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PHYSICO-CHEMICAL CHARACTERISTICS OF UPPANAR RIVER FROM CUDDALORE, SOUTH EAST COAST OF INDIA

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Abstract

The physico – chemical parameters of river water in Cuddalore were studied in the months of April-May 2015 for a period of forty five days from three different sites. Selected sites are Uppanar river - Thazhanguda-(Reg-I), old town of Cuddalore (Reg-II) and Thaikalthoniturai (Reg-III) .Water samples were analyzed for various physical parameters like temperature, electrical conductivity and total dissolved solids and chemical parameters like p^H, calcium, magnesium, free ammonia, nitrite, nitrate and chloride. The results obtained were compared with standards of WHO. From the results it was found that the water samples in Reg I and Reg III are slightly polluted while water of Reg II are highly polluted as a result of contamination with industrial ,agricultural and domestic wastes.

Keywords: Contamination, uppanar river, physico-chemical parameters, water.

INTRODUCTION

Nowadays, pollution of the aquatic environment is any discharge of material (or) matter from industrial, agricultural, and man-made chemicals into water have led to various deleterious effects on the aquatic organisms, including fish [1].

The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. The decision of WHO's 29th session (May 1976) emphasizes that the quality of water should be checked at regular time interval, and it should be free from pathogenic organism and toxic substances [2].

Natural water containing different types of impurities are introduced into aquatic system by different ways such as sewage , agricultural waste , domestic waste , industrial waste , accidental discharge, and compounds used protest plants and animals[3]. The increased use of metal-based fertilizer in agricultural revolution of government could result in continued rise in concentration of metal pollution in fresh water reservoir due to the water run –off [4].

Excessive amounts of heavy metals such as Pb, Cr, and Fe as well as heavy metals from industrial processes are of special concerns because they produce water or chronic poisoning to aquatic animals[5]. High levels of pollutants mainly organic matter in river water cause an increase in biological oxygen demand[6], total dissolved solids, total suspended solids and fecal coli form. They make water unsuitable for drinking, irrigation or any other use. Therefore the quality and the nature of water are determined by physical and chemical analysis[7]. The present study has been undertaken to evaluate the

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relationship between polluted and unpolluted sites in three regions of Uppanar river.

