Physical Attributes of Thamaraparani River Stretch at Kanniyakumari District

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Abstract

Riverine ecosystems is the very source where life and thereby human civilizations originated. Water the finite resource that is very essential for the human existence, agriculture, industry etc. Without any doubt, inadequate quantity and quality of water have serious impact on sustainable development. The present investigation looks into the physico-chemical characteristics of river Thamaraparani stretch flowing through Kanniyakumari district of Tamil Nadu which is under tremendous anthropogenic intervention. The observations reveal that the values of all these parameters indicate deterioration in water quality towards the downstream side due to additional discharge of sewage, illegal sand mining, inflow of agricultural wastes including harmful pesticides and other chemicals at successive downstream points.

Key words: Temperature, Turbidity, pH, Conductivity, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD)

I Introduction

Water is the most 'precious 'of all natural resources available on earth and the greatest gift of nature to biota. It fell freely from clouds and bubbled as springs in the hills, is fast becoming a rare commodity in its pure form. Man's desire to conquer nature for resources has put him in collision with natural environment. Over many areas of the ecosphere it has become a limiting factor, to plant and animal biodiversity and primary production. Water covers about two third of the surface area of earth and out of this 97.2% is in the oceans and fresh water regime constitutes only about 2.8%. Most of the freshwater is not available to man as it is blocked in glaciers and icecaps and another fraction remains underground. The contribution of rivers to the quantum of fresh water is only 0.0001% (Allan, 1995). Aquatic ecosystems are historically the source of life on earth. They are discrete parts of landscape with an abundant array of flora and fauna. It is the medium within which all aspects of the ecosystem coexist, both living and non-living and is the source of all nutrients for aquatic life including the gaseous nutrients such as oxygen and carbon dioxide. The aquatic environment provides nursery grounds for many organisms from microbes to fish as well as a resting and feeding place for migratory birds and a habitat for a great variety of mammals.

The ecology of river which is a lotic habitats differs from lentic systems by the dominance of linked flow, erosion, deposition and substrate processes. Lotic ecosystems are dynamic, multicomponent, complex, heterogeneous entity where the abiotic and biotic components are in constant interaction with each other. The unidirectional flow of water, linear patters, short residence time of water, erosion, deposition and changing boundary conditions through out the length of the system impart its uniqueness. River systems are increasingly degraded due to discharge of wastes generated in municipal, industrial and agricultural areas into the rivers and tributaries (Kannel *et al*., 2007). Pollutant sources of lotic systems are hard to control because they derive, often in small amounts, over a very wide area and enter the system at many locations along its length. Agricultural fields often deliver large quantities of sediments, nutrients, and chemicals to nearby streams and rivers. Urban and residential areas can also add to this pollution when contaminants are accumulated on impervious surfaces such as roads and parking lots that then drain into the system. Elevated nutrient concentrations, especially nitrogen and phosphorus which are key components of fertilizers, can increase periphyton growth, which can be particularly dangerous in slow-moving stream (Cushing and Allan, 2011). The authors also suggest that many rivers are dammed at multiple locations, amplifying the impact. Dams can cause enhanced clarity and reduced variability in stream flow, which in turn cause an increase in periphyton abundance. Invertebrates immediately below a dam can show reductions in species richness due to an overall reduction in habitat heterogeneity.

The composition of river water, which supports living medium, is subject to spatial and temporal variations. The physiochemical properties of river water impart profound influence in the patters of the distribution and abundance of the flora associated with the river and its riparian zone. The metabolic processes in aquatic organisms are largely governed by abiotic factors of water. A lot of literature is available on the hydrological studies of the rivers in India (Nandan & Patel,1985; Boruah *et al*., 1995; Bhattacharya & Saha, 1997;Pande & Sharma., 1999; Jayaraman *et al.,* 2003: Jha & Barat, 2009 : Gajendran, 2011 : Khound, 2012: Banerjee & Ghosh, 2016: Dwivedi, 2017).

II Materials and Methods

The study area, was Thamirabarani river which flows through Kanyakumari district of Tamil Nadu. Thamirabarani river is a perennial river that originates from the Agastyarkoodam peak of Kanyakumari, Tirunelveli and Tuticorin districts of the Tamil Nadu state of southern India into the Gulf of Mannar. The river area is subjected to anthropogenic impact as agriculture, illegal sand mining, rubber plantations and sewage flow, makes it polluted. The present work was aimed to evaluate the present health status of the river stretch in Kanyakumari district. In Kanniyakumari district it flows through Kadayal, Thriparappu, Chithral, Kuzhithurai, Kappikaddu, Munchirai, and Thenkapattanam finally into Arabian sea.

