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Studies on the Seasonal Variation of Physicochemical Characteristics of Kadiyapattanam Estuary, the South West Coast of India

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Abstract : The objective of the study is to evaluate the physicochemical parameters of river Valliyar adjacent to Kadiyapattanam estuary. For the present study, five sampling stations were identified and water samples were collected for a period of twelve months from June 2015 to May 2016 covering, the monsoon (June-September), post-monsoon (October-January) and pre-monsoon (February-May) seasons. Seasonal variation of physicochemical characteristics of surface water such as water temperature, pH, electrical conductivity, TDS, Alkalinity, Total hardness, sodium, nitrate, chloride, and dissolved oxygen was estimated for the collected samples. Station I (Kadiyapattanam estuary) shows higher values of electrical conductivity, TDS, Total hardness, Sodium, and chloride, in all seasons throughout the study period compared to other stations. Highest value was recorded in Station I at pre monsoon seasons may be due to increase in rate of evaporation. Water quality parameters may vary due to different environmental and climatic conditions, geological location, agricultural practice and land run off during rainy seasons. All stations show values below the acceptable limits except estuary station.

Keywords : Water, seasons, physicochemical characteristics, pollutant, estuary.

Introduction

Nature has plenty of resources in which water is the most important natural resource for the substance of life on biosphere. It is the medium in which all the living process occurs¹. Fresh water on earth is categories into ground water source and surface water source. Most of the fresh water source is in the form of permanent ice locked in polar region (Antarctica and Greenland) or in deep underground aquifers. So the main source of water used for the life on earth and other human activities are surface water bodies like rivers, springs, lakes and shallow underground water. Fresh water is the finite resource essential for use in drinking, bathing, agriculture and industrial, propagation of wild life, fisheries and for domestic purpose². Clean water is essential for survival of all living organisms because synthesis of protein and other biological activities occurred in aqueous media. Majority of the rivers on the planet are receiving pollutant from anthropogenic activities. Water quality of major aquatic ecosystem is getting degraded rapidly due to heavy discharge of pollutants from industries. In fact due to rapid growth of industrialization and urbanization, the quality of surface as well as ground water is seriously affected. Fresh water environmental quality parameters are the natural and manmade physical, chemical, biological and microbiological characteristics of surface as well as ground waters. Water pollution may be defined as the degradation of water quality by the introduction of physical, chemical and biological pollutant into the hydrosphere. The pollution status of the environment depends on the change in concentration of the above quality parameters. Many major rivers, lakes, estuaries and spring are heavily polluted and the main

source includes chemical discharges, untreated sewage and industrial effluence, and agrochemical waste that runoff from agricultural field.

The objective of the present study was to analyse the physicochemical characteristics of Kadiyapattanam estuary, where river Valliyar conflicts with Arabian Sea the South west coast of India.

Description of Study Area

Kanyakumari district is a coastal district situated at the southernmost tip of India. It is situated between $77^{\circ}15'$ and $77^{\circ}36'$ east longitude and $8^{\circ}03'$ and $8^{\circ}35'$ north latitude. This district receives rain fall during monsoon seasons, both south west (June to September) and north east monsoon (October to December). Rivers also collect maximum amount of water during monsoon season and get flooded. Kadiyapattanam is one of the minor estuaries in Kanyakumari District. Valliyar is the one of the main river systems in the district. Valliyar along with its tributary Thoovalar originates from Velimalai Hills in Western Ghats and travels about 29kms before entering into Arabian Sea through Kadiyapattanam estuary. Station I Kadiyapattanam Estuary is the bar mouth of the river Valliyar. Kadiyapattanam estuary situated about 32 kilometers northwest of Cape Comorin falling within the latitude $8^{\circ}12'N$ and longitude $77^{\circ}29'E$ and $77^{\circ}31'E$. Natural radiation levels in this region are higher than normal which are believed to be emitted from the rich deposits of the monazite bearing beach sands. Station II Manavalakurichi Bridge is situated approximately 2kms from estuary station. Station III Thiruninarkurichi is a very beautiful place situated 3kms away from station II. The surrounding area of this location is mainly agriculture field. Station IV Keezhkalkurichi is situated approximately 4.5kms away from station III. In this station where its tributary Thoovalar joins with Valliyar. Station V Puliyoorkurichi is situated approximately 3kms away from station IV.

Materials and Methods

To study the seasonal variation of physicochemical characteristics of river Valliyar adjacent to Kadiyapattanam estuary was selected. For the present study, five different locations were selected and water was collected for a period of twelve months from June 2015 to May 2016 covering the monsoon (June-September), post-monsoon (October-January) and pre-monsoon (February-May) seasons. Samples from 5 selected stations were collected in pre cleaned two liter plastic bottles every month. Collection of samples was done between 8am and 10am every month. Physicochemical characteristics such as water temperature, pH, electrical conductivity, TDS, Alkalinity, Total hardness, sodium, nitrate, chloride, and dissolved oxygen were estimated for the collected samples following standard methods and procedures.³⁻⁵ Water temperature is measured on site using thermometer. The pH of the sample is measured using calibrated pH meter and conductivity meter is used for measuring electrical conductance. Alkalinity is determined using volumetric method following mixed indicator system. Total hardness is estimated using EDTA method. Concentration of sodium is determined using flame photometric method. Chloride content in the water sample is measured by Argentometric method and dissolved oxygen by Winkler's method.

