

STUDIES ON THE ASSESSMENT OF COASTAL POLLUTION IN THE PUDUCHERRY REGION

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Abstract: The levels of hydrological pollution had significantly increased in the Puducherry region situated in the South Eastern part of South India and their impacts are felt more on the coastal zone by an uncontrolled disposal of wastewater and pollutants directly into the sea. The study emphasizes on the pollution level on the vulnerable zones and to suggest an appropriate remedial measures for the effected zone of the Puducherry city. Sampling was carried out along the identified locations of the coastal zones from September to November 2019[pre-monsoon] January to march 2020[post-monsoon], including monsoonal storm which significantly influenced large variations in the pollution level on the seaside. Analysis of physio-chemical parameter indicated the concentrations of pH, Electrical Conductivity Total Dissolved solids, Carbonate, Bicarbonate, Calcium & Magnesium, Sodium, Potassium, chloride, Total hardness, Total Alkalinity and reached notably normal levels at all sample locations during and after monsoonal storm may be due to large fresh water input to the coastal system reducing the levels of pollution to some extent. Analysis of water samples collected during November to April apparently indicated that the concentrations of above parameters attained abnormal level and often exceeded the permissible limit of international standards. The concentration of trace/toxic metals such as manganese, copper, chromium, lead, cadmium and cobalt also reached high levels as a result of sub-aqueous disposal to these areas, leading to further and ecological destruction. The higher concentration of toxic elements such as, manganese, chromium, copper and cobalt from the influence of industrial wastes disposal which contaminated coastal waters were also found to deteriorate the quality of coastal water system. Based on detailed examinations, five sites which include veerampattinam estuary, vambakeerapalayam estuary, vaithikuppam, rock beach and kalapet are identified as highly vulnerable zones because of receiving a large quantity of municipal and industrial wastes. To reduce the severity of the pollution levels in these areas it is therefore necessary to design a suitable safe disposal system to transport and disperse such a large quantity of waste materials.

Keywords; Keywords: coastal and marine pollution, contaminant, puducherry region, physio-chemical parameters, trace and toxic metals.

1. INTRODUCTION:

The Puducherry coastal region in the recent years faces a severe treat due to unplanned and uncontrolled disposal of wastewater and had a serious issue on the rapid increase in the pollution level. Disposal of municipal wastes, industrial wastes and waste generated by numerous recreational and commercial activities had degraded the quality of coastal water and also caused a serious health hazard to marine biota's and in returns to human. Moreover a multitude of anthropogenic impacts are attributed due to accelerated coastal settlements and development of small-scale and large- scale industries, expansion of harbors and tourism related activities in the coastal zone. Hence to understand the pollution level in the coastal zone, it is required to assess the level of coastal water pollution both spatially and temporally, in order to make further recommendations for safe disposal of wastewater.

The main source of pollution in the identified estuaries and coastal belts of the Puducherry coastal region are mainly due to direct discharge of untreated industrial effluent and domestic sewage at various points along the coast. Technically it is advisable to discharge the wastewater at a water depth of more than 20m in the ocean for better diffusion and dispersion, would automatically reduce the concentration levels of the organic and inorganic materials below the threshold level (which is the level of concentration of organic and inorganic materials, which will not hamper the environment, living organisms etc.) (Bender, 1989). Moreover, the surf zone dynamic activities retain all these wastewater in the coastal zone itself and prevent them from proper dispersion into the offshore waters. Already the fishing community has reported few types of dermatologic Problems due to coastal pollution in the puducherry zone. it is reported that the fish growth is reducing in the coastal waters of springer water resource manage (2007) 21:1187:1206 1189.

Point source	Non- point source
Municipal sewage wastes	Urban runoff
Eg: industrial wastes	Eg: mining/dredging
	Eg: ash

Table 1: point and non-point sources of pollution

Consumption of the fish thriving in polluted coastal waters also will deteriorate the human health. Pollutants in coastal marine environments of Pondicherry are derived from both point and non-point sources (Table 01) waste disposal operations intentionally release material to coastal water via direct dumping and pipeline discharges, which constitute point source of solution. The dumping of municipal sewage sludge, dredged spoils, and industrial wastes (Ex: Acid – Iron waste, Alkali, chemical, pharmaceuticals and the discharge of municipal and industrial effluents from outfalls are the primary point source category.