Surface water was sampled at monthly intervals from five stations (Kadayal, Thirparapu, Chithral,Kuzhithurai and Munchirai along the river for a period of one year (Annually) from February 2016 to January 2017 and seasonally from 2017 May to 2017 December. The physical features such as air and water temperature and depth of all study sites were measured during each time of sampling. The water samples were collected in pre-cleaned polyethylene containers, transferred to the laboratory and stored at 4°C until analyses. The water samples were analysed for various physio chemical parameters such as temperature, pH, conductivity, turbidity, Biochemical Oxygen Demand, Chemical Oxygen Demand. The atmospheric and surface water temperatures were note using a sensitive mercury thermometer. The pH of the water samples was measured using a pH meter (Elico LI 612) and the conductivity values with a conductivity meter (Elico CM 180). The turbidity was detected by Digital Nephelo Turbidity meter (Systronics 132).Dissolved oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand were estimated following standard methods (Trivedy & Goel,1986; APHA,1992).

III Results and Discussion

The monitoring of physicochemical characteristics of water is of great relevance today as it the key to manage and conserve precious water resources. Evaluating the physicochemical parameters of lotic systems gives us a picture of the deteriorating/pollution status of the same and also the nature of pollutants. Extensive use of pesticides and insecticides pose severe threat to rivers. These pollutants continuously alter the water quality of rivers. Hence an account of water quality of a lotic system continuously vary. Allan (1995) is of the opinion that temperature, dissolved elements, organic and inorganic matter, gases, trace elements are some of the factors which determine the chemistry of the water body. Temperature an important parameter in water bodies influences chemical reactions in water thereby the taste and odour (Trivedy and Goel, 1986). In the present investigation a hike in temperature was noticed during summer months and dip in post monsoon and winter months (Table 1). The maximum month wise average water temperature was read at station V (38.3 ± 0.23 °C) and minimum at station I (25.2 ± 0.61°C) (Table 1).This variation in temperature is due to various factors like presence of canopy near the embankments, pollutant inflow, biological activity of living organisms in water and the atmospheric temperature. The seasonal water temperature was consistent with the atmospheric temperature and ranged from 40.1°C to 21.4°C (Fig 2-4). The seasonal variation in this parameter is accounted from heating up of air and subsequent transfer of heat to water surface (Mahopatro and Pandhy, 2001). The seasonal minimum and maximum water temperature was recorded during postmonsoon and premonsoon respectively at all stations studied. Similar observations were also recorded by Mini *et al*., 2003 in a lotic system- Vamanapuram river. Analysis of variance exhibited a P value of 0.56, while the monsoon season had a 1% significance (P=0.011 and P= 0.028). Temperature showed negative correlation with DO (-0.7363) and positive correlation with turbidity (+0.8272). Earlier studies in Perumchani reservoir by Deleep Packiaraj (2011) has also recorded such results. Positive correlation of temperature with turbidity is due to the fact that particles causing turbidity absorb heat and radiate it to the surrounding (Zafar, 1966).

Turbidity is an expression of the optical properties of water and it affects the biological status of any water body. The average turbidity in this work varied from 6.1 ± 0.87 NTU at station I to 66.5 ± 0.41 NTU at station IV (Table 1). Still higher turbidity was noticed and

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recorded during monsoon months (Fig 3-4) due to inflow also mixing of colloidal, suspended matter and plankton through the run off sewage. However compared to other rivers flowing through India (Savita, 2013 and Mondal *et al*., 2016), Thamaraparani river exhibited less turbidity suggesting lesser pollution. The present levels when increased will affect riverine ecosystem in a very bad way. During monsoons turbidity levels increased due to in flow of sediments from upstream in downstream stations (Fig 3). The level of significance showed 5% during this season (P= 0.072).

The pH of river water is the measure of how acidic or basic the water is on a scale of 0-14. If the pH of water is too high or too low, the aquatic organisms living within it will die. pH can also affect the solubility and toxicity of chemicals and heavy metals in the water thereby life in the system . In this work the pH levels varied from 6.4 ± 0.36 to 8.7 ± 0.58 (Table 1). Maximum pH was recorded at station IV and lowest at station II (Table 1). Decrease in pH levels at station 11 is contributed from rubber processing using formic acid in the catchment area of the river. The formic acid flows into the river and makes it acidic at source. During monsoon season further decrease in pH was observed (5.7) which again accounted from the inflow of acidic matter from rubber processing in the embarkments (Fig 3). Flow of rain water also increases turbidity and characteristic temperature which decrease photosynthesis leading to accumulation of dissolved carbon dioxide (carbonic acid) as suggested by Boruah *et al*., 1996. The level of significance of this parameter annually was P= 0.0036 (1%) and P= 0.0854 (5%) during monsoons.

