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Analysis of Marine Pollution in Ennore Region (Chennai)

B.Naveen karthik, V.Mirunalini, J. Oliver Paul nayagam, S.Kabilashasundari

Abstract: Shipping and Ports plays a critical role in coastal development; though, it retains several probable hazards to the coastal region and its environment. Sustainable growth is an important idea which incorporates the multiple extremity line: social, environmental, and economic components into entire features of decision making. There is frequent oil spillage occurring in marine water that leading to adversative influence over the aquatic ecosystem. The interception of industrials wastes in marine water highly impacts the living of people and marine ecosystem. Because of impact of marine effluence, the economic progress of fisherman has also been reduced. This study aids to recognize the impurity load in marine water. The key aim of the research is to scrutinize the marine effluence in Ennore region that influences the surrounding environment, to study complete data of Ennore region and to suggest a various solution for prevention of marine effluence and to grow a conceptual tool for achieving sustainable development.

Index Terms: Sustainable development; Marine pollution; Air pollution

I. INTRODUCTION

The concern of globalization over sustainable and environmental growth is residues the Indian evolution. Because of improved foreign and export exchange, reducing industrial production for entry of barriers, revenues, foreign production and enterprises, reducing public spending and expanding privatization. The India's economic climate has led to a devastating impact on its natural resources, mainly faster, exploitation of resources, and loss of wealth, land, commercialization, water resources, expansion of industries, wind, agriculture, urbanization and high level migration. Modern customers seek lifestyle regarding on consciousness, convenience, and product reductions, resource efficiency and waste generation have led to further progress (Duraisamy and Latha, 2011).

The pollutions of marine happen once possibly harmful impacts may consequence as of the access obsessed by aquatic of particles, residential, chemicals, agricultural and industrial trashes or the kind of aggressive organisms. Maximum resources of sea pollution are air-scattered debris and land-based agricultural run. Many potential poisonous chemicals are committed to the minute content, which are taken by Benthos animals and Plankton, with maximum pledge and sieve feed, poisons leading to the most deprivation of food chains, ocean, and many associations of chemicals, O2, instigating estuaries to convert absorbent. While pesticides are combined with marine ecosystems, pesticides are rapidly integrated into the seafood web, when the food web; pesticides can source changes, which might not safe for whole food web, including humans. Poisoned metals are introduced as seaweed cycles, which also rise in advance of tissue material, regeneration, behaviour, biochemistry and marine life, and many animal foods in situation of most fish meat, in which the sea poisons are transported to animals indigenous and later found in dairy and meat products (Pooja Mandal, 2014).

The port area makes it easy, the port area makes it easier, the cargo and the transit unloading and loading, the heavy vehicular traffic, the fishing harbour continuously functioning in active practices, wedding halls, schools, shops, commercial establishments, hospitals, small restaurants, certain chemical industries, refineries Hours, etc. processing industries. The infrastructure in the port is inaccurate, illegal waste removal, filling of poor water, and very bad roads. The description on water quality was documented in 2009 by the Tamil Nadu Pollution Board. Consistent with report huge density of collected water quality was identified as huge amounts of ammonia, nitrate, and also large quantity of petro-carbon values, cadmium, phenols and mercury (Duraisamy and Latha, 2011).

The richness of phenols and cadmium in water as a result of occurrence of industrial waste is cleared without treatment. Higher amounts of ammonia is combined the release of sluge water, Hg and PHC from boat traffic and harbour activities. To demonstrate the ecology of Ennore coastal area, marine ecosystem has largely been acknowledged as anthropogenic resources and many of the physiochemical procedures. Abundance is the extreme of 24-51%. Perhaps, Doph, SS, silicate-copper and ammonia-N phosphate pollution are as high as 10.61 percent. 10.10% of zinc-like terrain, surface waters and adjacent ocean waters are highly contaminated, close to tornadoes from the ruins of the contiguous areas, and other causes (Duraisamy et al., 2011).

II. BACKGROUND OF THE STUDY SITE

Ennore region which is 20km long has been freshly combined with Chennai and it is famous for fishing.

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***** Correspondence Author (s)
B. Naveen karthik research scholar, Enivronmental engineering, Department of civil engineering, SRM institute of science and technology, Chennai, India.
V.Mirunalini, Assistant professor, Department of civil engineering, SRM institute of science and technology, Chennai, India.
J. Oliver Paul nayagam, Enivronmental engineering, Department of civil engineering, SRM institute of science and technology, Chennai, India.
S.Kabilashasundari, Enivronmental engineering, Department of civil engineering, SRM institute of science and technology, Chennai, India.