The primary objectives of the study is to asses and study the nature, intensity and extent of physio –chemical and trace metal pollutants of the coastal waters and Pondicherry coastal areas which is severely affected by enormous quality of industrial and domestic waste water disposal. This study will recommended a method for proper waste water disposal and product in the health of coastal eco system.

2. Materials and methods

Sea water samples were collected from the five identified locations (seaside) of the Pondicherry coastal region on 17 September, 16 October 2019 [pre- monsoon] and 12 January, 14 February 2020 [post monsoon] and were collected at both point source and non-point source. The water samples were analyzed for various physical, chemical, trace/toxic elements and based on the procedures described in volumetric analysis and Inductively Coupled plasma mass spectrometry [ICP-MS]. The physio chemical parameters (pH, Electrical conductivity, total dissolved solids, carbonate and bicarbonate, sodium, potassium, chloride, total hardness and total alkalinity). Trace and toxic (Mn, Cr, Pb, Cu, Co, Cd) have been studied pH. electrical conductivity were measure the using pH meter, conductivity meter, respectively. While the concentrations of toxic and trace metals were estimated using an inductively coupled plasma mass spectrometry (Icp-ms) special care was taken during collection and analysis of water sample for determining all parameters.

S.NO	NAME OF THE STATION	SOURCE	LATITUDE	LONGITUDE
1	Veerampattinam	Point Source	11° 8'44" N	79° 82'54"E
2	Vambakeerapalayam	Point Source	11°5'6" N	79°5'3" E
3	Vaithikuppam	Point Source	11° 9'4" N	79° 83'74" E
4	Rock Beach	Point Source	11° 9'3" N	79° 83'56"E
5	Kalapet	Point Source	12° 1'56.3" N	79 51'52.64" E

Table 2: Name and location of the sample stations along the Pondicherry coast

3. Background of study site

The Pondicherry Coastal Zone Covers a Stretch of Approximately 21km Length from Kalapet Beach in North to Veerampattinam Beach in the South of the Puducherry town. The Area Is Bound within a Latitude 11°56'N And Longitude 79°53'E Nearly 35.5% Of the Land Area were used for Industrial, Residential And Commercial Purposes.

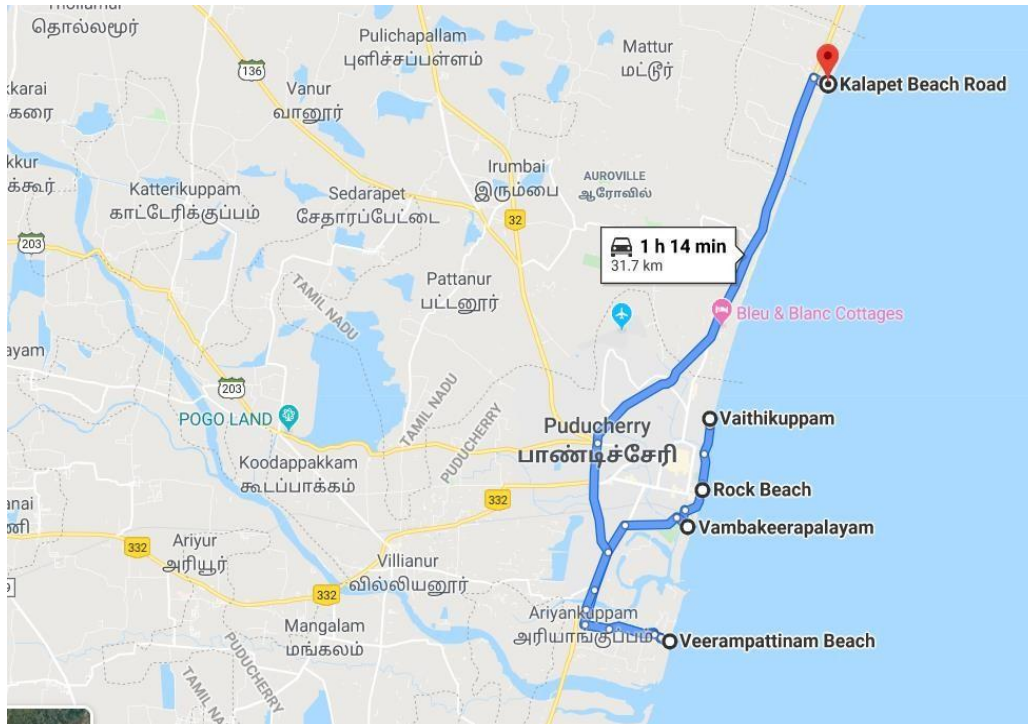


Fig 1: Location of the sampling points along the different zones of the Pondicherry coast

