



Studies on the seasonal variation of water quality parameters of Manakudy estuarine region, South West coast of India

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Abstract : The present study includes the analysis of Manakudy estuary with adjoining rivers for a period of one year from October 2016 – September 2017. Water samples in the present study were analyzed for physico chemical parameters like pH, EC, Turbidity, TDS, Phosphate, Nitrate, Chloride, Ammonia, DO and Fluoride by Standards methods. Mean values of seasonal variation shows that pH was high in post monsoon and low in monsoon, EC and Fluoride were high in pre monsoon and low in post monsoon, TDS and Chloride were high in pre monsoon and low in monsoon. Turbidity, phosphate, Nitrate, Ammonia and DO were high in monsoon and low in post monsoon. Parameters of water samples in all the five stations results considerable seasonal changes.

Keywords : water, estuarine region, physico chemical parameters, seasonal variation.

Introduction

Estuaries are the meeting place of saltwater from the sea and freshwater from rivers, are dynamic environments characterized by large fluctuations in environmental conditions (1). Estuaries and mangroves are highly potential for fishery development in the aquatic environment and are considered as the potential source for feeding, spawning and nursery ground for most of the fin fishes and shell fishes. Rivers play a major role in assimilation or carrying off of municipal and industrial wastewater and runoff from agricultural land, the former constitutes the constant polluting source whereas the later is a seasonal phenomenon. Physico chemical properties of the water gets varied season wise and in addition, anthropogenic activities such as agriculture, urbanization, domestic sewage, etc in the catchment area result in the deterioration of water quality (2). Temperature, turbidity, nutrients, hardness, alkalinity and dissolved oxygen are some of the important factors that play a vital role for the growth of living organisms in the water body. The objective of the study is to find out the physico chemical parameters of water samples of Manakudy estuary and adjoining rivers.

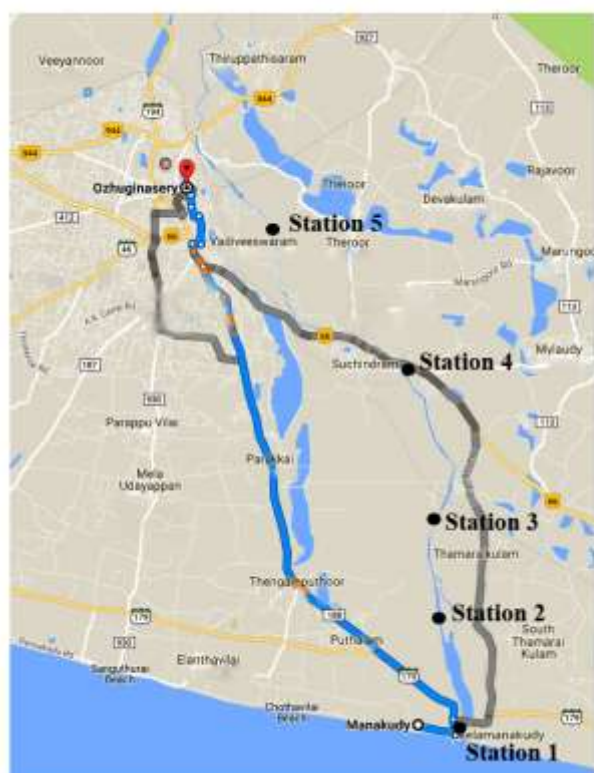
Description of Study Area

The Manakudy estuary is the second largest estuary in Kanyakumari District. It has a total area of 145 hectares. Manakudy estuary is situated about 8 kilometers north west of cape Comorin falling within the latitude

International Journal of ChemTech Research, 2018,11(02): 394-398.

