M	M	F	F	F	M	M	M	C	M
	MWS	MWS	MDS	MWS	MDS	MDS	MWS	MWS	MDS	MDS	MWS	MWS	MDS	MWS	MWS
	SYM	SYM	FSK	SYM	SYM	SYM	SYM	SYM	CSK	CSK	SYM	SYM	SYM	SYM	CSK
	MSK	LPK	MSK	LPK	LPK	MSK	LPK	LPK	LPK	MSK	LPK	LPK	LPK	PLK	LPK
Jul_22	M	M	M	M	M	F	M	C	M	M	C	M	M	C	M
	MWS	MWS	MDS	MWS	MWS	MWS	MWS	MWS	MWS	VWS	MWS	MWS	MWS	MWS	MDS
	SYM	CSK	FSK	CSK	CSK	CSK	CSK	SYM	CSK	FSK	CSK	CSK	FSK	FSK	CSK
	MSK	MSK	MSK	MSK	LPK	VLPK	PLK	PLK	PLK	MSK	PLK	LPK	MSK	LPK	MSK
Aug_22	M	M	F	M	C	M	M	M	M	M	F	M	M	M	M
	MDS	MWS	MWS	MDS	MDS	MDS	MWS	MDS	MDS	MWS	MWS	MDS	MDS	MDS	MDS
	SYM	SYM	SYM	SYM	SYM	SYM	SYM	SYM	CSK	CSK	CSK	CSK	SYM	CSK	SYM
	LPK	MSK	PLK	MSK	MSK	LPK	LPK	MSK	MSK	PLK	MSK	MSK	MSK	MSK	MSK
Sep_22	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
	MDS	MDS	MWS	MWS	WS	MWS	MWS	MDS	MWS	MWS	MWS	MWS	MDS	MWS	MWS
	SYM	CSK	FSK	SYM	FSK	SYM	FSK	CSK	SYM	SYM	SYM	FSK	CSK	SYM	FSK
	PLK	PLK	LPK	LPK	MSK	LPK	MSK	MSK	LPK	LPK	LPK	MSK	MSK	LPK	MSK

	Gopalpur Tourist Beach								
	GPB_2 (1.0 km)			GPB_4 (2.0 km)			GPB_6 (3.0 km)		
	BS	MS	FS	BS	MS	FS	BS	MS	FS
Apr_22	M	F	M	M	F	C	M	M	M
	MDS	MWS	PS	PS	MWS	MWS	MDS	MDS	MWS
	FSK	CSK	SYM	FSK	SYM	SYM	SYM	SYM	CSK
	LPK	LPK	PLK	PLK	MSK	PLK	LPK	MSK	MSK
May_22	C	C	M	M	C	M	C	M	M
	MWS	MDS	MDS	MDS	MWS	MDS	MDS	MDS	MDS
	FSK	SYM	CSK	SYM	SYM	SYM	SYM	CSK	CSK
	PLK	VPK	MSK	LPK	PLK	MSK	MSK	MSK	MSK
Jun_22	M	M	M	M	C	M	M	M	C
	MDS	MDS	MWS	MDS	MWS	MWS	MDS	MDS	MDS
	SYM	SYM	FSK	CSK	SYM	SYM	SYM	SYM	FSK
	MSK	MSK	MSK	MSK	MSK	MSK	MSK	MSK	MSK
Jul_22	M	C	C	M	M	C	C	F	C
	MWS	MWS	MWS	MDS	MWS	MWS	MWS	WS	MWS
	CSK	FSK	CSK	SYM	CSK	FSK	VCSK	SYM	CSK
	MSK	MSK	MSK	LPK	MSK	VLPK	PLK	LPK	MSK
Aug_22	M	M	M	M	M	M	M	M	M
	MWS	MWS	MWS	MDS	MDS	MDS	MWS	MWS	MWS
	SYM	FSK	CSK	SYM	SYM	SYM	SYM	SYM	FSK
	LPK	MSK	MSK	MSK	MSK	MSK	MSK	LPK	MSK
Sep_22	M	M	M	M	M	M	M	M	M
	MDS	MDS	MDS	MDS	MWS	MWS	MDS	MWS	MWS
	FSK	FSK	SYM	SYM	SYM	FSK	SYM	FSK	SYM
	MSK	LPK	MSK	MSK	LPK	LPK	MSK	MSK	LPK