The majority of wastewater is disposed of in the Veerampattinam Estuary, Vambakeerapalayam Estuary and Rock Beach, Vaithikuppam Canal Outlets. Apart from these major disposal Sites, A number of domestic and industrial wastewater sites are prevalent along the coastal zone of the Pondicherry Region .In general the Puducherry region is a flat pen plain with an average elevation Of 15 M above the mean sea level. The terrain has an Undulation with prominent high grounds varying from 30 To 100 M above mean sea level towards Northwest And North-Eastern parts of the region. The climate of Puducherry is Classified By Koppen-Ginger System as tropical wet and dry, and Summer season Lasts between April To Early June, when maximum temperature frequently hit to about 41°c (106°F). The average maximum temperature is in the order of 36°c (97°F). Minimum temperature are in the order of 28-32°c (82-90°F). This is followed by a Period of high humidity and occasionally thundershowers from June till September. The Northeast Monsoon sets during the middle of October, and Puducherry gets the Bulk of its annual rainfall during the period from October To December. The annual average rainfall recored was 1,240 mm. Winter are warm, with an average temperature of 30°c (86°F) and lows often dipping to around 18-20°c (64-68°F)

4. Results and Discussions:

4.1 physico-chemical pollutants in coastal waters.

The general water quality standards (swimming and aquatic life) for several parameters specified TABLE 3. (national environmental board report)

s.no	Parameters(mg/l)	standards
1	Ph	5.5 to 9.5
2	Ec	NG

3	TDS	NG
4	Sodium	NG
5	potassium	Unobjectionable
6	Total hardness	Unobjectionable
7	Alkalinity	Unobjectionable
8	Chloride	Unobjectionable
9	Corbonate	NG
10	Bi-carbonate	NG
11	Calcium	NG

Table 3. general coastal water quality standards

Samples collected along the Pondicherry coast are presented in table 4-5, and it is observed that several parameters are within the permissible limit of the international standards and this result shows that the normal amount of physio-chemical parameters in the maximum limit of the international standard. The water samples analyses from [table 4&5] have accepted such values might result from normal pollution demanding substances disposed to coastal waters by heavy runoff in this two monsoon.

S.No	PARAMETERS	S1	S2	S3	S4	S5
1	pH	6.87	6.74	6.88	7.1	6.93
2	EC [ds/m]	46	44.3	49.8	50.4	45.1
3	TDS [mg/l]	29440	28352	31872	32256	28864
4	Carbonate [ppm]	-	-	-	-	-
5	Bicarbonate [ppm]	195.2	207.4	158.6	195.2	195.2
6	Calcium & Magnesium[mg/l]	2645.14	2605.07	2805.46	2966.57	2524.91
7	Sodium [ppm]	8960	8344	9688	10006	9201
8	Potassium [ppm]	250.1	241	257.9	261.7	243.7
9	Chloride[ppm]	17750	18815	21655	21655	23430
10	Total Hardness as CaCo3 [ppm]	6600	6500	7000	7400	6300
11	Total Alkalinity [ppm]	195.2	207.4	158.6	195.2	195.2

TABLE 4: LEVELS OF VARIOUS PHYSIO-CHEMICAL POLLUTION OF THE PONDICHERRY COASTAL WATER [PRE -MONSOON].

S.NO	Parameters	S1	S2	S3	S4	S5
1	pH	6.92	7.2	7.1	7.47	6.82
2	EC [ds/m]	52	49	48.8	52.4	46.16
3	TDS [mg/l]	28880	29002	33876	32886	29123
4	Carbonate [ppm]	-	-	-	-	-
5	Bicarbonate [ppm]	198.2	220	168	200	220
6	Calcium &	2780	2702.07	2900.6	3002.7	2602.91

	Magnesium [mg/l]					
7	Sodium [ppm]	8704	8422	9802	10002	9801
8	Potassium [ppm]	261	252	268	271	250
9	Chloride [ppm]	27860	20162	23165	22680	24702
10	Total Hardness as CaCo ₃ [ppm]	7200	7162	6982	7200	6600
11	Total Alkalinity [ppm]	202.4	242	220.4	200.7	212

TABLE 5: LEVELS OF VARIOUS PHYSIO-CHEMICAL POLLUTION OF THE PONDICHERRY COASTAL WATER [POST- MONSOON]

