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ORIGINAL RESEARCH ARTICLE

Seasonal Variations in Physico-Chemical Parameters of Vellar River, Vellar Estuary and Portonovo Coastal Waters, South East Coast of India

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ABSTRACT

In the present study, hydro biological characteristic features of the Vellar river, Vellar estuary and Portonovo coastal water samples were collected from 3 sampling stations for the period of 6 months in both monsoon and summer seasons (2005-2006). The Physico-chemical factors like pH, temperature, EC, alkalinity, hardness, Chloride nutrients such as PO_4, NO_3, SO_4, TDS, DO, BOD and COD were estimated by the samples. The overall analysis, it was observed that the fluctuations in the Physico-chemical parameters of water samples. The Vellar estuary daily has been facing the problems of municipal sewage, industrial wastes and anthropogenic activities *etc.*

Key words: Vellar River, Vellar estuary, Portonovo coastal waters and Seasonal variations.

INTRODUCTION

Water is the universal solvent required for all the living beings. Without the knowledge of water quality, it is difficult of understand the biological phenomenon fully, because the chemistry of water reveals much about the metabolism of the ecosystem and explains the general hydro biological inter – relationship. The physico-chemical parameters of water and the dependence of all life process of these factors make it desirable to take water as an environment [1]. Most human activities and needs are closely related to water. First, the need of drinking water, agriculture and industry, made people build their homes near river banks [2]. Today, the largest cities with highly developed industries are built along the river basins. Large quantities of hazardous wastes often come out as a result of industrial production, when improperly stored, can spread to the environment. The role of sediments in such cases of great importance [2]. However, the suspended sediment load and turbidity of a river are increased during the removal of bed or bank material and as a consequence other water quality characteristics such as temperature are affected [3]. Also increased turbidity reduces high penetration and therefore primary productivity, which has a knock on effect throughout the food chain and also most fishes, will have a reduced capacity to find and capture prey or food. Major modifications of the hydrological characteristics enhance pollutant re-routing capabilities of flood plains [4]. But the effects of dredging on soft bottom organisms may be difficult to identity as the dredge may miss some areas entirely, leading to some sediment slumping [5]. Hence, this present study focused on to carry out to investigate on hydro biological feature of these river and estuaries.

METRIALS AND METHODS

Physico-chemical parameters of water samples were analyzed by following the standard methods given in [6]. pH was estimated by using Digital pH meter Elico-Li-120. Temperature was measured by using standard mercury thermometer. EC was measured by using conductivity meter. Nitrate was measured by nitrate reduction column method. The PO_4 and SO_4 were determined by Titrimetric method. Alkalinity and hardness were estimated by EDTA Titrimetric method. Dissolved oxygen, Chloride, TDS, BOD and COD were determined by Standard procedures by Pandey and Carney [7].

RESULTS AND DISCUSSION

Environmental conditions is most of the tropical aquatic ecosystem are largely governed by marked seasonal changes induced by the monsoonal cycle [8]. Understanding of the hydrography and nutrient cycling in the river water much complicated by the continuous mixing of water masses with

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different physico-chemical properties [9]. Monthly variations of different environmental features in the Vellar river ecosystem depend on the fresh water discharge, which in turn is chiefly controlled by the pattern of rainfall in the study areas. Environmental conditions in most of the tropical pond and lake are largely governed by marked seasonal and spatial changes induced by the monsoonal cycle [10] important parameter for the biochemical and physiological process in the aquatic organisms. In the present study, atmospheric and surface water temperature values varied from 27°C to 32°C during the study period in these stations. Water temperature plays an important role in influencing the periodicity, occurrence and abundance of phytoplankton. It is known fact that the duration and intensity of light are most important factors controlling the algal periodicity. However, many years ago Fritsch and Rao stressed more on the significance of bright sunshine than temperature in the production of green algae [11] stated that high temperature favoured the growth of certain taxa of Chlorococcales [12] also stated that chlorococcales can grow in a wide range of temperatures i.e., 19°C to 37°C. However, very high temperature exerts an inhibitory influence on the growth of Euglenineae [13].