Ennore is established at peninsula and is constrained by the River korttalaiyar, Stream of Ennore and Bay of Bengal. The watercourse ruptures the Ennore from the port of Ennore. The railway station of Ennore helps the locality of Ennore. The Ennore region has a populace of 40,000 as of Indian population census 2011. Ennore has become the pivot of industrial developments, mostly thermal power plant, fertilizer industrial unit, manufacturing ports, and many oil refineries. Oil spillage and interception of industrial sludge waste in aquatic is the chief problem happening in Ennore coast. The 11 km in length of beach extending from fishing harbour to Ennore creek is underneath enormous stress regarding to an increased growth combined with harbour facilities, caused in alterations in coastal dynamics. Despite being secured in such guidelines, the unintentional industrial progress of Ennore region above the previous few periods has had divesting the impacts on the entire ecosystem, resultant in harm of livings and ecosystem of fishing peoples. The area that is stagnant enclosed the water depth is decreased by fly ash from north Chennai thermal power plant. In some regions, the ash has decreased the dissemination of creek from 14 feet underneath sea level to 2-4 feet. The North Ennore Coast already experiences a high wave operation, usually the protective barriers, "Ennore Shoals", disturbed by the architecture of the port. Beslen data revealed that Ennore Creek, a grown-up siltation in south of Inner Port. After construction of Chennai harbour, northern coast of the harbour was destroyed.

The Ennore region has a populace of 40,000 as of Indian population census 2011, Chennai. Ennore has converted to pivot of industrial developments, chiefly thermal power plant, fertilizer units, industrial ports, and many oil refineries. Oil spillage and interception of industrial sludge waste in aquatic is leading problem occurring in the Ennore coast. Pollution issues are encountered in Ennore estuary as it takes domestic sludge and industrial sewages frequently in an untreated condition. These affect quality of water and living organisms. It has been assessed that about 449,000L per day of industrial sewages carrying heavy metals are let out into this estuary by these industrial formations. Regarding present scenario, it could be described that the existence of certain metallic components, along their toxic effects, might have infected the water resultant in the mass impermanence of fishes and prawns; disruption of maximum lowest fauna after their locale in Ennore creek (James et al., 1986).

The 11 km in length of the coast extending from fishing harbour to Ennore creek is underneath enormous stress due to an increased growth combined with harbour facilities, caused in variations in coastal dynamics. The map of Ennore region is presented in Figure 1 and Figure 1.1. The study area is positioned from 13°49'09.92"N 80°02'23.46"E to13°12'59.53"N 80°19'34.99". The total area is about 3.44 Hectares vast. The topography of the study area consists of gentle slopes towards west and east. The regular annual rainfall of Ennore area is around 1000 mm study area experiences rainfall during October to December.