The result showed that the physio- chemical parameters (Tds, calcium and magnesium, sodium, potassium, chloride, total hardness had accepted the maximum limit prescribed by the international standard. The Alkalinity of water sample collected from the identified location for pre and post monsoon season was found to have a pH value ranged between 6.24 to 7.2 in the water sample collected from station 2 (table 4) (table 5) and pH value ranged between 7.1 to 7.47 in water sample collected from station 4 (table 4&5) and the pH values of water sample collected from station 1,3,5 are found to be in the range of 6.87 – 6.92, 6.88-7.1, 6.93-6.82 (Table 4, 5) . The alkalinity value of the water quality ranged between 30 and 500 mg/ L which was found to be in a acceptable range for safe fish breeding in accordance with the specified standard. According to these results, it can be concluded that, the Pondicherry coastal region is suitable for aquatic life and marine biotas.

Total dissolved solids (TDS) affect aquaculture directly. Normal concentrations of dissolved solids can impair water quality as a result of absorbing the light. Then, waters become warmer and the water's ability to hold oxygen, which is essential for aquatic life, that the conditions in the coastal zone are suitable for aquaculture. The chloride level is an important indicator for the water quality. These results shows that the normal amount of chloride value found to be all stations, respectively (table 4&5). As a result of these data, it can be said that the coastal zone is suitable for aquaculture.

Ca⁺⁺ and Mg⁺⁺ are the most important dissolved solid matters and alkali soil minerals in fresh water. The max recommended level of Ca⁺⁺ is reported to be 75 mg/L. In this research, the value of calcium (Ca⁺) level was found to be high level from all the sampled stations (table 4&5). This calcium concentration indicates that the value of Ca⁺⁺ in Pondicherry coastal zone is within the acceptable limits. The Ca⁺⁺ values in study area showed significant variance between the seasons. The level of magnesium in normal waters varied from 5 mg/L to 60 mg/L. which is an indication of mild hard waters. The Mg⁺⁺ values in coastal zone showed significant less variance between the stations (Table 4&5).

The concentration of sodium (Na) and potassium (K) ranged between 2-100 mg/L and 1-10 mg/L in natural waters, respectively. But the annual potassium level in the study area was found to be 250.1, 241, 257.9, 261, 243.7 mg/L and 261, 252, 268, 271, 250 mg/L, respectively [table 4&5] and considered to be in a normal range and the levels of sodium concentration was found to be 8920, 8344, 9688, 10006 and 9201 mg/L from [Table 4] and 8704, 8422, 9802, 10002 and 9801 from [Table 5] , and found to be within the acceptable limit for international standards.

TRACE AND TOXIC METALS IN COASTALWATERS:

The increased accumulation of anthropogenic trace/toxic metals in the Pondicherry, harbor, and veerampattinam [S1] and vambakeerapalayam [S2] marine environments is less desirable by-products of industrialized society of these regions because of their extreme persistence, high toxicity, and tendency to Bioaccumulation (Neelamani, 2006; ligy Philip, 2006;).

BDL= Below Detection Limit

S.NO	Parameters	S1	S2	S3	S4	S5	Asper IS:10500:20 12
1	Manganese [Mn]	58.2	8.478	12.43	9.495	18	0.1 mg / L
2	Chromium [Cr]	6.476	2.819	3.033	1.308	2.454	0.1 mg / L
3	Lead [Pb]	0.011	0.009	-	BDL	0.032	0.1 mg / L

4	Copper [Cu]	14.39	14.53	32.99	36.3	37.96	0.02 mg / L
5	Cobalt [Co]	1.414	1.65	1.06	0.775	1.524	0.005 mg / L
6	Cadmium [Cd]	0.071	0.089	0.142	0.092	0.1	0.01 mg / L

TABLE 6: LEVELS OF VARIOUS TRACE AND TOXIC ELEMENTS OF THE PONDICHERRY COASTAL WATER

[PRE-MONSOON]