The values of the total dissolved solids varied from 4219 ± 776.9 mg 1^{-1} to 6891 ± 310.5 mg 1^{-1} during winter season. During summer season, TDS values varied from 4190 ± 602.3 mg 1^{-1} to 4650 ± 260.9 mg 1^{-1}. A highest value of 6891 ± 310.5 mg 1^{-1} recorded in station 1 which may be due to the fact that the river water carries different types of solid wastes during the winter season. Further TDS value was decreased in summer which might be due to low level of flowing water in station 1. No remarkable difference observed in station 3. The dissolved solids may directly increase the turbidity of water which in turn affects the light penetration. In the present investigation, the TDS values are higher than the permissible limits suggested in [14].

The electrical conductivity recorded in station 1, 2 & 3 is given in (**Table 1 & 2**). It varied from **423** ± 70.2 µmhos/cm to **981** ± 202.7 µmhos/cm in winter season, and it varied from 401 ± 60.6 µmhos/cm to **719** ± 162.8 µmhos/cm in summer season. The conductivity usually depends upon the dissolved nutrients and other dissolved ions have reported higher conductivity after the disposal of paper mill effluents in Cauvery river [15] and [16] also reported higher conductivity value in natural freshwater after discharge of sugar factory effluents. Values of pH, total alkalinity and total hardness observed during the present study period are presented in Table 1 & 2. In the present investigation pH, total alkalinity total hardness variations in station 1,2 & 3 were minimal. The pH of natural waters mainly depends upon the carbonic system and interactions between carbonates and bicarbonates [17]. Changes in the pH of water may be attributed to the climatologically and pollution factors [18]. The pH, alkalinity and hardness of water are generally interrelated factors.

Chloride content of water observed during the present investigation in station 1, 2 & 3 was shown in Table 1 & 2. Chloride variation seems minimal. However, elevated chloride level in summer in station 1 may be due to low level of water. No remarkable variations recorded in station 2 and station 3. [19] Investigated a positive correlation between chloride concentration and phytoplankton population. [20] Suggested that the higher chloride content in the freshwater bodies may be due to pollution effect.

Dissolved oxygen content, BOD and COD values recorded in station 1, 2 & 3 are presented in Table 1& 2. The variation of these factors appears to be minimal during the study period. The dissolved oxygen is very essential for the respiratory metabolism of all aquatic animals and it favours the solubility and availability of many nutrients to the animals, therefore, increasing the productivity of the aquatic ecosystem [21]. The dissolved oxygen content in the water bodies depends on the temperature and seasons. A study on correlation between dissolved oxygen and total phytoplankton showed an inverse relationship between them indicating that the changes in the dissolved oxygen content might be due to the abundance of phytoplankton [19, 22] observed a negative correlation between dissolved oxygen content and phytoplankton community. However [23] reported a negative correlation between dissolved oxygen content and phytoplankton productivity. Biological oxygen demand is the measure of the degradable organic material present in a water sample and can be defined as the amount of oxygen required by the microorganisms in stabilizing the biologically degradable organic matter under aerobic conditions. Chemical oxygen demand was the measure of oxygen consumed during the oxidation of the oxidizable organic matter by a strong oxidizing agent. Potassium dichromate in the presence of sulphuric

acid was generally used as an oxidizing agent in determination of COD. In the present study, the values are within the prescribed limits of ICMR (1975) indicating that the water bodies not highly polluted.