DOI= <http://dx.doi.org/10.20902/IJCTR.2018.110247>

8°4' and 8°21' N and longitude 77°26' and 77°30' E. The climate of the region is greatly influenced by both South West and North East monsoons. The tail end of Pazhayar River merges with the Arabian Sea at Manakudy. The river originates at the Western Ghats, flowing through Surlodu, Azhagiapandipuram, Ozhiginasery, Suchindrum, Thamaraiikulam finally destinating at Manakudy covering a distance of 67kms. It is a sand built estuary connected to the sea during the rainy season. During the period of total occlusion of the river mouth, the estuarine water swells due to heavy inflow of water from the head of the estuary and also by the land drainage. During heavy inflow into the estuary the sand bar opens up under the force of gravity. Compared to the expanse of the estuarine area, the bar mouth is relatively small and even during summer months the local people cut open the bar mouth and the estuary has open access to the sea. The location map of Manakudy estuary is shown in fig 1. Station 1 is located at the mouth of the estuary, Station 2 is Puthalam which is 6 km away from station 1, Station 3 is Thamaraiikulam which is 10 km away from station 1, Station 4 is Suchindrum, which is 14 km away from station 1 and Station 5 is Ozhiginasery which is 18 km away from station 1.



- Station 1**
Manakudy Estuary
- Station 2**
Puthalam
- Station 3**
Thamaraiikulam
- Station 4**
Suchindrum
- Station 5**
Ozhiginasery

Materials and Methods

Water samples were collected for a period of one year from October 2016 – September 2017. Five sampling stations representing different ecological conditions were chosen for collection of water samples in the Manakudy estuary from estuarine mouth bed to Ozhuginasery river basin. Sampling was done usually during the morning hours between 9.00 am to 11.00 am. Water samples were collected by using 3 liter polyethylene plastic containers. All containers were rinsed at least three times with sample water that was to be analyzed. For analysis of dissolved oxygen content, water samples were fixed immediately in separate BOD sample bottles. After collection the water samples were packed and brought to the laboratory for the analysis of various physicochemical parameters. pH was measured using digital pH meter. Electrical conductivity measured using conductivity meter. Turbidity was determined by turbidometer. TDS was determined using water analyzer (Elico, PE 138). Phosphate was determined by standard method, described in APHA 1998 (3). Nitrate was determined by Cadmium Reduction Method APHA 1998. Chloride was determined by modified Mohr's Argentometric titration method. Ammonia was determined by indophenol blue method of Koreleff (4). Dissolved oxygen was determined by Winkler's method (5). Fluoride was determined by SPANDS method.

Results and Discussion

Variation of physico chemical parameters of water samples collected from Manakudy estuary during the period of October 2016 to September 2017 are given in Table 1 and the seasonal variation of physico chemical parameters are given in Table 2.

Table: 1 Variation of Physico-chemical parameters of water samples recorded at Manakudy estuary from October 2016 – September 2017.

Parameters	Stations				
	S1	S2	S3	S4	S5
pH	8.35 ± 0.13	8.23 ± 0.19	7.59 ± 0.52	6.94 ± 0.41	6.61 ± 0.09
EC (dS/m)	3.25 ± 0.11	3.22 ± 0.09	3.12 ± 0.25	2.74 ± 0.50	2.41 ± 0.26
Turbidity (NTU)	2.31 ± 0.70	2.3 ± 0.72	2.18 ± 0.75	2.12 ± 0.77	1.78 ± 0.62
TDS (ppt)	3.41 ± 0.17	3.39 ± 0.16	3.34 ± 0.19	3.24 ± 0.22	3.19 ± 0.24
Phosphate (µg/l)	1.16 ± 0.34	1.13 ± 0.32	1.07 ± 0.30	0.81 ± 0.25	0.66 ± 0.27
Nitrate (µg/l)	7.56 ± 1.54	7.47 ± 1.62	6.54 ± 1.29	6.06 ± 1.24	5.09 ± 1.13
Chloride (mg/l)	194.4 ± 72.43	186.98 ± 72.33	158.9 ± 63.88	71.36 ± 19.56	59.7 ± 16.57
Free ammonia (mg/l)	1.01 ± 0.18	1.24 ± 0.20	0.71 ± 0.16	0.73 ± 0.11	0.79 ± 0.28
DO (mg/l)	5.39 ± 0.52	5.38 ± 0.61	5.25 ± 0.78	6.07 ± 0.57	6.22 ± 0.70
Fluoride (mg/l)	0.83 ± 0.08	0.68 ± 0.09	1.25 ± 0.10	1.2 ± 0.09	1.14 ± 0.20

Table: 2 Seasonal Variation of Physico - chemical parameters of water samples of Manakudy estuary from October 2016 – September 2017.