	Rushikulya Spit (SPIT_A)		
	BS	MS	FS
Apr_22	M	M	C
	MDS	MDS	MWS
	SYM	SYM	CSK
	MSK	MSK	PLK
May_22	M	M	M
	MWS	PS	MDS
	VCS	SYM	SYM
	MSK	MSK	MSK
Jun_22	M	M	M
	MWS	MDS	MWS
	CSK	CSK	CSK
	LPK	LPK	LPK
Jul_22	M	M	M
	MDS	MWS	MDS
	CSK	FSK	SYM
	MSK	MSK	MSK
Aug_22	M	M	M
	MDS	MDS	MWS
	CSK	CSK	SYM
	LPK	LPK	MSK
Sep_22	F	F	F
	MWS	MWS	MWS
	SYM	SYM	SYM
	MSK	MSK	MSK

Legends: **Mean:** **Fine Sand (F) Medium Sand (M) Coarse Sand (C) Very Fine Sand (VF)**

Sorting: **Well Sorted (WS) Moderately Well Sorted (MWS) Moderately Sorted (MDS) Poorly Sorted (PS)**

Skewness: Symmetrical (SYM), Coarse Skewed (CSK), Fine Skewed (FSK), VCS-Very coarse skewed

Kurtosis: Platykurtic (PLK), Leptokurtic (LPK), Mesokurtic (MSK), Very Platykurtic (VPK)

3. Littoral Environment Observation

Table 9: Littoral Environmental Conditions along Gopalpur Coast from April, 2022 to September, 2022

Month	Breaker type	Breaker height (m)	Breaker angle (deg)	Wave period (sec)	Wave direction	Uprush (m/s)	Backwash (m/s)	Surf zone width(m)
Gopalpur Tourist Beach								
Apr_22	Spilling	1.16	15	9.09	SSE	1.11	0.99	105
May_22	Plunging	0.82	12	9.87	SSE	1.02	0.97	133
Jun_22	Spilling	1.40	15	10.44	SE	1.15	0.95	120
Jul_22	Plunging	1.56	25	10.24	ESE	1.2	0.9	110
Aug_22	Spilling	1.64	20	9.86	SSE	1.3	1.0	105
Sep_22	Spilling	1.70	25	9.17	SSE	1.15	0.92	100
Gopalpur Port								
Apr_22	Plunging	1.37	15	10.02	SE	1.19	0.97	115
May_22	Spilling	1.06	0	10.92	SE	0.88	0.68	110
Jun_22	Plunging	1.36	5	9.35	SE	1.01	0.76	100
Jul_22	Spilling	1.40	20	12.43	SSE	1.3	1.01	105
Aug_22	Spilling	1.56	20	11.62	SE	1.2	0.93	110
Sep_22	Plunging	1.50	22	9.06	S	1.27	0.90	105
Rushikulya Mouth								
Apr_22	Spilling	1.34	10	8.92	ESE	1.13	1.04	90
May_22	Plunging	1.58	10	14.45	SSE	1.36	0.90	110
Jun_22	Plunging	1.52	15	11.08	SE	1.37	0.93	95
Jul_22	Plunging	1.66	15	11.95	SSE	1.39	1.08	90
Aug_22	Plunging	1.58	14	10.19	SE	1.15	1.06	85
Sep_22	Spilling	1.63	20	9.35	SSE	1.37	1.05	88

4. Ambient Air Quality and noise level

Table 10: STATION-A (19^0 17' 18.69''N, 84^0 56'41.82''E) near southern breakwater (PM- Particulate matter, SO_2-Sulphur dioxide, NO_2-Oxides of nitrogen)