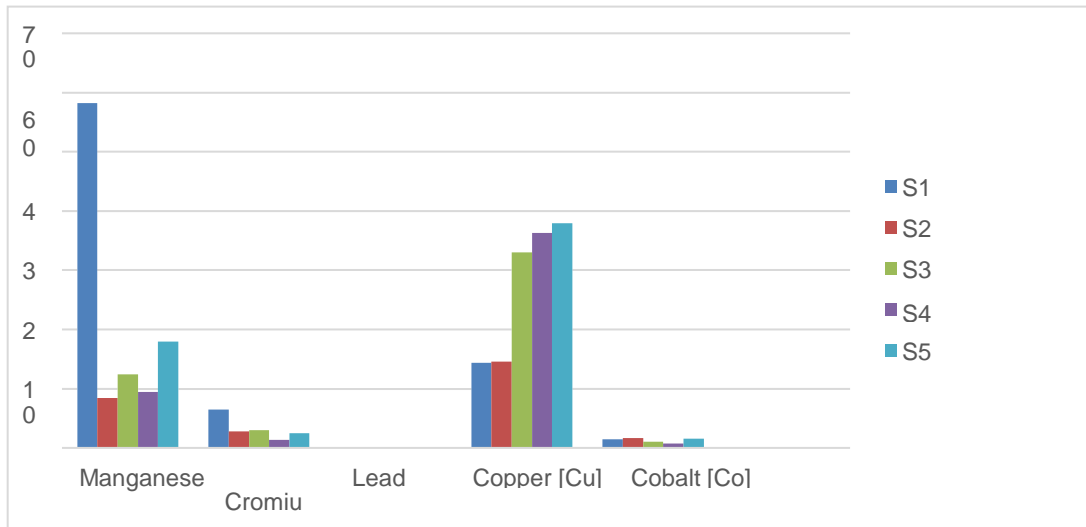


FIGURE 2: Concentrations of Various Trace/Toxic Metals in the Pondicherry Coastal Region for Pre-Monsoon

BDL= Below Detection Limit

S.NO	Parameters	S1	S2	S3	S4	S5	Asper IS:10500:2012
1	Manganese [Mn]	59.2	8.9	12.7	9.82	17.3	0.1 mg / L
2	Chromium [Cr]	6.77	2.91	3.72	1.22	2.68	0.1 mg / L
3	Lead [Pb]	0.021	0.099	0	BDL	0.043	0.1 mg / L
4	Copper [Cu]	14.42	14.62	31.9	34.2	37.62	0.02 mg / L
5	Cobalt [Co]	1.521	1.67	1.66	0.98	1.621	0.005 mg / L
6	Cadmium [Cd]	0.076	0.092	0.162	0.082	0.1	0.01 mg / L

TABLE 7: LEVELS OF VARIOUS TRACE AND TOXIC ELEMENTS OF THE PONDICHERRY COASTAL WATER [POST-MONSOON]

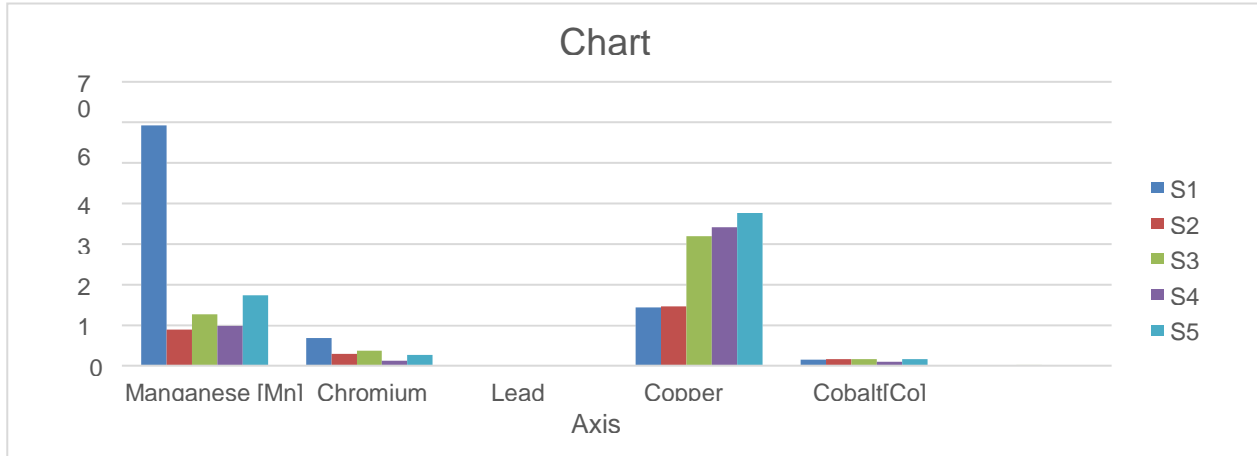


FIGURE 3: Concentrations of Various Trace/Toxic Metals in the Pondicherry Coastal Region for Post Monsoon