Parameters	Post monsoon	Pre monsoon	Monsoon
pH	7.7 ± 0.85	7.6 ± 0.72	7.3 ± 0.76
EC (dS/m)	2.76 ± 0.42	3.15 ± 0.32	2.95 ± 0.36
Turbidity (NTU)	1.28 ± 0.14	2.21 ± 0.28	2.29 ± 0.24
TDS (ppt)	3.33 ± 0.06	3.42 ± 0.09	3.19 ± 0.11
Phosphate (µg/l)	0.65 ± 0.15	0.92 ± 0.23	1.32 ± 0.26
Nitrate (µg/l)	4.95 ± 0.76	7.04 ± 0.58	7.65 ± 1.74
Chloride (mg/l)	122.54 ± 65.97	191.64 ± 101.05	88.62 ± 26.16
Free ammonia (mg/l)	0.73 ± 0.19	0.92 ± 0.25	1.05 ± 0.24
DO (mg/l)	5.04 ± 0.47	5.51 ± 0.41	6.45 ± 0.49
Fluoride (mg/l)	0.985 ± 0.26	1.055 ± 0.23	1.035 ± 0.27

In the present study, pH value of water varied from 6.5 – 8.5. The maximum value of pH was recorded at station 1 (8.35) and the minimum value of pH was recorded at station 5 (6.61), Table 1. Maximum value was recorded in post monsoon season (7.7 ± 0.85) and minimum value was recorded in monsoon season (7.3 ± 0.76). The low pH observed during the monsoon season may also be due to the influence of rainwater, low temperature and organic matter decomposition given by (6). Similar trends in pH also been reported by (7) in Bonny River. EC value of water varied from 2.01 - 3.45 dS/m. The maximum value of EC was recorded at station 1 (3.25) and the minimum value of EC was recorded at station 5 (2.41), Table 1. Maximum value was recorded in pre monsoon season (3.15 ± 0.32) and minimum value was recorded in post monsoon season (2.76 ± 0.42). It is due to the river water enters into the estuary, wide variation in the discharge of fresh water. Similar results reported in (8). Turbidity value of water varied from 1.11-3.13 NTU. The maximum value of turbidity was recorded at station 1 (2.31) and the minimum value of turbidity was recorded at station 5 (1.78), Table 1. Maximum value was recorded in monsoon season (2.29 ± 0.24) and minimum value was recorded in post monsoon season (1.28 ± 0.14). High turbidity was obtained during monsoon where fresh water meets sea water.

This is due to the movement of water in and out of the estuary by tides, causing fine particles to mix and be stirred up postmonsoon season settlement of silt, clay results low turbidity. Same results were reported by (9). TDS value of water varied from 2.81 - 3.62 ppt. The maximum value of TDS was recorded at station 1 (3.41) and the minimum value of TDS was recorded at station 5 (3.19), Table 1. Maximum value was recorded in pre monsoon season (3.42 ± 0.09) and minimum value was recorded in monsoon season (3.19 ± 0.11). This is due to the dissolved solids runoff water, household wastes, sewage and many effluents.