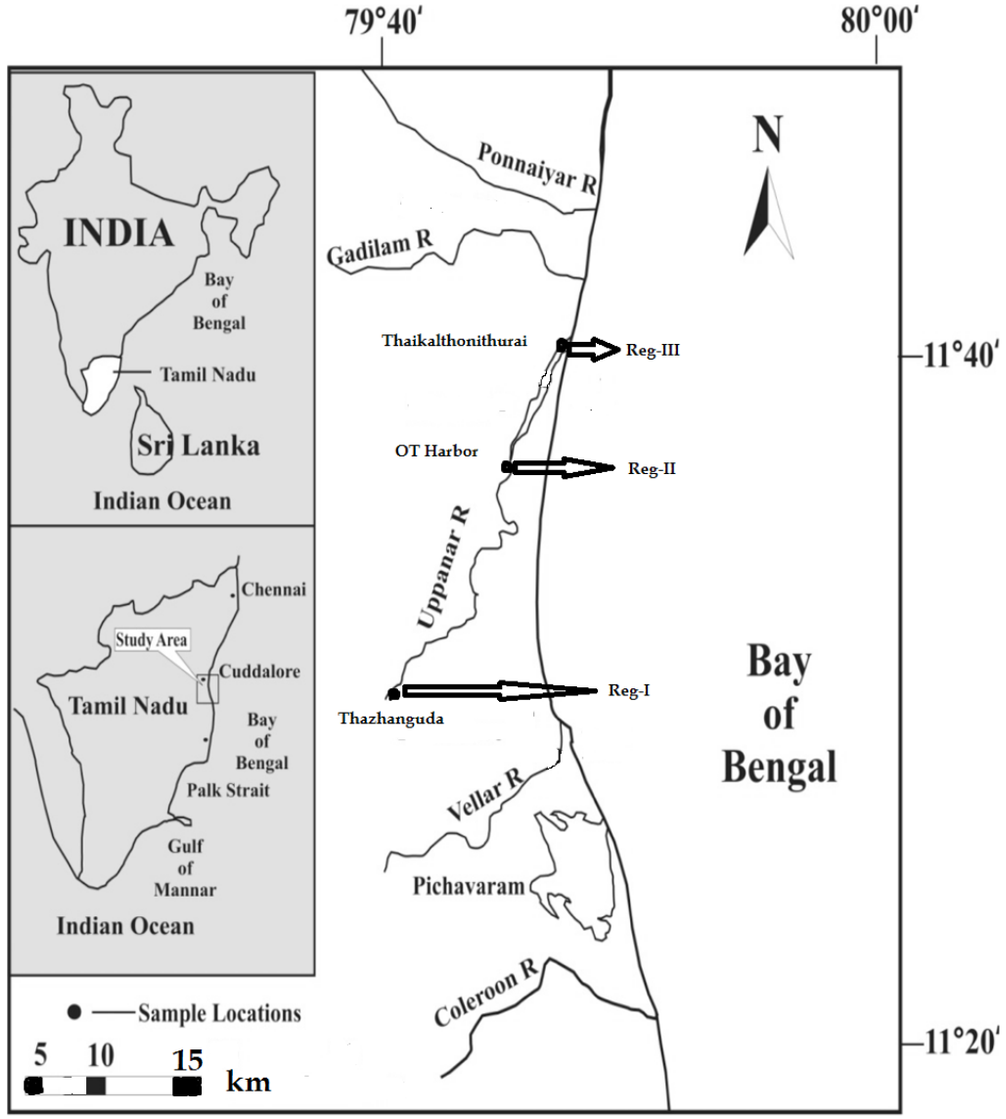
MATERIALS AND METHODS

Study Area

The Uppanar river is situated at Cuddalore (N 11° 43'E; N 79° 46'E) (Figure 1), 180 Km South of Chennai and 25 Km South of Pondicherry. This river flows between Cuddalore town and most part of Chidambaram Taluk and confluences with the Bay of Bengal through a mouth of Gadilam River. It runs behind the SIPCOT (State Industrial Promotion Corporation of Tamil Nadu Limited) industrial complex covering an area of about 700 acres with 70 industries (Mullai et al., 2013)[8]. It is specifically established for chemical, petrochemical, fertilizers, pharmaceutical, dyes, soap, detergent, packing materials resins, pesticides, drugs, antibiotics etc., manufacturing industries. Most of the industries are wet process industries and they consume large quantity of water for their manufacturing process. The effluents of these industries are released untreated into the estuary. In addition to the industrial wastes, the estuary receives also the municipal wastes and domestic sewage from Cuddalore old town (OT).

Sampling Stations

The present study was carried out over a period of 45 days from April 1, 2015 to May 15, 2015, from Uppanar river, Cuddalore district, Tamilnadu , India. The three sampling station, namely Region-I (Thazhanguda-Fig 2),Region-II (Old town of Cuddalore-Fig 3) and Region-III (Thaikalthonithurai-Fig 4), were selected along uppanar river.



Map Showing the Sampling Location at River Uppanar, Cuddalore, Bay of Bengal, India.

Figure-1

(Table-1) List of Chosen Regions in River Uppanar

S.No.	Channels	Region No.
1.	Thazhanguda	I
2.	Old Town Harbor	II
3.	Thaikalthonithurai	III

Figure-2: Region-I: Thazhanguda at the bank of River Uppanar;

Figure-3: Region-II: OT Harbor (5 Kms away from the I-Region) at the bank of River Uppanar.

Figure-4: Region-III: Thaikalthonithurai (5 Kms away from the II-Region) at the bank of River Uppanar

Collection of Water Samples

The water samples were collected only from three regions and analyzed. From every sampling region the samples were collected in the morning time. These samples were collected in sterilized, clean high density polythene bottle (1000 ml). First the bottles were rinsed with sample and then samples were collected in the bottles. After the collection of samples, these samples were brought to the laboratory and analyzed (within 24 hours).

Analysis of Water Samples

Water samples were tested for different physicochemical parameters. The physical parameters like that of temperature, Total dissolved solids (TDS) and Electrical conductivity was noted down. The chemical parameters like pH was measured using a portable pen type pH meter, Calcium, Megnesium, Free ammonia, Nitrite, Nitrate, and choloride were analyzed following the standard methods described by [9].

Statistical Analysis

All the grouped data were statistically evaluated and significance of changes caused by the various Regions was determined using *Turkey* test[10]. The results are expressed as mean ± SE (standard error) of each group. A one way ANOVA was done wherever appropriate. The level of statistical significance was set at $p<0.05$.

RESULTS

Physico-chemical properties and chemical analysis of water samples are given in Table (2&3)

The physico-chemical properties and chemical analyses of water samples Temperature, Total dissolved solids, Electrical conductivity, pH and inorganic substance such as Chloride, Sulphate, Calcium, Magnesium, Free Ammonia, Nitrite and Nitrate levels were high in water samples taken from Region-II when compared with Region-I and Region-III.