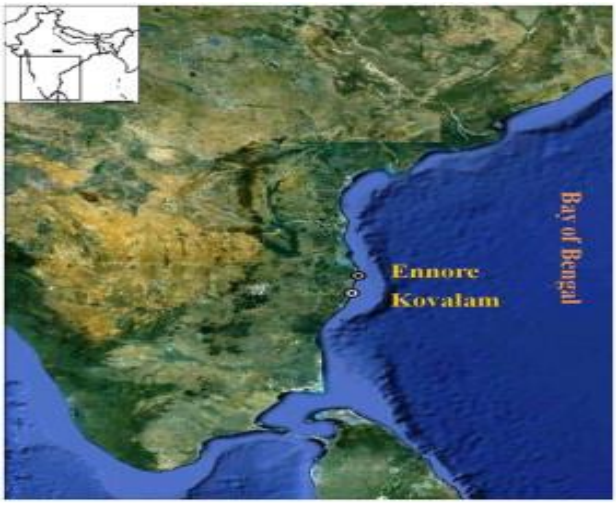

Figure 1: Pictorial View of Ennore Region

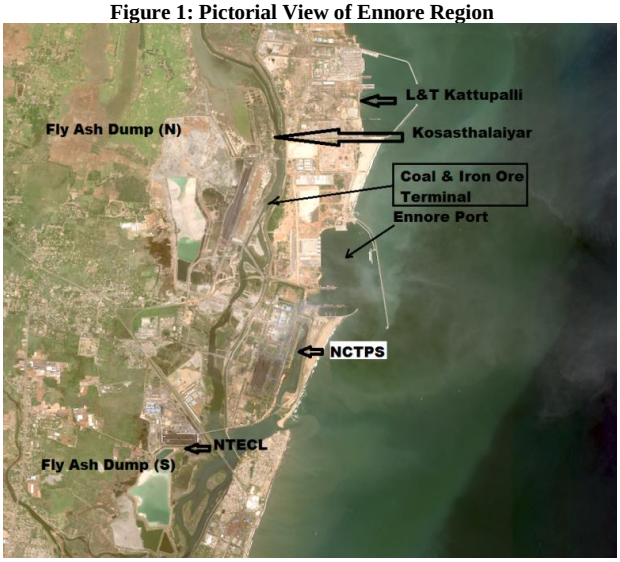

Figure 2: Satellite image of Ennore Region

A. *Ennore Creek*

The backwater of Ennore creek is located at Ennore, Chennai alongside the Coromandel Coastline of Bay of Bengal. It is untaken in the region containing creeks with backwaters and salt marshes, flooded when water in the course of higher tide and creating a support of the seaside with original to Bay of Bengal at stream. The creek attains wastewater from several sources like treated and untreated sludge from industrial bases in the contiguous area by a combination of rivers, from the north Kosasthalaiyar River and Arani River from south. Ennore coast obtains unprocessed sludge from Royapuram sludge vent, treated/untreated industrialized sewages from Manali Industrial sludge, as well as from chemical industries like sugar, oil refineries, and fertilizer. Separately from industrial waste, it obtains thermal plant releases and fly ash from the nearby Ennore Thermal Power Station. Besides that, navigational and fishing doings occurs in the Ennore coast. The rummaging events in Ennore area have caused in alterations in sediment conveyance, landscape and dirt contamination to the coastline by mining procedure (Padmini and Vijaya Geetha, 2007; Seshan et al., 2012).

III. MATERIALS AND METHODS

The samples were collected from six sampling points during the month of September. The location coordinates of the water sampling points labelled from 1 to 6 are listed out in Table 1. The Water samples are labelled from WS1 to WS6. The satellite image of Ennore region with the sampling points marked on it is shown in figure 2. Totally 24 samples were taken in 6 locations at a distance 50 meters between each sample in Ennore region. Four samples each for different categories of 1 litre each were taken in the 6 locations. Based on pH, Turbidity and DO values, which were similar, the 4 individual samples were composited as on single sample. The water samples were investigated for several chemical, physical, toxic/trace components and biological limits based on the procedures described in American Public Health Association (APHA), American Water Works Association (AWWA) and Water Pollution Control Federation (WPCF) (1998) and other literature survey for this research. The physicochemical parameters (Total Dissolved Solids, pH, Dissolved Oxygen, Turbidity), trace/toxic elements (Fe, Zn Se, Ni, Pb, Cu, Cd, As, Hg) and biological parameters (BOD, COD, and DO) have been studied. pH and turbidity were assessed using pH and conductivity and nephelometer, respectively. BOD, COD, and DO concentrations were determined to utilize titrimetric techniques, while the absorptions of trace metals were assessed employed an Atomic Absorption Spectroscopy (AAS). Special care has been taken in the course of the collection and investigation of water samples to define all constraints to maintain high accurateness.

Table 1: Water sampling location

S. No	Sample	Sample location	Latitude	Longitude
1	WS1	River water	13°49'09.92"N	80° 02'23.46"E
2	WS 2	Pond water	13°13'26.01"N	80° 19'22.16"E
3	WS 3	Stream flow	13°13'55.86"N	80° 19'49.89"E
4	WS 4	Stream water	13°13'56.95"N	80° 19'04.76"E
5	WS 5	Estuary water	13°13'57.09"N	80° 19'03.99"E
6	WS 6	Seawater	13°12'59.53"N	80° 19'34.99"E

Figure 3: Satellite image of Ennore region water sampling points

IV. RESULTS AND DISCUSSIONS

A. *Physico-chemical pollutants in waters*

The common coastal water quality principles for many parameters are listed in Table 2 (Moore, 2012). The consequences of analysis of several biological, chemical and physical constraints from water samples gathered from coastal areas of Chennai (Ennore) are presented in the tables 3 and 4.