Phosphate value of water varied from 0.39-1.60 $\mu\text{g/l}$. The maximum value of phosphate was recorded at station 1 (1.16) and the minimum value of phosphate was recorded at station 5 (0.66), Table 1. Maximum value was recorded in monsoon season (1.32 ± 0.26) and minimum value was recorded in post monsoon season (0.65 ± 0.15). It might be due to the intrusion of sea water as well as heavy rainfall and mixing of land run off from agricultural fields contaminated with super phosphates and alkyl phosphates from soap and detergents used by the public for bathing and washing cloth, agricultural wastes. Faecal contamination and excreta of birds enhanced the higher level of phosphate in the mangrove ecosystems. Same result was reported by Prasanna and Rajan, (10) from Dharma estuary. Nitrate value of water varied from 3.82 - 9.95 $\mu\text{g/l}$. The maximum value of nitrate was recorded at station 1 (7.56) and the minimum value of nitrate was recorded at station 5 (5.09), Table 1. Maximum value was recorded in monsoon season (7.65 ± 1.74) and minimum value was recorded in post monsoon season (4.95 ± 0.76). Similar study shows that the higher nitrate value recorded during monsoon season may be due to heavy rainfall, and runoff contaminated with fertilizers from the surrounding coconut gardens and paddy fields (11). Chloride value of water varied from 35.5 - 287.9 mg/l. The maximum value of chloride was recorded at station 1 (194.4) and the minimum value of chloride was recorded at station 5 (59.7), Table 1. Maximum value was recorded in pre monsoon season (191.64 ± 101.05) and minimum value was recorded in monsoon season (88.62 ± 26.16). This may be due to the continuous dissolving of chlorine in rain water which is washed away from the estuary. The presence of chloride ion influences the marine community in the estuarine system. Human excreta and industrial wastes are rich in chlorides (12). High amount of chloride fertilizer used for irrigation is also harmful for aquatic life.

Free ammonia value of water varied from 0.4-1.6 mg/l. The maximum value of free ammonia was recorded at station 2 (1.24) and the minimum value of free ammonia was recorded at station 3 (0.71), Table 1. Maximum value was recorded in monsoon season (1.05 ± 0.24) and minimum value was recorded in post monsoon season (0.73 ± 0.19). This is due to surface water runs offs agricultural wastes, decaying dead plants wastes and decomposition increased the value maximum in monsoon. Excess ammonia shows that polluted water and algal growth. The higher concentration could be partially due to the death and subsequent decomposition of phytoplankton and also due to the excretion of ammonia by planktonic organism (13). DO value of water varied from 4.19 -7.22 mg/l. The maximum value of DO was recorded at station 5 (6.22) and the minimum value of DO was recorded at station 3 (5.25), Table 1. Maximum value was recorded in monsoon season (6.45 ± 0.49) and minimum value was recorded in post monsoon season (5.04 ± 0.47). The highest value recorded during monsoon season was due to the turbulence of water facilitating the diffusion of atmospheric oxygen and the increased solubility of oxygen at lower temperature (14). Fluoride value of water varied from 0.5-1.4 mg/l. The maximum value of fluoride was recorded at station 3 (1.25) and the minimum value of fluoride was recorded at station 2 (0.68), Table 1. Maximum value was recorded in pre monsoon season (1.055 ± 0.23) and minimum value was recorded in post monsoon season (0.985 ± 0.26).

Conclusion

The present study reveals that EC, TDS, Fluoride and Chloride were maximum in pre monsoon season. Turbidity, DO, Nitrate, Phosphate and Ammonia were maximum in monsoon season. pH was maximum in post monsoon season. From the aboveresults it was clear that Manakudy estuary was highly polluted. This pollution attributed to the anthropogenic activities, household wastes, agricultural wastes like fertilizers, pesticides, domestic sewages, coconut husk retting effluents deteriorate the water quality of the estuary and other activities near the river and estuaries which lead to the intrusion of the sea water in to the river water. These activities which cause damaging to water. So it is necessary to advice the public and creates awareness about the pollutants to protect the Manakudyestuarine water. The wastes must be treated properly before entering into the estuary.

Acknowledgement

The authors are thankful to the management and staff of S.T. Hindu college, Nagercoil, Kanyakumari District, Tamil Nadu.

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