Table 2- Physical Analysis of Water Samples Collected From Different Regions at River Uppanar

PARAMETERS	APRIL I			APRIL I5			APRIL 30			MAY 15		
	REG I	REG II	REG III	REG I	REG II	REG III	REG I	REG II	REG III	REG I	REG II	REG III
TEMPERATURE (ºC)	31.00 ^{a} ±0.36	38.83 ^{b} ±0.47	34.50 ^{c} ±0.42	32.00 ^{a} ±0.32	39.73 ^{b} ±0.45	35.00 ^{c} ±0.33	30.00 ^{a} ±0.28	38.00 ^{b} ±0.55	34.56 ^{c} ±0.32	32.00 ^{a} ±0.56	39.00 ^{b} ±0.77	33.00 ^{c} ±0.87
TOTAL DISSOLVED SOLIDS(mg/L)	2.59 ^{a} ±14.47	3.32 ^{b} ±07.56	3.15 ^{c} ±15.14	2.48 ^{a} ±13.48	3.33 ^{b} ±08.55	3.10 ^{c} ±15.17	2.50 ^{a} ±15.57	3.38 ^{b} ±07.45	3.13 ^{c} ±14.47	2.58 ^{a} ±12.12	3.40 ^{b} ±08.58	3.17 ^{c} ±16.67
ELECTRICAL CONDUCTIVITY (mho/C)	3.71 ^{a} ±30.55	4.75 ^{b} ±130.03	4.51 ^{c} ±31.79	3.71 ^{a} ±23.20	4.75 ^{b} ±15.91	4.51 ^{c} ±43.79	3.55 ^{a} ±44.45	4.44 ^{b} ±45.44	4.50 ^{c} ±44.34	3.32 ^{a} ±22.34	4.88 ^{b} ±99.34	4.34 ^{c} ±22.14

Values represent by one way ANOVA in each group differ significantly at $p< 0.05$ by Turkey

$^{a-c}$ In each row, means with different superscript latter differ significantly at $p<0.05$ by (Turkey's)

Table 3- Chemical Analysis of Water Samples Collected from Different Sampling Regions of River Uppanar

PARAMETERS	APRIL 1			APRIL 15			APRIL 30			MAY 15		
	REG I	REG II	REG III	REG I	REG II	REG III	REG I	REG II	REG III	REG I	REG II	REG III
pH	7.10 [a] ±0.30	8.16 [b] ±0.03	7.30 [c] ±0.08	7.11 [a] ±0.02	8.09 [b] ±0.26	7.22 [c] ±0.05	7.09 [a] ±0.29	8.23 [b] ±0.01	7.77 [c] ±0.05	7.10 [a] ±0.30	8.16 [b] ±0.03	7.30 [c] ±0.08
CALCIUM (mg/L)	6.41 [a] ±13.01	7.70 [b] ±15.91	7.21 [c] ±15.79	6.55 [a] ±11.23	7.80 [b] ±14.45	7.14 [c] ±12.43	6.22 [a] ±23.11	7.88 [b] ±23.45	6.45 [c] ±67.76	6.31 [a] ±45.56	7.90 [b] ±55.66	6.78 [c] ±66.75
MAGNESIUM (mg/L)	1.26 [a] ±17.52	1.40 [b] ±16.36	1.28 [c] ±15.31	1.29 [a] ±16.02	1.54 [b] ±15.35	1.24 [c] ±12.12	1.12 [a] ±15.15	1.98 [b] ±66.78	1.30 [c] ±33.12	1.14 [a] ±45.78	1.89 [b] ±55.89	1.45 [c] ±24.57
FREE AMMONIA(mg/L)	0.00 [a] ±0.0	1.12 [b] ±0.01	0.17 [c] ±0.01	0.00 [a] ±0.0	1.14 [b] ±0.03	0.15 [c] ±0.12	0.00 [a] ±0.0	1.34 [b] ±0.07	0.11 [c] ±0.09	0.00 [a] ±0.0	1.35 [b] ±0.15	0.15 [c] ±0.09
NITRITE(mg/L)	0.05 [a] ±0.003	0.09 [b] ±0.006	0.06 [c] ±0.003	0.04 [a] ±0.004	0.08 [b] ±0.003	0.07 [c] ±0.005	0.05 [a] ±0.003	0.09 [b] ±0.006	0.06 [c] ±0.003	0.04 [a] ±0.004	0.08 [b] ±0.003	0.07 [c] ±0.005
NITRATE(mg/L)	17.00 [a] ±1.06	19.50 [b] ±1.47	17.50 [c] ±1.77	14.00 [a] ±I.12	19.77 [b] ±2.45	16.22 [c] ±2.43	14.14 [a] ±1.76	18.23 [b] ±1.22	13.14 [c] ±4.47	15.00 [a] ±6.76	19.34 [b] ±3.83	17.44 [c] ±1.05
CHLORIDE(mg/L)	1.30 [a] ±14.75	1.72 [b] ±14.81	1.63 [c] ±15.52	1.22 [a] ±12.21	1.89 [b] ±34.43	1.55 [c] ±56.76	1.01 [a] ±22.31	1.99 [b] ±77.45	1.65 [c] ±67.24	1.27 [a] ±22.69	1.87 [b] ±22.16	1.71 [c] ±12.76

Values represent by one way ANOVA in each group differ significantly at $p < 0.05$ by Turkey

[a-c] In each row, means with different superscript latter differ significantly at $p<0.05$ by (Turkey's)

DISCUSSION

Physcio-chemical analysis has long been employed to assess water quality. The results of the physic-chemical analysis are discussed separately. Table 2&3 gives the level of different parameters on river Uppanar Reg-I, Reg-II and Reg-III.