TABLE 2: GENERAL COASTAL WATER QUALITY STANDARDS (AQUATIC AND SWIMMING LIFE)

S.No	Parameters	Standards
1	PH	7.8–8.3
2	Temperature (◦C)	30
3	Odour	Unobjectionable
4	Turbidity (NTU)	10 NTU or less
5	Total Suspended Sediments (TSS)	25 mg L^{-1} or less
6	Dissolved Oxygen (DO)	4 mg L^{-1} or more
7	Biochemical Oxygen Demand (BOD_5)	30 mg L^{-1} or less
8	Chemical Oxygen Demand COD	250 mg L^{-1} or less
Trace/toxic metals (Maximum Limit)		
9	Cadmium	0.01 mg L^{-1}
10	Lead	0.1 mg L^{-1}
11	Copper	0.02 mg L^{-1}
12	Nickel	0.01 mg L^{-1}
13	Zinc	0.1 mg L^{-1}
14	Iron	0.1 mg L^{-1}

TABLE 3: WATER QUALITY ANALYSIS OF SAMPLING POINT-DURING SOUTH EAST MONSOON

S. No	Parameter	units	WS 1	WS 2	WS 3	WS 4	WS 5	WS 6
1	pH (at 25°C)	-	6.84	7.32	6.67	7.95	7.86	7.89
2	Turbidity	NTU	1	1	16	92	1	1
3	BOD,3 days @27°C as O_2	mg/l	78	15	180	480	87	28
4	Chemical oxygen demand as O_2	mg/l	440	92	1080	12	520	176
5	Dissolved oxygen	ml	51	5.8	5.3	4.2	5.1	5.6
6	Zinc	mg/l	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.01)	BLQ(LOQ 0.1)	BLQ (LOQ 0.1)
7	Copper	mg/l	0.18	BLQ(LOQ 0.1)	0.47	2.247	0.87	0.96
8	Cadmium	mg/l	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)	BLQ(LOQ 0.01)	BLQ(LOQ 0.001)	BLQ (LOQ 0.01)

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9	Lead	mg/l	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.1)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)
10	Selenium	mg/l	0.092	BLQ(LOQ 0.005)	0.096	0.09	0.15	0.12
11	Arsenic	mg/l	0.069	BLQ(LOQ 0.005)	0.084	0.152	0.11	0.11
12	Mercury	mg/l	0.014	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)	BLQ(LOQ 0.005)
13	Nickel	mg/l	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)

Note: BLQ- Below the Limit of Quantitation

TABLE 4: WATER QUALITY ANALYSIS OF SAMPLING POINT-DURING SOUTH EAST POST MONSOON

S.No	Parameter	units	WS 1	WS 2	WS 3	WS 4	WS 5	WS 6
1	pH (at 25 °C)	-	7.61	7.65	7.49	7.52	7.35	7.86
2	Turbidity	NTU	180	7	2	54	98	2
3	Total Hardness as CaCO3	mg/l	1230	390	5800	5900	5850	5950
4	Iron as Fe	mg/l	1.24	0.26	0.41	1.88	2.36	0.12
5	Zinc as Zn	mg/l	2.604	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
6	Copper as Cu	mg/l	0.513	0.206	1.3	2.29	2.68	2.86
7	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)	BLQ(LOQ 0.001)
8	Selenium as Se	mg/l	BLQ(LOQ 0.001)	0.197	0.429	0.522	0.54	0.57
9	Arsenic as As	mg/l	BLQ(LOQ 0.001)	0.071	0.162	0.189	0.2	0.19
10	Mercury as Hg	mg/l	BLQ(LOQ 0.001)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.00005)	BLQ(LOQ 0.0005)	BLQ(LOQ 0.00005)	BLQ(LOQ 0.0005)
11	Total suspended solid	mg/l	360	16	5	118	215	5
12	BOD,3 days @27°C as O2 #	mg/l	1080	2	32	98	300	121
13	Chemical oxygen demand as O2 #	mg/l	4000	12	192	592	1800	728
14	Dissolved oxygen	ml	BDL (DL)	5.8	5.8	5.6	5.5	5.6
15	Total Chromium	mg/l	BLQ(LOQ 0.001)	BLQ(LOQ 0.01)	0.02	0.022	0.026	0.02