The values of nitrate, sulphate and phosphate recorded in the present investigation are presented in Table 1 &2. Nitrate is an important factor which controls the occurrence and abundance of phytoplankton. A correlation study with total plankton, chlorophyceae, Bacillariophyceae and Cyanophyceae showed a positive relationship with nitrate content. [19] Stated that Cyanophyceae algae are capable of growing rapidly in minimal quantities of nitrate and phosphate**.** [13] stated that the nitrate is the main nutrients controlling the periodicity of diatoms while [13] reported that nitrate and phosphate both are significantly important for planktonic growth [12] suggested that water bodies in general having enough content of phosphate and nitrate support the growth of volvocales. It has been reported that the nutrient, sulphate, may induce the growth of phytoplankton [24]. Many workers have reported seasonal fluctuations of phosphate in the freshwater environment [25, 19]. A study on correlation between phosphate content and phytoplankton showed a negative relationship indicating that this phosphate nutrient is utilized by phytoplankton for their growth and development [19]. Research of [26] reported that the development and growth of diatoms depend upon the phosphate content in the water.

Table 1: Physico-chemical variables (mgl^{-1}) recorded in the study area during monsoon season 2009

S.No	Ecological Parameters	Monsoon season		
		Station1 Vellar river	Station 2 Vellar estuary	Station 3 P. coastal area
	Physical Parameters			
1	Atmospheric temperature (^oC)	26.8	27.2	29.4
2	Surface water temperature (^oC)	27	28	28
	Chemical Parameters			
3	pH	7.1	7.2	7.8
4	Electrical Conductivity (EC) (µmhos / cm)	891±1978	662 ± 106.3	562 ± 81.3
5	Total Dissolved Solids (TDS)	5931±291.2	4763 ±291.6	4473 ± 672.4
6	Dissolved Oxygen (DO)	3.26 ± 0.33	5.10 ± 0.03	4.82 ± 81
7	Biologoical Oxygen Demand (BOD)	2.66 ± 0.19	1.73 ± 0.11	0.87 ± 0.01
8	Chemical Oxygen Demand (COD)	2.01 ± 0.01	7.10 ± 0.77	4.36 ±0.01
9	Chloride	18.2 ± 4.26	29.3 ± 8.82	31.2 ± 4.26
10	Total Alkalinity	89 ± 11.03	114 ± 7.26	122 ± 7.33
11	Total hardness	128 ± 4.77	1.32 ± 11.46	126 ± 1.13
12	Nitrate (NO_3)	46.33±1.3	48.11 ± 1.12	30.73 ± 3.16
13	Sulphate (SO_4)	31.22±1.76	32.16 ± 0.11	36.74 ± 1.21
14	Phosphate (PO_4)	19.26 ±1.33	16.26 ± 1.82	16.78 ± 12.6

Table 2: Physico-chemical variables (mgl^{-1}) recorded in the study area during summer season 2010

S.No	Ecological Parameters	Summer season		
		Station1 Vellar river	Station 2 Vellar estuary	Station 3 P. coastal area
	Physical Parameters			
1	Atmospheric temperature (^oC)	33	34	33.2
2	Surface water temperature (^oC)	29	30	32
	Chemical Parameters			
3	pH	7.2	7.3	7.4
4	Electrical Conductivity (EC) (µmhos / cm)	816 ± 182.2	632 ± 7.82	426 ± 70.1
5	Total Dissolved Solids (TDS)	42.41±316.2	45.20±271.6	39.30± 32.06
6	Dissolved Oxygen (DO)	3.60 ± 0.18	4.46 ± 0.70	4.27 ± 0.63
7	Biologoical Oxygen Demand (BOD)	2.20 ± 0.30	1.84± 0.43	0.96 ± 0.02
8	Chemical Oxygen Demand (COD)	2.16 ± 0.10	6.87 ± 0.41	9.23± 1.36
9	Chloride	22.16 ± 3.23	26.7 ± 3.62	28.1 ± 5.24
10	Total Alkalinity	118± 7.03	106 ± 2.26	112 ± 35.9
11	Total hardness	163 ± 2.05	154± 16.72	132 ± 50.10
12	Nitrate (NO_3)	34.26±2.13	37.16 ± 1.27	36.90 ± 2.30
13	Sulphate (SO_4)	30.34±1.79	32.71± 2.20	36.10 ± 2.30
14	Phosphate (PO_4)	17.30±1.10	18.70 ± 2.91	18.20 ± 2.10

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