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). The present investigation showed conductivity values increased at station II and decreased at station IV which is in consistent with temperature values (Table 1). Conductivity is affected by temperature and dissolved salts in the water body which may be due to natural causes or by human intervention as suggested by Pal *et al*., 2015. During monsoons the trend observed was premonsoon>monsoon>postmonsoon (Fig. 2-4). The P value calculated for this parameter during monsoon season was significant at 1% (0.0285) and annually it was significant at 1 % (0.0047).

DO plays an important role in supporting aquatic life in lentic and lotic water bodies (Jameson and Rana, 1996). Thamaraparani river stretch in Kanniyakumari district exhibited reduced monthly DO levels at station IV (Table 1: Fig. 1). While the DO recorded at station IV and V was more than the other stations (Table 1: Fig. 1). The DO is in accordance with anthropogenic activity at station III and IV suggesting sewage and agricultural waste inflow into the water body. Low DO leads to fish mortality, odours and other nuisance due to unbalanced ecosystems (Mini, 2003). Post monsoon season was accompanied with higher DO levels (6.8 ± 0.15 mg/l at station I) and pre monsoon DO levels in consistent with monthly average levels (Fig. 2-4). Enhanced levels of DO exhibited after monsoons is due to increased phytoplanktonic growth in this water body resulting from nutrient inflow. A negative correlation was observed with DO levels and temperature variation (-0.7363).

Biological oxygen demand (BOD) measure the amount of oxygen required by bacteria for breaking down to simpler substances of the decomposable organic matter present in any water, wastewater or treated effluent. It is also taken as a measure of the concentration of organic matter present in any water. The greater the decomposable matter present, the greater the oxygen demand and the greater the BOD values (Mezgebe *et al*., 2015). BOD levels in water bodies gives the level of organic pollution in it and is the result of two counteracting mechanisms: pollutant loading and natural cleaning. BOD levels affect the DO content in water bodies thereby aquatic biota. The monthly average in Thamaraparani river stretch in Kanniyakumari district ranged from 7.4 ± 0.21 to 13.8 ± 0.67 mg/l at station I and station IV respectively (Table 1). High levels of pollutants in river water causes an increase in biological oxygen demand (BOD) and chemical oxygen demand (COD) (Lone *et al*., 2013).The BOD values obtained in this investigation is consistent with the findings of Murthy *et al*.,1994 in Tungabadra river. Higher BOD levels suggest impact of organic matter and anthropogenic activities in this water body in the downstream stations. Analysis of variance of BOD levels among stations annually showed a 5 % significance (P= 0.0694). During monsoons the trend noticed in this parameter was monsoon > postmonsoon > premonsoon (Fig. 2-4). Lower levels of BOD during post monsoon is because of dilution of water by inflow of rain water. A 5% significance was also observed in the significant level of BOD levels during monsoon season among stations P= 0.0512. BOD and DO showed an inverse relationship, with levels of BOD increasing with decrease in DO (Fig.1).

Chemical Oxygen Demand (COD) is a better estimate of organic matter that measures the carbonaceous fraction much closer to the actual amount (Katariya and Jain, 1995). Level of COD varied from 8.6 ± 0.68 to 51.8 ± 0.12mg/l (Table 1). The Chemical Oxygen Demand (COD) varied from 9.2 to 52.5mg/l in premonsoon and 24.0 to 65mg/l in post monsoon season. Annual average varied from 8.7 to 45.2 mg/l at station I and IV respectively (Fig 2-4). Presence of high amount of COD in water indicates the contamination though domestic sewage containing decaying organic matter and other effluents. Similar observation have been made in river Ganga by Pradip Kumar *et al*., 2015.

IV Conclusion

Anthropogenic pollutants related to land use result in drastic deterioration of aquatic systems in Thamaraparani river stretch at Kanniyakumari district. Additionally, the river play an important role in assimilating municipal and industrial effluents as well as run off from agricultural land and the surrounding area. On the other hand, rivers comprise the most important water resources for irrigation, domestic water supply, industrial, and other purposes in a watershed, thereby tending to stimulate serious hygienic and ecological problems. Consequently, prevention and controlling of river pollution by making the public aware of the consequences and reliable evaluation of water quality are an imperative stipulation for effective management.

