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Water pollution Status of Varahanadhi River by Physico-chemical Analysis

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Abstract: Water is the most essential and prime necessity of life. It is an essential requirement for the life supporting activities. The usual source of drinking water is from rivers, wells and bore wells which are usually not treated. Quality of water generally refers to the component of water, which is to be present at the optimum level for suitable growth of plants and animals. Aquatic organisms need a healthy environment to live and have adequate nutrients for their growth. The productivity depends on the physicochemical characteristics of the water body. The maximum productivity is obtained when the physical and chemical parameters are at optimum level. In the present investigation, different locations of Varahanadhi river were sampled and analyzed over a period of one year for various physico – chemical water quality using appropriate certified and acceptable procedures, in order to access the purity of the water in the upstream, midstream and downstream within the basin for drinking and other domestic uses. This river was chosen as a case study because of people's reliance on the water for their domestic and agricultural use. The present study emphasizes on the magnitude of pollution by monitoring water quality parameters such as alkalinity, hardness, conductivity, turbidity and total dissolved solids. The results showed that the upstream and midstream remains unpolluted, but the downstream was found to be more polluted.

Introduction

Lakes, rivers and streams are the sources of drinking water, irrigation, fishery and energy production[1]. Almost all the freshwater bodies are being polluted by expanding human population and in consequence, industrialization, intensive agricultural practices and discharges of massive amount of wastewater which result in deterioration of water quality[2]. The main pollutants that pose to natural water quality problems are organic wastes, bacteria, nutrients and other chemical substances. There is an intricate relationship between the external and internal factors in aquatic environments. The physic chemical parameters have major influences on biochemical reactions that occur within the water. Sudden changes of these parameters may be indicative of changing conditions in the water. The physico-chemical However, no comprehensive work has been done till yet to explore the seasonal variation in parameters of different freshwater systems (river, stream, ocean) have

been studied by various researchers[3,4,5,6]. However, no comprehensive work has been done till yet to explore the seasonal variation in physiochemical parameters on the water quality of Varahanadhi river. Keeping this in view, our work was done during the period October 2012- November 2013, to measure some physiochemical parameters of Varahanadhi river water in different seasons.

Varahanadhi river basin is located in parts of Villupuram district in Tamil Nadu, India. It lays 12.04" N latitude and 79.34' E longitude. It covers within the survey of India and covers a total area of 798ha. Total length of the river is about 1298m; with a catchment area of about 21 Km. The Varahanadhi basin is one of the major basins located in Villupuram, Thiruvannamalai, Kancheepuram and Cuddlier districts of TamilNadu and Pondicherry. Varahanadhi basin consists of in Varahanadhi, Ongur and Nallavur sub basins. This basin is surrounded by Bay of Bengal in the east, Palar basin and Nallavur sub basin in the north and Ponnaiyar basin in the south and west.

The study was carried out with the following objectives:

To monitor seasonal variations of physiochemical parameters in the Varahanadhi river,

To assess the water quality parameters for the aquatic organisms in the river.

Experimental

For analysis of various river water parameters AR Grade chemicals (Merck, India) were used. All glassware's and other sample containers were rinsed with double distilled water and sterilized prior to use. Standard methods [7,8].Were used for collection, preservation and estimation of water samples.The present study was carried out over a period of one year from October 2012 – November 2013, in different sites. Site A which is situated in Gingee town and has its source at the hills of Melmalayanur in the South Arcot District of TamilNadu, site B is the branch of the river that flows through Villupuram District and site C is the downstream part of the river called Sankaraparani that drains into Bay of Bengal. Water sampling was carried out in early hour of the morning on a bimonthly basis throughout the study period at three stations. Generally two liters of water sample in 2.5 litre polythene can is sufficient for most of the physical and chemical examinations. The water samples were collected from a depth of 0.5m and collected up to the top with the mouth facing slightly upward in the direction of the current. The container was properly labeled; the samples were transported to the laboratory in an ice box to avoid unpredictable changes in physicochemical and biological characteristics. Sampling and analysis were carried out according to standard methods prescribed by[9].