Temperature is a factor of great importance for aquatic ecosystem, as of effects of organisms, as well as the chemical and physical characteristics of water. In this content we have observed the maximum temperature was recorded at Reg-II of Uppanar river in the month of April -1 to May -15.This may be due to industrial waste water as compared to Reg-I and Reg-III. The relative increase in temperature of Reg-II water has potential implications on the oxygen capacity of the water[11] as increase in temperature affects the level of dissolved oxygen in the water column where dissolved oxygen (DO) is inversely proportional to temperature[12].

The pH value is considered to be an important factor in the chemical and biological system of aquatic environmental [13]. The relatively high pH of Reg-II water can be attributed to the large amounts of different pollution sources discharged in this water. pH has profound effects on water quality affecting the ability of bacteria which require slightly acidic pH to degrade toxic substance to less harmful forms [14]. The high electrical conductivity values observed in water samples collected from Reg-II. It suggests possible source of run-off from adjacent land and strongly implicates industrial and sewage sources. These agree with reports [15] of conductivity being a direct measure of anthropogenic impact. It was found that the values of water samples collected from Reg-II OT Harbor were higher than that collected from Reg-I and Reg-III.

Solids refer to suspended and dissolved matter in water. The very useful parameters describing the chemical constituents of the water and can be considered as a general of edaphic relations that contribute to productivity within the water body [16]. The higher values of TDS were recorded in water collected from OT Harbor (Reg-II). The obvious increase in the TDS is mainly due to increase in temperature that consequently increases the evaporation rate and accumulation of dissolved salts in water. These results are coincident with that reported by Abdel et al.,(2005)[17].

A direct co-relation between chloride concentration and pollution was shown by (Authman *et al.*,2008)[18]. Chloride concentration is indicators of large amount of organic matter in the water. It serves as the indicator of fecal pollution. In the present study maximum content of chloride were reported in Reg-II of Uppanar river. The higher content of chloride suggests that water polluted may be due to disposal of human waste into the presence of higher values of chloride showed higher pollution load by domestic waste [19]. The distributions of calcium and magnesium concentration in the water of OT Harbor were found higher than the water collected from Reg-I and Reg-III.The high calcium content recorded in Reg-II, may be related to the relative increase in the dissolved oxygen level.

Generally the calcium contents in the water is affected by the absorption of the calcium ion on the metallic oxides[20] in addition to the effect of the microorganisms, which play an important role in the calcium exchange between sediment and overlying water[21]. The present results show that the magnesium concentration were higher in OT Harbor (Reg-II).

Nutrient salts (NO_2^-, NO_3^-, NH_3^- and PO_4^-) play an important role in the productivity of the aquatic ecosystem supporting the food chain for phyto and zooplanktons as well as fish[22]. Dissolved inorganic nitrogen is the summation of the ammonia, nitrite and nitrate. These parameters were found in high concentration in Reg-II water which may be due to sewage out falls, as recorded [23]. The higher content of nitrite in Reg-II water is indication of the microbial activity. The recorded increase in NO_3 comparing to the Reg-I and Reg-III water might be attributed to the fast conversion of NO_2-NO_3- ions by nitrifying bacteria. The increase ammonia level in water samples collected from Reg-II water is indicator of the presence of pollution of high activity via sewage discharge, industrial effluents and agriculture-runoff and could be attributed to the increase in the oxygen matter and oxidation of chemical contributions [24].

The presence of large concentration of NO_2 and NO_3 in water can create a large oxygen demand. High concentration of nitrate and nitrite can cause algae to grow in large quantity. Dead algae can cause oxygen depletion problems which in turn can kill fish and other aquatic organism [25].In the present investigation free ammonia, nitrite (NO_2), and nitrate(NO_3) was found to be high in the OT Harbor(Reg-II) water and this may be partly due to the death and subsequent decomposition of phytoplankton and may be due to the industrial effluents mixing with extuary[26].

CONCLUSION

Based on the physico-chemical properties of water, the present study revealed that water at OT Harbor (Reg-II) are affected by industrial, agricultural and sewage effluents and contaminated with some organic and inorganic substances. High concentrations of organic and inorganic substances in this region deteriorating its quality to the point that it could be hazardous to human.

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