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Table 1 Annual average of physical parameters of Thamaraparani river stretch in Kanniyakumari district

	Station I	Station II	Station III	Station IV	Station V
Temperature(°C)	**25.2 ± 0.61**	**28.9 ± 0.45**	**31.2 ± 0.34**	**36.5 ± 0.59**	**38.3 ± 0.23**
Turbidity(NTU)	**6.1 ± 0.87**	**15.6 ± 0.74**	**58.2 ± 0.61**	**66.5 ± 0.41**	**51.3 ± 0.32**
pH	**6.8 ± 0.36**	**6.4 ± 0.82**	**8.1 ± 0.26**	**8.7 ± 0.58**	**7.9 ± 0.18**
Conductivity (µs)	**36.5 ±0.95**	**62.5 ± 0.28**	**71.4 ± 0.85**	**76.8 ± 0.56**	**52.9± 0.63**
DO (mg/l)	**7.6 ± 0.55**	**6.1 ± 0.47**	**5.9 ± 0.64**	**5.6 ± 0.87**	**5.8 ± 0.50**
BOD (mg/l)	**7.4 ± 0.21**	**8.3 ± 0.58**	**9.2 ± 0.55**	**13.8 ± 0.67**	**10.7 ± 0.79**
COD (mg/l)	**9.3 ± 0.68**	**8.6± 0.33**	**45.4 ± 0.27**	**51.8 ± 0.12**	**39.5 ± 0.91**

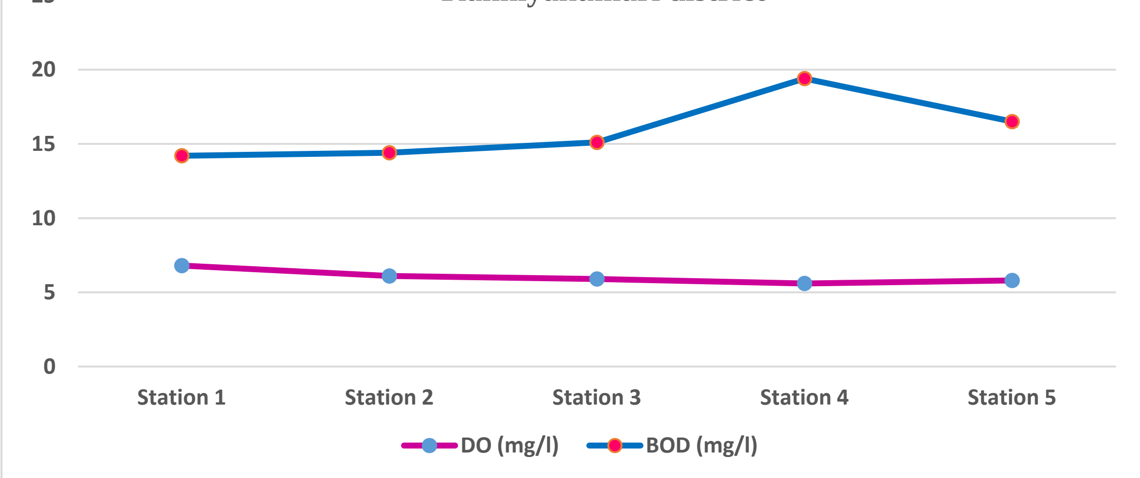

Fig. 1 DO and BOD levels in Thamaraparani river stretch in Kanniyakumari district

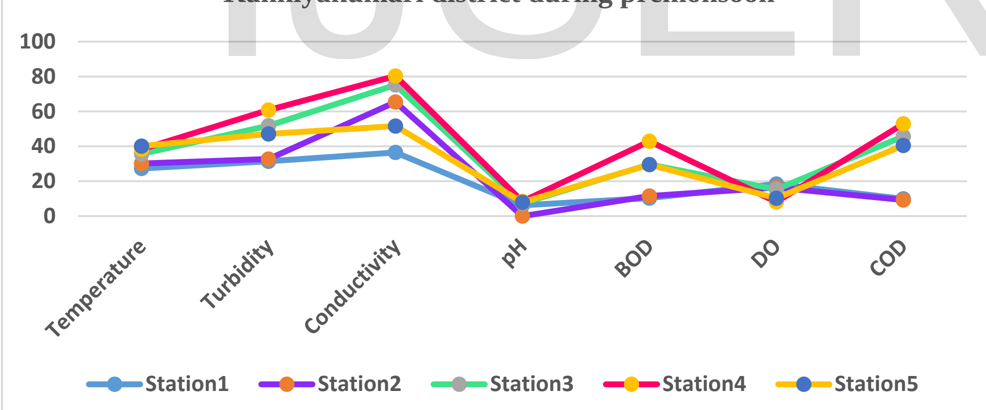

Fig. 2 Physical attributes of Thamaraparani river stretch in Kanniyakumari district during premonsoon