Table1:List of physicochemical parameters and their methods

S.No	Parameters	Unit	Method
1.	Total Alkalinity	mg/l	Titrimetric method
2.	Total Hardness	mg/l	EDTA Titration
3.	Total Dissolved Solids	mg/l	Digital conductivity meter
4.	Turbidity	NTU	Nephelometric method
5.	Conductivity	µhos/cm	Conductivity meter

Results and discussion

Electrical conductivity:

Electrical conductivity in natural water is the normalized measure of water's ability to conduct electrical current. This is influenced by dissolved salts such as sodium chloride and potassium chloride. If the conductivity of a natural resource increases there is a source of dissolved ions in the vicinity. Therefore conductivity measurements can be used as a quick way to locate potential water quality problems. Higher the value of dissolved solids,greater the amount of ions in water[10]. Increasing levels of conductivity and cations are the products of decomposition and mineralization of organic materials [11]. Seasonal variations showed a higher value of EC in pre-monsoon season and lower value in monsoon season due to dilution with rain water. The electrical conductivity was found to be low at the upstream site of the river. This was due to low salts as there were no polluted areas. Maximum values recorded during themonsoon season at the downstream site may be due to accumulation of ions owing to evaporation, biological turnover and interaction with sediment. These findings are in agreement with the statement of[12]. Elevated level of conductivity along with high dissolved

solids can cause certain physiological effects on desirable food plants and habitat forming plant species, gives a mineral taste in drinking water and can be a problem in water used for irrigation [13].

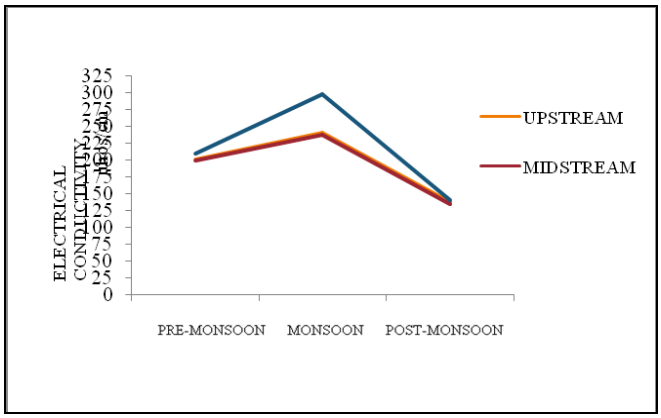

Fig 1 Seasonal variation of electrical conductivity

Turbidity:

Turbidity is another indicator of the amount of material suspended in water, it measures the amount of light that is scattered or absorbed. Suspended silt and clay, organic matter and plankton can contribute to turbidity [14]. In post monsoon season, the concentration of turbidity decreases due to dilution effect by the surface run-off received during rainfall [15].The average concentration of turbidity found higher in monsoon season, due to surface runoff of rainfall that decreased after the settling of suspended matter after monsoon, which supported the statement of [16]. The turbidity at all sampling sites was found to be higher in monsoon season as compared to other seasons which can be attributed to flow of muddy water. Furthermore, the turbidity values of downstream were found to be more than other sites, indicating mixing of both industrial and domestic effluents from the neighboring township area of the river.