STATION-A	Date	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	Noise level (dB)
Apr_22	03.04.2022	87.63	29.61	2.04	2.98	66.16
	04.04.2022	82.64	28.37	1.92	2.59	53.18
	14.04.2022	71.92	34.92	3.11	2.67	54.16
	15.04.2022	78.39	28.66	2.67	3.16	43.11
	20.04.2022	86.37	24.61	3.15	3.07	59.22
	21.04.2022	88.58	32.88	3.22	2.45	58.49
	23.04.2022	76.52	33.16	2.94	2.99	48.67
	27.04.2022	79.64	27.94	2.86	3.18	68.67
May_22	03.05.2022	90.35	38.42	1.35	1.94	58.61
	04.05.2022	86.53	32.64	2.07	2.56	65.28
	14.05.2022	88.59	29.46	1.92	2.18	42.61
	15.05.2022	76.28	30.18	3.45	2.37	50.18
	20.05.2022	81.67	34.19	4.08	3.07	49.27
	21.05.2022	83.46	28.58	3.59	2.99	61.37
	26.05.2022	72.38	27.11	2.48	3.28	54.19
	27.05.2022	77.59	28.43	3.07	2.59	63.75
Jun_22	05.06.2022	85.35	42.31	2.35	2.07	52.16
	06.06.2022	94.26	39.16	2.46	2.49	54.38
	16.06.2022	92.46	38.16	3.19	3.07	62.19
	17.06.2022	88.37	28.18	1.94	2.37	66.37
	20.06.2022	91.38	36.22	3.76	1.08	65.43
	21.06.2022	75.38	24.38	3.94	2.75	68.46
	28.06.2022	90.18	37.19	4.08	1.94	54.93
	29.06.2022	79.38	23.49	3.33	2	57.39
July_22	04.07.2022	82.34	38.61	3.16	2.67	63.18
	05.07.2022	91.64	34.29	2.15	2.91	62.81
	12.07.2022	88.37	27.58	2.33	3.43	68.19
	13.07.2022	87.58	29.88	3.07	2.66	70.46
	22.07.2022	82.37	30.46	3.45	2.37	68.44
	23.07.2022	84.28	28.91	2.98	0.68	70.94
	25.07.2022	77.35	22.67	2.46	2.41	62.43
	26.07.2022	84.22	25.61	3.16	1.93	57.29
Aug_22	02.08.2022	76.51	28.61	2.34	1.94	58.23
	03.0.2022	83.29	30.18	3.15	2.61	62.48
	09.08.2022	88.64	24.28	2.19	1.64	45.92
	10.08.2022	86.35	26.51	2.64	2.18	68.49
	16.08.2022	90.18	19.73	2.57	3.16	52.37
	17.08.2022	87.65	22.35	1.64	3	58.91
	29.08.2022	90.42	29.48	1.92	2.84	66.28
	30.08.2022	79.33	20.82	1.85	2.43	68.57
Sept_22	01.09.2022	72.38	18.37	3.19	2.37	62.37
	02.09.2022	74.29	28.64	2.84	2.67	58.33
	07.09.2022	68.27	31.08	1.95	2.61	51.08
	08.09.2022	63.57	27.61	3.07	3.49	48.39
	12.09.2022	80.15	25.39	2.92	3.22	70.19
	13.09.2022	82.67	22.81	2.84	2.57	52.18
	19.09.2022	84.39	29.61	3.18	3.41	60.72
	20.09.2022	79.27	19.27	4.91	2.22	58.94
Mean (Range)		**82.73 (63.57-94.26)**	**29.19 (18.37-42.31)**	**2.81 (1.35-4.91)**	**2.57 (0.68-3.49)**	**59.28 (42.61-70.94)**
Reference value (NAAQS, 2009)		**100**	**60**	**80**	**80**	**70-75 (Env. Protection Act, 1986)**

Table 11: STATION-B (19^0 17' 48.1''N, 84^0 57' 03.3''E) near intermediate breakwater