Results and Discussion

The present investigation deals with the study of seasonal variation of physicochemical characteristics of Kadiyapattanam estuary. To carry out the work 5 different stations were selected and samples were collected throughout the year from June 2015 to May 2016. Results obtained for water samples at 5 different stations were represented in the tables listed below. The result observed was compared with the standards specified for surface waters^{6,7}. Some parameters in station I show higher values and this may be due to weathering of rocks, anthropogenic activities or surface runoff of water during rainy season. Seasonal variation depends on local rain fall, tidal incursion and fresh water inflow⁸.

Seasonal Variation of water temperature at five different stations during three seasons is shown in table I. Lowest value of water temperature ($26.5^{\circ}C$) was recorded at station I Kadiyapattanam estuary in the post monsoon season and highest water temperature ($27.8^{\circ}C$) at station V in the pre-monsoon season. The pH is the measure of hydrogen ion (H^+) concentration of a solution. It is the measure of the intensity of acidity or alkalinity of the sample. A seasonal variation of pH is shown in the table 2. The pH of water samples ranges from 6.9 to 7.47. Due to the mixing of fresh water with sea water, the estuary station shows slightly alkaline pH,

the highest value (7.47) is observed at station I in pre-monsoon season and lowest (6.9) at station IV in monsoon season. Conductivity measurement gives an idea about the ionic concentration of water samples. Seasonal Variation of Electrical Conductivity at different stations is shown in Table-3. In the present study the highest value (6,830.5 μ S/cm) of electrical conductivity was observed in samples from station (I) Kadiyapattanam estuary in pre-monsoon season. Station I shows higher values in all seasons compared to other stations. Lowest value (137.25 μ S /cm) was observed in station V in the monsoon season. Higher conductivity values obtained for estuary station may be due evaporation, high salinity or variation in the discharge of river water. Number of studies explained the higher values of electrical conductivity in estuaries^(9, 10). Seasonal variation of Total dissolved solids content in the water samples of different stations is shown in the table-4. TDS is the presence of dissolved minerals in water samples. The present study indicates higher values of TDS in the station I (4,965.25 mg/l) in the pre-monsoon season. The lowest value (90.5 mg/l) was seen in station V in the monsoon season. There are number of studies which indicate higher values of TDS in estuaries¹¹ during pre-monsoon season.

Table -1 Seasonal Variation of water temperature in °C

Stations	Monsoon (average of 4 months)	Post-monsoon(average of 4 months)	Pre-monsoon (average of 4 months) °C
I	26.7	26.5	27
II	26.9	26.8	27.4
III	27	27.2	27.5
IV	27.2	27.5	27.7
V	27.2	27.3	27.8

Table-2 Seasonal Variation of pH

Stations	Monsoon (average of 4 months)	Post-monsoon(average of 4 months)	Pre-monsoon (average of 4 months)
Station I	7.24	7.10	7.47
Station II	7.07	7.05	7.00
Station III	7.00	6.98	7.00
Station IV	6.90	7.06	7.01
Station V	6.97	6.92	6.93

Table-3 Seasonal Variation of Electrical Conductivity (μ S/cm)

Stations	Monsoon (average of 4 months)	Post-monsoon(average of 4 months)	Pre-monsoon (average of 4 months)
Station I	1,890.50	1,014.00	6,830.50
Station II	190.75	212.25	262.75
Station III	173.75	184.00	243.50
Station IV	151.75	274.00	218.75
Station V	137.25	169.00	225.75

Table-4 Seasonal Variation of TDS (mg/l)

Stations	Monsoon (average of 4 months)	Post-monsoon (average of 4 months)	Pre-monsoon (average of 4 months)
Station I	1,283.25	715.25	4,965.25
Station II	126.25	140.00	173.50
Station III	114.50	121.50	160.75
Station IV	100.00	180.75	259.75
Station V	90.50	111.50	148.75

Table-5 Seasonal Variation of alkalinity (mg/l)

Stations	Monsoon (average of 4 months)	Post-monsoon (average of 4 months)	Pre-monsoon (average of 4 months)
Station I	47.5	40	70
Station II	32	38	35.5
Station III	28.5	36	37
Station IV	26.5	41	45.5
Station V	25	33	42

Table-6 Seasonal Variation of total hardness (mg/l)

Stations	Monsoon (average of 4 months)	Post-monsoon (average of 4 months)	Pre-monsoon (average of 4 months)
Station I	415.75	207.75	1,633.50
Station II	58.00	48.00	62.50
Station III	50.00	44.00	68.00
Station IV	42.50	64.00	83.00
Station V	39.50	51.00	55.00

Table-7 Seasonal Variation of sodium (mg/l)