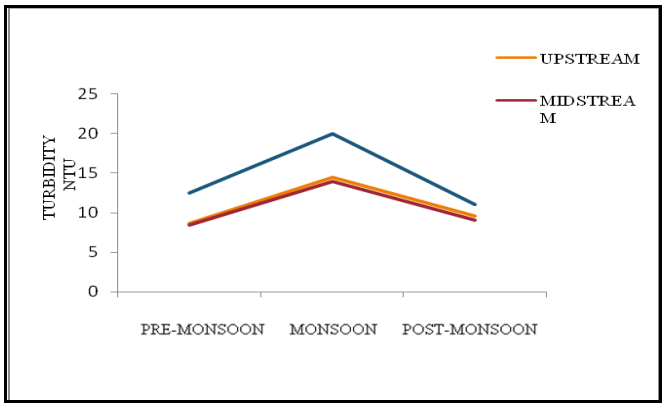

Fig.2 Seasonal variation of turbidity

Alkalinity:

Total alkalinity is the measure of capacity of water to neutralize the acids. Alkalinity of natural water derived principally from the salts of weak acids. Hydroxide, Carbonates and bicarbonate are the dominant source of natural alkalinity. Reactions of carbon dioxide with calcium or magnesium carbonate in the soil creates considerable amounts of bicarbonates in the soil. Organic acids such as humic acid also form salts that increase alkalinity. More levels of total alkalinity are considered to be more productive [17]. According to[18].Removal of carbon from bicarbonates by algae for photosynthesis may increase total alkalinity. Total alkalinity may be used as a tool of productivity. Alkalinity values were found to be higher during post monsoon season at the downstream site than the upstream site and midstream sites, which may be ascribed due to the discharge of industrial and domestic sewage, which puts large amount of alkaline ions into the river system.

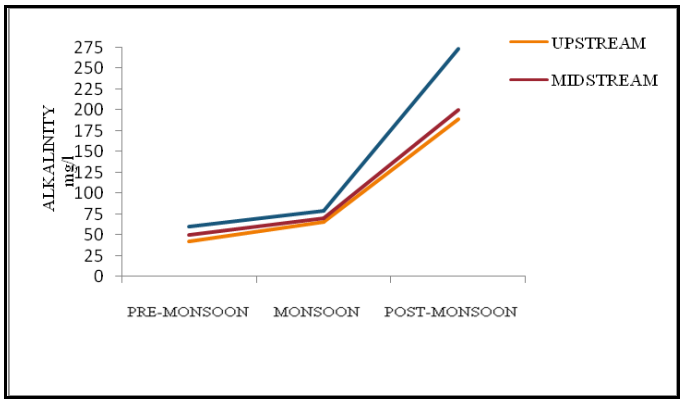

Fig 3 Seasonal variation of alkalinity

Hardness:

Total Hardness is the parameter of water quality used to describe the effect of dissolved minerals mostly (Ca & Mg), determining suitability of water for domestic, industrial and drinking purpose attributed to presence of bicarbonates, sulphates, chloride and nitrates of calcium and magnesium[19]. Calcium occurs in water due to presence of limestone, gypsum, dolomite and gypsiferrous matters. Calcium and magnesium are the major scale forming constituents in raw water. Calcium is an essential element for man (about 2gm daily) and for plant growth. Magnesium is an essential element for human beings, but higher levels of magnesium are harmful as they act as cathartics and diuretics in man. Due to addition of sewage and large scale human use, this might cause elevation of hardness[20, 21, and 22]. Increase in hardness value can be attributed to the decrease in water volume and simultaneous increase in rate of evaporation at high rate temperature, as a result high loading organic substances, detergents and other pollutant [23], which was at the downstream site when compared to the other two streams of the river.

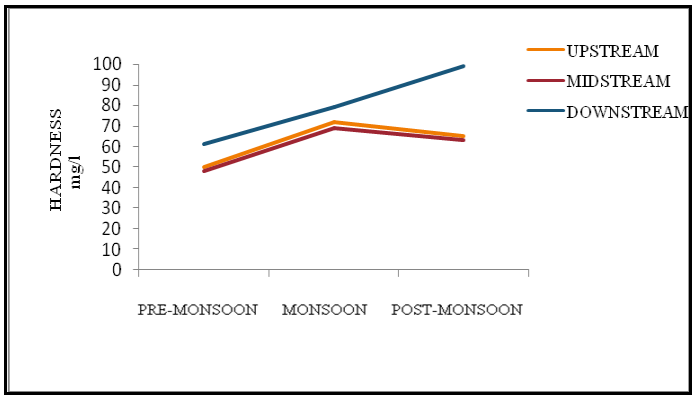

Fig 4 Seasionalvaration of hardness

Total Dissolved Solids:

In water, total dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium and manganese, organic matter, salt and other particles [24]. At high flows, the TDS values tend to be diluted by surface runoff and for most rivers there are an inverse correlation between discharge rate and TDS[25]….