Stattion-B	Date	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	Noise level (dB)
Apr_22	03.04.2022	83.94	28.67	3.27	3	58.49
	05.04.2022	83.29	29.46	2.55	2.46	60.18
	12.04.2022	76.46	25.76	3.67	2.58	64.38
	13.04.2022	75.81	30.46	2.94	2.49	54.29
	20.04.2022	79.16	32.94	2.56	3.16	68.16
	21.04.2022	80.49	30.16	3.07	2.42	50.5
	23.04.2022	85.91	27.64	3.11	2	54.62
	27.04.2022	82.73	29.46	2.64	3.48	49.38
May_22	03.05.2022	70.59	26.15	2.66	2.99	48.22
	04.05.2022	84.28	28.34	3.16	3.46	52.49
	14.05.2022	81.61	24.22	2.95	3.57	62.37
	15.05.2022	91.38	30.19	2.83	2.58	66.57
	20.05.2022	78.49	29.43	3.08	2.37	58.43
	21.05.2022	84.92	27.68	3.51	2.68	61.33
	26.05.2022	84.38	30.19	2.99	3.55	64.82
	27.05.2022	76.59	28.43	3.48	2.82	59.51
Jun_22	05.06.2022	82.58	30.16	3.07	3.13	51.39
	06.06.2022	84.67	28.67	2.16	2.58	46.18
	16.06.2022	72.69	24.39	2.95	2.88	48.38
	17.06.2022	70.46	33.19	2.43	3.18	54.39
	20.06.2022	88.91	38.43	3.28	3.07	61.94
	21.06.2022	90.46	24.39	2.78	2.94	58.19
	28.06.2022	73.67	22.46	3.16	2.85	51.38
	29.06.2022	74.99	27.94	3.44	3.42	49.57
July_22	04.07.2022	84.26	32.67	2.84	2.04	58.19
	05.07.2022	87.38	30.16	2.92	2.38	64.22
	12.07.2022	88.46	29.46	2.46	2.16	63.49
	13.07.2022	75.29	27.66	3.18	2.38	70.94
	22.07.2022	77.16	24.92	3.07	3.14	58.94
	23.07.2022	82.48	31.64	3.24	2.67	62.75
	25.07.2022	80.57	30.18	2.99	2.93	67.39
	26.07.2022	79.22	24.38	2.84	1.86	62.75
Aug_22	02.08.2022	86.49	29.64	2.64	3.07	62.94
	03.0.2022	84.38	25.43	2.53	1.29	68.27
	09.08.2022	75.46	22.94	1.63	2.46	64.39
	10.08.2022	77.29	31.08	1.28	2.82	71.94
	16.08.2022	82.46	30.68	2.76	1.99	59.49
	17.08.2022	67.66	31.02	2.43	3.07	68.24
	29.08.2022	85.91	24.64	3.08	2.18	61.38
	30.08.2022	92.55	23.91	2.84	2.08	57.95
Sept_22	01.09.2022	79.38	27.64	1.99	2.64	57.28
	02.09.2022	62.37	24.59	2.64	2.91	68
	07.09.2022	69.48	30.19	2.76	3.18	53.42
	08.09.2022	61.38	24.33	3.19	3.27	65.27
	12.09.2022	84.09	31.07	2.82	3.66	58.64
	13.09.2022	56.81	21.64	3.44	2.83	61.57
	19.09.2022	76.27	28.67	3.91	2	57.08
	20.09.2022	79.33	18.94	1.67	3.46	64.27
Mean (Range)		**79.47 (56.81-92.55)**	**28.05 (18.94-38.43)**	**2.85 (1.28-3.91)**	**2.75 (1.29-3.66)**	**59.67 (46.18-71.94)**
Reference value (NAAQS, 2009)		**100**	**60**	**80**	**80**	**70-75 (Env. Protection Act, 1986)**

_Table 12: STATION-C (19^0 18' 29.0''N, 84^0 57' 41.1''E) near signal station/Environmental Laboratory