It should be observed that numerous parameters are not within the permitted limit of the international standards described in Table 2. The concentration of DO appears to be normal in river water. The zero DO level in river results mostly due to higher nutrient loading and dumping of other O2 demanding substances. The decline in concentration of DO is attributable to enormous amounts of waste sludge that are straight settled in coastal waters over pipelines. It is importance that in monsoon storms in October, DO is decreased after and after the storm. BOD is another factor of the quantity of oxygen that bacteria will intake while disintegrating organic substance under aerobic circumstances. From this investigation, it has been perceived that a great BOD pattern has occurred and has surpassed the extreme boundary of the global standard of all time (30 milligrams L-1). Examination of water samples in November increased most BOD values in sampling areas.

High BOD values can be removed by high flow of ocean water from high OD materials in October. Conversely, in October and September, the variation of streams in the east-west course steered to a rise in BOD concentrations of coastal areas of Marina, and thus reducing BOD densities appeared in harbour areas. A similar trend can be identified in the Adyar River areas.

Similarly, the COD is a factor of the quantity of O2 needed to corrode all organic compounds as CO2 and H2O through chemical oxidation. Therefore, COD contains less chemical species (reduced Fe) with organic matter. Therefore, major COD substances have reduced chemicals other than laboratory organic matter. COD values in sample regions have been found to be greater than the acceptable limit in September (250 mg L-1). Higher COD values indicate the occurrence of maximum organic matter, ultimately causing bad effect on sea organisms (Harrison, 2017).

However, the COD values have exceeded the allowed limits in the sample positions; there is a substantial reduction in COD concentration found in November. The reduction in COD values in October and November is because of a slight decline in coastal water in huge volumes of freshwater involvement as exaggerated by the monsoon storm in October.

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High concentrations of organic substances increase hypoxia or anoxia by O2, and COD, O2 and O2 by oxidation oxidase and other inorganic reduced components (Kennish, 2017) when decomposing microorganisms. Due to the shallow nature of the water, high water inputs have a long coastline input throughout the year, except for the winter water (December <1 mg L-1) winter (December and November).

The Turbidity is the best indicator of adjourned material in the water by estimating scattered light size within the medium. Suspended clay and silt, organic matter and plain spots can be donated. Analysis of water samples for confusion is 10 (NT NT), where monsoon levels are less than the monsoon storm (Table 3 and 4) and below international standards. The high disadvantage in the river occurs in huge amounts of industrial and municipal wastes, high flow in 4 places from sewage wastes through a series of pipelines (Gowri and Ramachandran, 2001).

B. *Trace and toxic metals in coastal waters*

The increased accretion of anthropogenic trace/toxic metals in the ennore, harbour and marine atmospheres are less appropriate side-effects of the industrial culture of these areas since of their great perseverance, high toxicity, and tendency to bioaccumulation (Clark, 1992; DeSanto, 1991). In the current investigation, variations in metal absorptions earlier and in course of monsoonal hurricanes are compared (table 3 and 4).

It is found that copper densities are greater than allowable limit (0.02 mg / l) thru monsoon storms. Because of surface overflow and aids of river and pipeline discharges to coastal system a sudden rise in copper density and river and pipeline discharges to the coastal system. The densities of nickel, lead and cadmium are very eminent in September, and it is clear that the extreme permissible perimeter in sample regions (0.01, 0.01 and 0.1 respectively) is higher. As an outcome of the monsoon storm in October, these standards have significantly reduced the scope of international standards (limit 2). In river-affected areas, toxic metals, such as cadmium, have higher concentrations. High concentrations of cadmium can prompt to serious health risks for marine breed (Selvakumar, et al., 1996).

Based on environmental-toxicological studies, it is recommended to prompt to the following sublethel effects on metal level water organisms, slightly elevated in estuarine and coastal waters: (1) histological or morphology variation in tissues; (2) variations in physiology, for instance to suppress the progress, changes in poor swimming, circulation; (3) Diversity in biochemistry, eg blood chemistry and enzyme activity; (4) variation in behaviour; (5) and difficulties in imitation (Connell et al., 1984). From the result, many fishing societies suffer from exacting skin diseases around the coastal town (Balasubramanian, 1999).