In the present study, variations in metal concentrations for pre-monsoonal and post-monsoonal storms are compared (fig 2&3). It is observed that copper concentrations during Pre and post monsoonal storm are found to be in the range of 14.39, 14.53, 32.99, 36.3 and 37.96 in (fig 2) and 14.42, 14.62, 31.9, 34.2 and 37.62 in (fig 3) from the all stations higher than the allowable limit (0.02 mg/l) (fig 2&3). The abrupt increase in copper concentrations is due to surface runoff and may be some industries contributions of river and pipeline discharges to the coastal system. In both periods, the manganese concentrations 58.2, 8.47, 12.43, 9.495 and 18 in (fig 2) and 59.2, 8.9, 12.7, 9.82 and 17.3 in (fig 3) are not within the permissible limit (0.1 ppm) in all sample locations, though increased levels of magnesium at all places can be attributed to the concentrated municipal wastes accumulated before storms prevailed (fig 2&3). It is evident that the concentrations of Cobalt, and chromium appeared to be very high during the both periods and exceeded the maximum permissible limit (0.005 and 0.1 ppm), but the cobalt concentration in the study area was found to be 1.414, 1.65, 1.06, 0.775, 1.524 mg/l and 1.521, 1.67, 1.66, 0.98, 1.621 mg/l, respectively (fig 2&3) considered to be in the higher range from the all sample locations. The level of chromium concentrations is found to be 6.47, 2.8, 3.033, 1.3, 2.4 mg/l and 6.77, 2.91, 3.72, 1.22 and 2.68 in (fig 2&3) from the all stations exceeded in the maximum permissible limit for international standards. Though the increased level of concentrations at all places can be attributed to the directly discharge from house hold waste to the coastal system. As a result of pre and post monsoonal storms during October and February, As a result of lead concentrations in the study area was found to be 0.011, 0.009, BDL, BDL, 0.032 and 0.021, 0.099, 0, BDL, 0.043 in (fig 2&3) from all sample station. The cadmium concentrations 0.071, 0.089, 0.142, 0.092, 0.1 and 0.076, 0.092, 0.162, 0.082, 0.1 in fig 2&3 from all the samples are within the permissible limit (0.1 ppm and 0.01 ppm) in all sample locations, these concentrations were considerably decreased to be within the permissible limit of the international standards (fig 2&3).

This results shows that the normal level concentrations of toxic metals such as copper, manganese, chromium, lead, cadmium and Cobalt during pre and post monsoonal storms above periods Such as a result in no affected in health hazards to the marine biota's Based on the ecotoxicological studies, it has been suggested that slightly elevated metal levels in estuarine and coastal waters may cause the in aquatic organisms: (1) histological or morphological change in tissues; (2) changes in physiology, such as suppression of growth and development, poor swimming performance, changes in circulation; (3) change in biochemistry, such as enzyme Activity and blood chemistry; (4) change in behavior; (5) and changes in reproduction (Connell and Miller, 1984). As a result, many fishing communities suffer from serious skin diseases around coastal city (Balasubramanian, 1999).

Conclusions:

In this study, the physio-chemical parameters and the heavy metal concentrations in the water samples collected from the puducherry coastal areas were determined. It is known that the heavy metals constitute the important pollutant group and accumulates within the bodies of living organisms creating health hazard, and also they have significant toxic and carcinogenic effects. It has been revealed from the Puducherry coastal area in accordance to CWQS most of the parameters such as sodium, potassium, magnesium is normal level and the lead and cadmium concentrations are within the permissible limit in all sample locations. Metals such as copper, manganese, cobalt and chromium are to exceeded in the permissible limit for international standards for all stations. In Station 01, Due to the household wastes of municipal sewage, it

directly discharges to the coastal areas. In Station 02, it is the Estuary region which is near to upper canal and the wastages are probably discharged from the homemade industry due to the mixing of back waters and it may occur pollution level. In Station 03, there is a handmade paper industry is near to seashore. So, the industrial effluent wastes are probably discharged in the coastal areas and it may occur pollution. In Station 05, There is a Alkaline and Shasun industry are near to the seashore and the medical wastes are probably discharged into the coastal areas and it may occur pollution. These results show that the concentration of trace and toxic metals and physio-chemical parameter are lesser than high level in permissible limit. So, In order to protect the water quality and to ensure no health hazard for aquatic life and marine biota's in these coastal areas, it is required to make regular observations by monitoring the parameters which would possibly affect the water quality and aquatic life and also the study will help in formulation of remedial plans for future.

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