STATION-C	Date	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	Noise level (dB)
Apr_22	06.04.2022	90.16	32.69	3.22	3.41	62.38
	07.04.2022	96.38	35.16	3.16	2.18	72.49
	17.04.2022	86.19	25.67	2.15	2.86	70.16
	19.04.2022	85.37	29.46	3.46	2.94	52.37
	24.04.2022	90.19	30.46	3.18	2.64	64.28
	25.04.2022	95.67	35.82	2.99	3.33	72.19
	26.04.2022	98.37	33.16	3.75	2.49	46.16
	30.04.2022	89.84	24.61	2.42	2.99	52.81
May_22	05.05.2022	92.46	30.18	2.81	2.94	62.38
	07.05.2022	95.38	32.61	2.62	2.73	68.27
	16.05.2022	82.64	28.46	3.07	3.49	62.94
	17.05.2022	94.38	30.85	2.88	3.17	66.49
	24.05.2022	90.19	32.46	3.42	3.45	64.25
	25.05.2022	88.37	29.16	3.73	3.27	70.46
	30.05.2022	94.37	33.28	2.66	3.28	64.83
	31.05.2022	95.67	32.94	3.94	2.88	72.16
Jun_22	07.06.2022	90.19	32.94	2.94	3.72	68.48
	08.06.2022	86.37	28.49	3.16	3.49	62.57
	18.06.2022	94.28	31.67	3.28	2.84	71.95
	19.06.2022	99.82	38.44	3.49	3.85	70.43
	23.06.2022	99.18	36.14	2.68	3.76	68.49
	24.06.2022	87.66	27.46	2.59	2.49	66.88
	26.06.2022	83.67	29.48	2.84	3.49	70.42
	27.06.2022	84.79	30.44	3.49	3.19	73.95
July_22	01.07.2022	84.37	29.54	3.85	2.99	67.29
	02.07.2022	88.64	26.42	2.94	3.16	68.27
	08.07.2022	85.19	27.68	2.99	3.42	59.43
	09.07.2022	76.27	25.46	1.08	2.59	58.37
	15.07.2022	92.49	34.82	3.61	2.37	72.46
	16.07.2022	93.57	37.99	3.57	1.95	69.49
	27.07.2022	97.33	35.18	2.84	2.41	67.29
	28.07.2022	81.28	28.49	3.46	2.28	69.46
Aug_22	04.08.2022	76.18	28.61	2.22	3.27	72.94
	05.08.2022	88.51	31.94	2.38	3.18	69.43
	11.08.2022	94.37	32.48	1.05	3.64	58.28
	12.08.2022	92.67	27.54	3.18	2.91	70.64
	19.08.2022	84.38	32..15	3.46	2.53	69.57
	20.08.2022	82.67	30.46	2.91	2.81	72.67
	24.08.2022	98.52	34.61	2.58	2.57	57.39
	25.08.2022	93.48	30.55	3.73	2.88	60.81
Sept_22	04.09.2022	81.39	27.62	3.07	1.95	70.42
	05.09.2022	86.75	29.38	3.19	2.67	68.27
	16.09.2022	82.64	20.18	2.58	3.18	58.37
	17.09.2022	75.92	18.37	2.46	2.61	54.29
	22.09.2022	67.28	34.09	2.94	2.99	61.84
	23.09.2022	75.22	24.33	3.54	3.18	68.19
	27.09.2022	69.57	32.05	1.88	3.07	52.66
	28.09.2022	88.57	34.24	2.67	2.82	58.91
Mean (Range)		**88.10 (67.28-99.82)**	**30.51 (18.37-38.44)**	**2.97 (1.05-3.94)**	**2.97 (1.95-3.85)**	**65.30 (46.16-73.95)**
Reference value (NAAQS, 2009)		**100**	**60**	**80**	**80**	**70-75 (Env. Protection Act, 1986)**

Table 13: STATION-D (19^0 18' 50.09''N, 84^0 58'09.12''E) near the entrance gate of Gopalpur port

STATION-D	Date	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	Noise level (dB)
Apr_22	06.04.2022	92.64	28.46	3.67	2.07	52.64
	07.04.2022	87.62	25.37	2.94	2.67	55.59
	17.04.2022	88.58	29.48	4	3.16	62.19
	19.04.2022	76.19	26.43	3.49	4.09	57.54
	24.04.2022	88.54	24.66	3.15	3.52	71.29
	25.04.2022	91.64	28.74	2.94	1.99	42.64
	26.04.2022	81.67	27.39	3.41	2.67	70.46
	30.04.2022	76.49	32.91	3.68	2.83	51.83
May_22	05.05.2022	82.64	27.99	2.88	2.07	61.94
	07.05.2022	87.19	26.37	2.49	2.19	56.77
	16.05.2022	94.28	25.61	3.19	2.46	58.34
	17.05.2022	79.42	27.82	3.84	1.07	42.92
	24.05.2022	81.38	25.46	3.59	3.28	72.64
	25.05.2022	89.46	23.78	2.88	3.19	68.11
	30.05.2022	78.22	27.61	2.79	2.72	62.49
	31.05.2022	92.38	30.49	3.07	3.49	72.68
Jun_22	07.06.2022	72.36	26.45	3.17	2.67	58.46
	08.06.2022	81.37	28.67	2.67	1.97	55.39
	18.06.2022	80.16	26.49	2.33	1.88	64.94
	19.06.2022	79.16	22.15	2.94	2.43	67.39
	23.06.2022	72.46	28.43	1.8	3.49	58.43
	24.06.2022	88.39	25.37	3.46	3.19	65.84
	26.06.2022	72.67	22.99	2.82	2.85	63.49
	27.06.2022	62.49	32.67	2.38	2.64	59.82
July_22	01.07.2022	80.16	28.37	2.84	1.95	52.49
	02.07.2022	78.29	25.81	2.63	1.38	63.48
	08.07.2022	85.37	28.49	2.88	2.18	54.29
	09.07.2022	94.66	30.18	1.95	2.07	68.33
	15.07.2022	73.51	24.22	3.07	2.34	65.19
	16.07.2022	74.33	24.64	3.55	2.19	49.27
	27.07.2022	69.81	20.49	2.11	1.09	59.43
	28.07.2022	70.64	21.92	2.63	1.84	68.76
Aug_22	04.08.2022	86.27	27.29	2.07	2.08	63.48
	05.08.2022	74.91	25.48	1.64	2.49	68.91
	11.08.2022	77.38	22.38	2.94	2.37	54.29
	12.08.2022	72.82	27.37	3.17	1.94	57.39
	19.08.2022	80.49	29.37	2.58	1.59	61.28
	20.08.2022	85.67	31.05	2.61	3.04	54.39
	24.08.2022	64.18	27.61	2.38	2.09	48.94
	25.08.2022	62.57	20.92	1.94	3.48	51.61
Sept_22	04.09.2022	69.18	18.67	2.48	2.37	55.28
	05.09.2022	62.37	24.39	3.27	2.64	57.64
	16.09.2022	58.64	27.84	3.56	3.42	60.19
	17.09.2022	70.91	19.37	2.08	4.05	64.22
	22.09.2022	64.28	28.61	2.46	2.66	67.39
	23.09.2022	58.66	25.99	2.92	2.57	57.19
	27.09.2022	82.91	27.38	3.11	2.92	54.33
	28.09.2022	72.68	17.64	3.84	3	62.91
Mean (Range)		**78.09 (58.64-94.66)**	**26.19 (17.64-32.91)**	**2.88 (1.64-4.0)**	**2.55 (1.07-4.09)**	**59.89 (42.64-72.68)**
Reference value (NAAQS, 2009)		**100**	**60**	**80**	**80**	**70-75 (Env. Protection Act, 1986)**