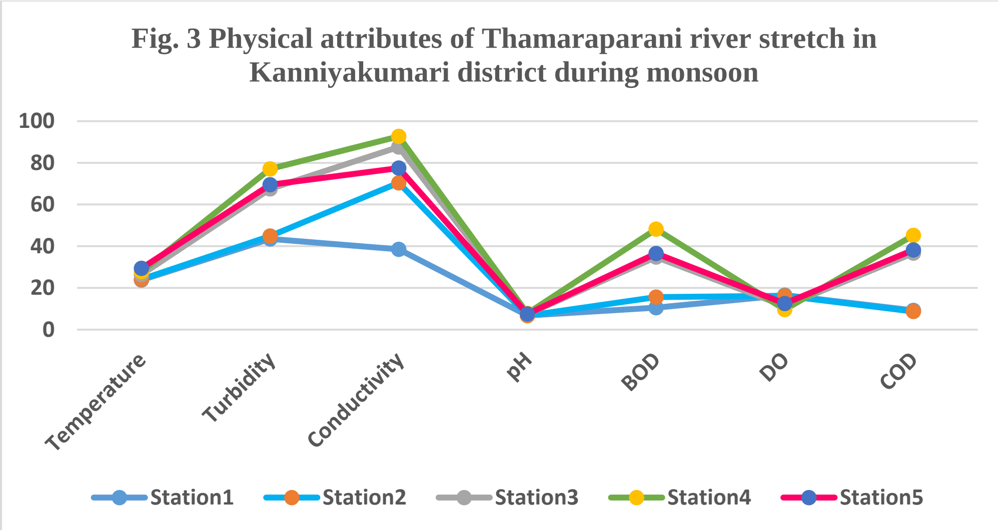
Fig. 3 Physical attributes of Thamaraparani river stretch in Kanniyakumari district during monsoon
100
80
60
40
20
0
Temperature
Turbidity
Conductivity
pH
BOD
DO
COD
Station1
Station2
Station3
Station4
Station5

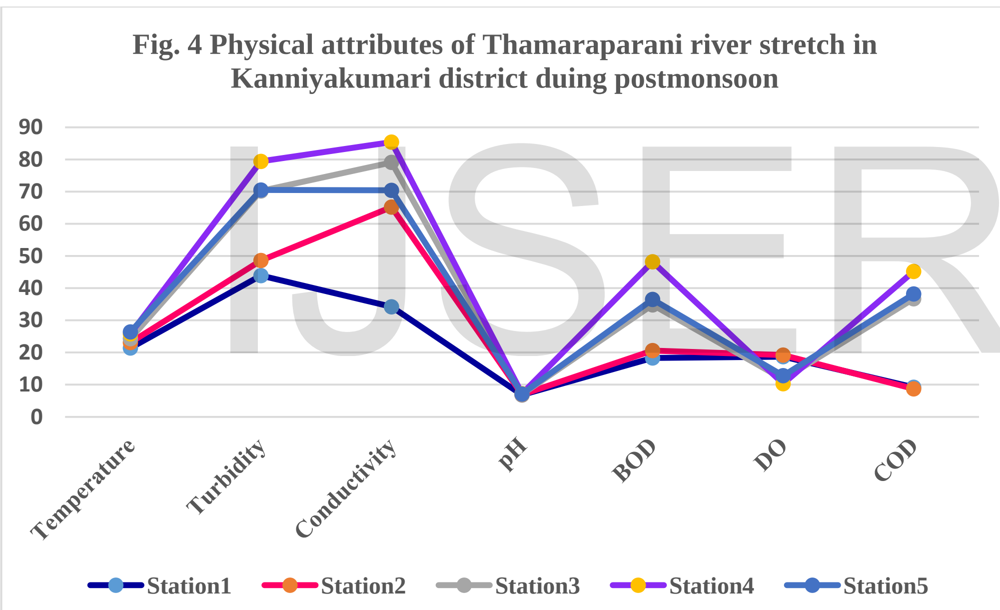
Fig. 4 Physical attributes of Thamaraparani river stretch in Kanniyakumari district duing postmonsoon
90
80
70
60
50
40
30
20
10
0
Temperature
Turbidity
Conductivity
pH
BOD
DO
COD
Station1
Station2
Station3
Station4
Station5

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