C. *Environmental assessment*

Estuarine atmospheres are stressful, and if heavy breeds disappear with heavy metal pollution, other species cannot replace it. Alongside with a huge amount of nutritional supplements, widespread chemicals are discharged into the environment every day, transported through lagoons and rivers in marine and estuarine atmospheres. Hence, there is a necessity to observe climate change, quantitative laboratory and field research that integrates environmental parameters with metal body load in Sentinel water bodies.

This area, situated in Ennore, has been detected to have density of high metals in summer than in monsoon period. This seasonal low value is comprised of lake water inputs from the Reservoir to sea over Ennore Creek, as rising values of the summer increases the density of metals (Murthy and Rao, 1987). In pre-study, low-level densities have been noticed in winter and high concentrations in summer (Caccio and Millero, 2003). The seasonal difference influenced the geology of molten metals and the densities of fertilizer metals due to freshwater flows. In the Western Scheldt estuary, chemical experimental research has presented that strong mineral supplements are strongly influenced by organic soluble carbon, salinity and dissolved O2 (Gerringa et al., 1998).

During the summer season, surviving freshwater stream is heavier with molten metal concentrates, and in certain case the partitioning is suitable for climbing suspended cells and sediment (Mubiana et al., 2005). The lowering of the decrease of the lower sediment has steered to increased levels of O2, which causes the polluted secondary pollution of the metals when redistributed. Previous Reports suggested that molten organic carbon (Winch et al., 2002; Guo et al., 2001) suggests that the involvement of metals in the firm is high.

TABLE 5: RAINFALL DATA DURING 2018-2019

S. No	Date	September	October	November	December	January	February
1	1	1.24	0.28	22.2	0.1	0	0
2	2	0.29	1.14	11.9	4.7	0	0
3	3	0.59	13.16	21	5.7	0	0
4	4	0	18.5	8.8	8.5	0	0.5
5	5	0	52.5	3.2	17.3	0.2	0
6	6	0	15.1	1.8	0.5	0	0
7	7	1.78	16.9	0	0.3	0	0
8	8	1.13	27	0	0	0	0
9	9	0	21.1	0.3	0	0	0.2
10	10	0.8	0	0	0	0	0
11	11	0	0	0.2	0	0.2	0.2
12	12	0	0.1	0.1	0	0	0
13	13	6.01	0.5	0	0	0	0
14	14	0.6	4.3	0.1	0.7	0	0
15	15	0	5.4	19.3	0.4	0	0
16	16	1.79	2.4	0.8	3.9	0	0
17	17	3.76	10.8	0.7	0	0.5	0
18	18	6.98	1.4	0.9	0	0	1.2
19	19	2.64	2	6.5	0	0	0.4
20	20	1.05	0	17	0.4	0	0

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21	21	1.27	6.2	188.2	2.3	0	0
22	22	0	0	78.3	0.2	0	0
23	23	2.36	0	66.2	1.7	0	0
24	24	0.07	0	0.1	0.1	0	0
25	25	0	0	0.2	0	0.2	
26	26	0	0	0	0	0	0
27	27	0	0	0	0	0	0
28	28	6.56	0	0.3	0.2	0	0
29	29	6.38	0	1.3	2	0.6	7.9
30	30	1.95	0.6	0.2	2.9	0.9	
31	31		17.1		0.1	0.4	

V. CONCLUSIONS

The ranges of several biological, physical and chemical constraints in the coastal water along with groundwater of the Chennai city has been assessed by regular government inspection and the periods of post-monsoon and monsoon are studied for company norms limits. During September, the observations demonstrated low dissolved O2 and high biochemical and COD in the coastal surface waters of ennore. The toxic/trace metal absorptions are identified to be considerably greater than the allowable perimeter of international standards in a regular survey at several locations of the research area. As a result of freshwater input in monsoon, the absorptions of certain of these constraints became less in many places it shows the pollution within limits. However, the new methods and spreading framework are essential to be presented to decrease the ranges of contamination in the coastal parts.

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AUTHORS PROFILE

B. Naveen karthik research scholar, Enivronmental engineering, Department of civil engineering, SRM institute of science and technology, Chennai, India.

V.Mirunalini, Assistant professor, Department of civil engineering, SRM institute of science and technology, Chennai, India.

J. Oliver Paul nayagam, Enivronmental engineering, Department of civil engineering, SRM institute of science and technology, Chennai, India.

S.Kabilashasundari, Enivronmental engineering, Department of civil engineering, SRM institute of science and technology, Chennai, India.