5. Harbour Water Quality

Table 14: Physico-chemical parameters near horbour area (Latitude- 19^0 $17^{'}$ $21^{''}$ N/Longitude-84^0 $56^{'}$ $55^{''}$E) from April, 2022 to September, 2022.

Water parameters	Apr_22	May_22	Jun_22	Jul-22	Aug_22	Sep_22	Range	Mean	Standard	Methods
pH	7.76	8.03	7.70	7.68	7.73	7.79	7.68-8.03	7.78	6.5-9[1]	Microprocessor based pH system Model 1012
DO (mg/l)	4.51	7.02	6.77	5.48	6.19	6.84	4.51-7.02	6.14	> 3mg/L[1]	Winkler's Titration method following Grasshoff et al (1999)
Colour & Odour	Bluish & Odourless	Bluish & Odourless	Bluish & Odourless	Brownish & Odourless	Brownish & Odourless	Bluish & Odourless	----------			-------
BOD (mg/L)	1.94	3.61	3.16	3.87	3.55	2.91	1.94-3.87	3.17	< 5 [1]	Winkler's Titration method following Grasshoff et al. (1999)
Salinity (PSU)	34.99	35.20	34.62	33.75	32.71	33.15	32.71-35.2	34.07	--	Mohr-Knudsen Argentometric titration method
EC (mS/Cm)	51.64	52.39	50.84	50.46	49.39	50.06	49.39-52.39	50.80	--	Hanna HI 98194 portable multi parameter water quality meter
TDS (PPT)	32.17	34.39	31.29	34.56	36.18	29.41	29.41-36.18	33.00	--	Hanna HI 98194 portable multi parameter Water Quality meter
TSM($g.l^{-1}$)	1.142	1.093	1.134	1.669	1.768	2.004	1.093-2.004	1.47	--	Filtration method using Vacuum pump and filtration unit
Sulphate (mg/L)	988	126.1	220	123.9	1232	1323	123.9-1323	668.83	--	APHA 4500 SO_4^{2-}E
Phosphate (mg/ L)	<0.01	<0.01	<0.01	<0.01	0.008	0.005	0.005-0.008	0.01	0.1 mg/L[2]	APHA 4500 PD
Nitrate (mg/L)	1.35	1.6	0.78	1.7	1.32	1.37	0.78-1.7	1.35	1.0 mg/L[2]	APHA 4500 NO_2 E
Chloride (mg/L)	18297	1815	1852	1862	13044	14038	1815-18297	8484.67	--	APHA 4500 CL^- B
PHC (mg/L)	0.13	0.11	0.12	0.12	0.16	0.14	0.11-0.16	0.13	10 mg/L[1]	EPA 3510
Lead(mg/L)	0.003	0.005	0.005	0.005	0.57	1.07	0.003-1.07	0.28	0.1 mg/L[3]	APHA 311 B.C
Mercury (mg/L)	0.002	0.001	0.001	0.001	0.002	0.001	0.001-0.002	0.00	0.01 mg/L[3]	APHA 5500 Hg
Hexavalent Chromium(mg/L)	0.02	0.01	0.01	0.01	0.02	0.04	0.01-0.04	0.02	0.1 mg/L[3]	APHA 3500 Cr B