Stations	Monsoon (average of 4 months)	Post-monsoon (average of 4 months)	Pre-monsoon (average of 4 months)
Station I	215.25	101.25	873.00
Station II	14.50	22.75	25.50
Station III	15.50	19.25	21.25
Station IV	14.75	30.25	43.25
Station V	12.50	13.75	24.25

Table-8 Seasonal Variation of nitrate (mg/l)

Stations	Monsoon (average of 4 months)	Post-monsoon (average of 4 months)	Pre-monsoon (average of 4 months)
Station I	1.50	2.25	1.50
Station II	1.50	2.25	2.00
Station III	1.50	2.50	1.75
Station IV	1.25	1.75	2.00
Station V	1.00	1.50	1.50

Table-9 Seasonal Variation of chloride (mg/l)

Stations	Monsoon (average of 4 months)	Post-monsoon(average of 4 months)	Pre-monsoon (average of 4 months)
Station I	695.00	283.25	1,816.00
Station II	38.50	38.00	50.00
Station III	38.00	32.50	49.00
Station IV	29.50	45.00	49.50
Station V	28.50	32.00	40.00

Table-10 Seasonal Variation of dissolved Oxygen (mg/l)

Stations	Monsoon (average of 4 months)	Post-monsoon(average of 4 months)	Pre-monsoon (average of 4 months)
Station I	5.00	6.60	6.25
Station II	5.48	6.80	6.85
Station III	6.28	6.88	6.90
Station IV	5.60	6.83	6.80
Station V	6.60	6.93	6.75

Seasonal Variation of alkalinity in the water samples of different stations is shown in the table-5. Lowest value of alkalinity (25mg/l) was recorded at station V in monsoon season and the highest value (70mg/l) of alkalinity was recorded at station I in the pre-monsoon season. Alkalinity observed for different station at the three seasons shows that all the values are under acceptable limit. Hardness is due to the presence of bicarbonate, chloride and sulphate of calcium and magnesium ion. Seasonal variation of total hardness of water samples at three seasons were shown in table-6. The highest value (1633.5mg/l) of total hardness is found in station (I) kadiyapattanam estuary in pre-monsoon season and lowest value of hardness (39.5mg/l) was seen at station V during monsoon season. Estuary station shows higher values in all three seasons. Weathering of salt deposit rocks, which are in contact with water are the natural source of sodium. Seasonal variation of concentration of sodium in water samples at three seasons were shown in table-7. The seasonal variation shows higher values (873 mg/l) in station (I) in pre-monsoon season and lowest value of sodium (12.5 mg/l) was seen at station V during monsoon season. Station I Kadiyapattanam estuary shows higher values in all seasons compared to other stations. Nitrate mainly enters into the water body from nitrogenous fertilizers used in the agricultural land by surface runoff. Seasonal variation of nitrate in water samples at three seasons at five different stations were shown in table-8. The highest value of nitrate (2.5mg/l) is found in station (III) in post-monsoon season and lowest value of nitrate (1mg/l) was seen at station V during monsoon season. The observed values show that all are well below the acceptable limit. Seasonal variation of chloride in the water samples of different stations is shown in the table-9. Chloride was found maximum (1816 mg/l) in station I in pre-monsoon season. Lowest value of chlorine (28.5 mg/l) was observed in station V in monsoon seasons. There is an increased concentration of chloride in all seasons in station I (Kadiyapattanam estuary). This may be due to the mixing of sea water with river water. In all other stations, the seasonal variations of chloride concentrations are under permissible limit. High chloride concentration leads to corrosion and damage bridges¹². Solubility of oxygen in water decreases when water temperature and salinity increases¹³. Seasonal Variation of dissolved Oxygen is shown in table 10. Certain concentration of dissolved oxygen is required for the support of aquatic life. Comparatively higher value (6.93 mg/l) of Dissolved Oxygen was observed in post-monsoon season in station (V) and lowest value (5mg/l) was found in station I in the monsoon season. Low value of dissolved oxygen may be due to the addition of high organic content leading to oxygen depletion.

Conclusion

The present study of investigating seasonal variation of physicochemical characteristic of river Valliyar adjacent to kadiyapattanam estuary, five different stations were selected and samples were collected for a period of twelve months continuously. The result obtained indicates that station I (Kadiyapattanam estuary) shows higher values of electrical conductivity, TDS, Total hardness, Sodium, and chloride, in all seasons throughout the study period compared to other stations. Since it is an estuary station, the variations may be due to over

mixing of sea water with fresh water. Water quality parameters vary due to different environmental conditions; geological location, modern agricultural practice and land run off during monsoon seasons. The estuarine region gets more polluted compared to other stations. Higher values obtained for Electrical conductivity, TDS, hardness, chloride and sodium in estuary station may be due natural weathering of rocks, and water pollution due to the discharge of industrial waste , use of agrochemical fertilizers and anthropogenic activities. High concentration of chloride leads to corrosion. Sewage should be properly treated before discharge in to water bodies, otherwise it will leads to serious environmental and health problems.

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