Total dissolved solids indicate the salinity behavior of river water. TDS values were observed at all sampling sites indicating the mixing of pollutants in river from anthropogenic activities in and around the river, such as the mixing of sewerage, cloth washing and garbage dumping, which are some common activities at the riverbank in this area. Higher TDS values were observed in the downstream during monsoon season when compared to other sites of the river, due to the sediment load that was transported from the watershed during rainy season. Higher level of TDS is more likely due to the influence of industrial activities such as effluent addition to the river. Higher TDS in water system at the downstream site was observed during monsoon season, increases the chemical and biological oxygen demand and ultimately depletes the dissolved oxygen level in water. Some but not the entire total dissolved solids act as conductors and contribute to conductance. Waters with high total dissolved solids are unpalatable and potentially unhealthy.

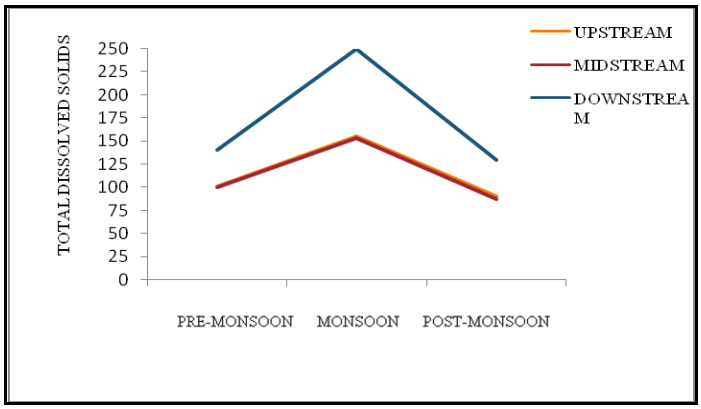

Fig 5 Seasonal variation of total dissolved solids

Table 2:Mean Values of physiochemical parameters at different sites

Parameters	sites	premonsoon	monsoon	Post monsoon
Electrical conductivity µ hos/cm	upstream	201	241	137
	midstream	200	238	135
	downstream	210	298	140
Hardnes s mg/l	upstream	50	72	71
	midstream	48	70	88
	downstream	71	69	77.8
Turbidity NTU	upstream	8.6	10	9.5
	midstream	8.5	9.7	8.9
	downstream	11	14.5	18.2
Alkalinity mg/l	upstream	42	65	189
	midstream	50	69.5	200
	downstream	60	79.1	273.3
Total dissolved solids mg/l	upstream	101.15	155	90
	midstream	100	153	87
	downstream	120	170	250

Conclusion

The study of physical and chemical characteristics of water provides a considerable insight into the quality of water present in rivers, lakes, ponds, oceans, canals and ground water. The water quality is directly related to health and is important for determination of water utility. The increasing concentration of various chemicalsgenerating from the industries and their subsequent release to their surrounding as well as the domestic water released into the drains raised a wide spread and increasing public concern over their adverse effects on human health and environment. Assessment of water quality is a critical factor for assessment of pollution levels. The results from the present study clearly pointed out that river water are highly polluted at the downstream site when compared to that of the other two sites. Thus the study shows that the river water has been polluted which should be dealt with utmost care. The study provides an informative data and helps to understand the contamination of water in the Varahanadhiriver due to discharge of effluents from industries nearby.

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