Sources:

[1] Primary water quality criteria for class SW-IV waters (Harbour) as per EPA, 1986

[2] Guidelines for coastal water quality, Dept. of Environment, Govt. of India, General notice no 620 of 1999.

[3] Central Pollution Control Board, Pollution Control Acts, Rules and Notifications, Fourth Edition, Ministry of Environment and Forests, 2001, 897pp.

6. Sediment and Soil analysis report

Table 15: Sediment quality at harbour area from April, 2022 to September, 2022

Sediment parameters	Apr_22	May_22	Jun_22	Jul-22	Aug_22	Sep_22	Range	Mean	Methods
Texture (Mean, sorting, skewness, kurtosis)	M MDS SYM LPK	M MDS SYM PLK	F MWS CSK LPK	F MWS SYM LPK	VF WS SYM MSK	F MWS SYM MSK	……	……	Sieve Analysis method using RETSCH AS 200
pH	5.5	5.88	5.32	5.97	6.98	6.72	5.32-6.98	6.06	Potentiometric method
Sodium (mg/kg)	523	479	482	466.0	110	84	84-523	357.33	Flame photometry
Potassium (mg/kg)	19.7	12.8	16.4	12.2	29	25	12.2-29	19.18	Flame photometry
Phosphate (mg/kg)	0.02	0.03	0.03	0.03	0.108	0.103	0.02-0.108	0.05	Methods of analysis of soil by HLS Tandon*
Chlorides (mg/kg)	373	238	255	246	180	150	150-373	240.33	USDA:1954 US -affirmed 2010
Sulphates (mg/kg)	85.2	121.5	123.2	123.8	63	52	52-123.8	94.78	Methods of analysis of soil by HLS Tandon*
PHC (µg/L)	0.006	0.004	0.004	0.005	0.005	0.007	0.004-0.007	0.01	UNEP 1992
Lead (mg/kg)	0.16	0.13	0.13	0.14	1.59	1.6	0.13-1.6	0.63	EPA 3050 B
Mercury (mg/kg)	0.004	0.003	0.003	0.003	0.004	0.005	0.003-0.005	0.00	EPA 3050 B
Hexavalent chromium (mg/kg)	0.03	0.05	0.05	0.05	0.07	0.09	0.03-0.09	0.06	Methods of analysis of soil by HLS Tandon*
Organic carbon (%)	0.09	0.11	0.12	0.12	0.18	0.12	0.09-0.18	0.12	Methods of analysis of soil by HLS Tandon*

*Methods of analysis of Soils, Plants, Waters, Fertilizers and organic manures by HLS Tandon published by FDCO, New Delhi, 1993.

BDL- Below Detectable Limits: Phosphate<0.2 (mg/kg), PHC <0.01(µg/L), Mercury <0.01 (mg/kg), Hexavalent chromium <0.2 (mg/kg)

Texture legends as per table 8.

7. Biological parameters

Table 16: Biological parameters from April, 2022 to September, 2022

Station	Parameters	Results (April, 2022 to June, 2022) (Value in average)	Results (July, 2022 to September, 2022) (Value in average)
Harbour Area Latitude- $19^0\ 17'\ 21''$ N Longitude- $84^0\ 56'\ 55''$ E	Light penetration (m)	1.6	1.1
	Chlorophyll (mg/m^3)	2.1	1.432
	Primary productivity ($g.C/m^3/hr$)	0.052	0.02
	Phytoplankton (no. of cells/l)	960	458
	Zooplankton (no. of individuals/l)	71	32
	Benthic meiofauna (per m^2)	3864	6400
	Benthic macrofauna (per m^2)	4400	24900

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