RESEARCH ARTICLE

ENVIRONMENTAL POLLUTION MONITORING STUDIES ON THAMIRAPARANI RIVER AT TIRUNELVELI DISTRICT, TAMILNADU

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ABSTRACT

The quality of water is of great importance also for human lives as it is commonly consumed and used by households. Runoff water is the carrier of pollutants on their way from the soil surface to the surface water. The fraction of pollutants deposited at the soil surface that ultimately reaches the surface water depends on the amount of runoff and the distribution between the different runoff components.In the present study,water samples were collected from two different locations of Thamiraparani river, Tirunelveli District, India for Physico-chemical analysis.The collected water samples were performed for the analysis of various parameters such as pH, Total Dissolved Solids, Total Alkalinity, Total Hardness, Chloride and Phosphate were analysed for a period of six months from January 2013 to June 2013. Agricultural runoff containing detergents etc, tend to increase pollution. The maximum values of hardness as observed in winter and minimum in summer. Nitrate values were generally high there was luxurious plant growth and results indicate that all the parameters are beyond the limit and unsuitable for human consumption.Due to increased human population, industrialization, use of fertilizers and man made activity, water is highly polluted with different harmful contaminants. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. So,it is necessary to know details about different physico-chemical properties. All the physico-chemical analyses revealed that Station II has been more polluted site. The source of pollution is most probably from the cement factory, textile and tannery industries.

INTRODUCTION

Natural resources are the important wealth of our country. Water is one of the naturally occurring essential requirement of all life supporting activities (Besavaraja Simpi *et al.*, 2011, Murhekar, 2011). Any change in the natural quality may disturb the equilibrium system and would become unfit for designated uses (Julie *et al.*, 2010).The quality of water is vital concern for mankind because it directly linked with humana health (Sayyed *et al.*, 2010; Ogbonna *et al.*, 2011). Water sources are polluted by domestic wastage in rural areas whereas industrial wastage discharge into natural water sources in urban areas. Industrialization without provision of proper treatment of wastage and effluents as well as excessive applications of fertilizers and pesticides for agriculture purposes (Dhake *et al.*, 2008; Mehta *et al.*, 2008 and Moscow *et al.*, 2011). Water is the universal solvent. It dissolves the minerals from the natural and anthropogenic activities in which it is stored. Therefore, the physical and chemical parameters of the particular area will be changed. Seasonal changes are governed by the extent and composition of dissolved salts depending on the surface environment (Shuba Srivastava *et al.*, 1999). All living organisms on the earth need

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water for their survival and growth. Due to use of contaminated drinking water, human population suffers from varied of water borne diseases. The increased use of metal based fertilizer in agricultural revolution of the government could rise in concentration of metal pollutants in freshwater reservoir due to water runoff (Adefemi and Awokunmi, 2010; Manjare, 2010). It is the high rate of exploration then its recharging, inappropriate dumping of solid and liquid wastes, lack of strict enforcement of law and loose governance are the cause of deterioration of ground water quality (Gupta, 2009). Toxic substances can enter lakes, streams, rivers and otherwater bodies and they get dissolved or lie suspended in water or get deposited on the bed. This results in the pollution ofwater, affecting aquatic ecosystems. Water pollution has many sources. Organic wastes are produced by animals and humans, and include such things as fecal matter, crop debris (Stoate *et al.*, 2009), yard clippings,food wastes, rubber, plastic, wood, and disposable diapers (Finnveden *et al.*, 2009).

MATERIALS AND METHODS

The River Thamiraparani originates from western side of the Western Ghats. The Tambarabarani is situated between latitudes 8.21' N and 9.13' N and between longitudes 77.10' E. Vanatheertham waterfalls (40 m deep) is located close to the origin of the main river. This river joins the Papanasam

Reservoir at its 16th km. The river has 4 tributaries called Peyar, Ullar, Karaiar and Pambar upstream of Papanasam Reservoir. The river Thamiraparani, after the confluence of Chittar, travels another 23-km where it has the Srivaikundam anicut. From thereon, it runs eastwards for 30-km and enters the Gulf of Mannar near Palayakayal.Water samples were collected at monthly intervals from two stations for a period of six months from January 2013 to June 2013 for the analysis of various physico-chemical parameters. The water samples were collected from different sampling Stations namely Naranammal Puarm (Station I), Sutthamalli (Station II). Samples were collected in one litre plastic bottles with tightly fitted lids. The samples were analysed every month January 2013 to June 2013 between 7 a.m to 10 a.m. at regular intervals. All the physic-chemical parameters were estimated by following the method of BIS- Bureau of Indian Standards – IS -10500: 2012 were represented in Table 1 and Figures. Except pH and conductivity all other parameters are expressed in mg/l (Trivedy and Goal, 1986).

RESULTS AND DISCUSSION

The range and concentrations of various physico-chemical factors of river Thamiraparni water at two different sampling stations (Station I and Station II) in Tirunelveli District from January 2013 to June 2013 (Table 1). The Turbidity values are found high (12 NTU) during the month of March, 2013 whereas, a minimum value of 2.4 NTU during April, 2013 at Station I. The turbidity value are found 6.78NTU which is maximum during January, 2013 whereas, a minimum value of 3.0 NTU during March, 2013 at Station II (Table 1 and Fig.1).
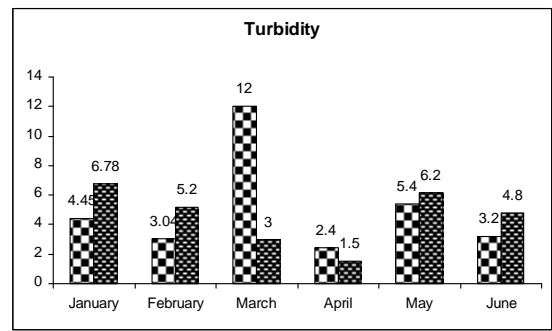
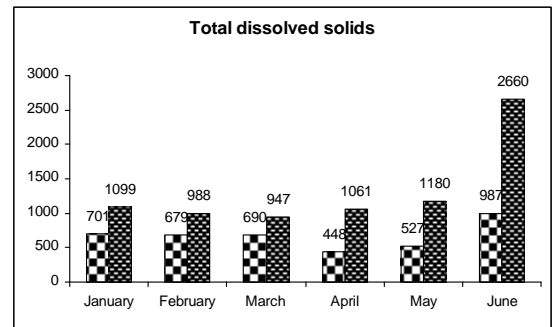**Table.1 :Physico-chemical parameters of River Thamiraparani (Tirunelveli) from January 2013 to June 2013 at 2 stations (I and II)**

Parameters	Units	January		February		March		April		May		June	
		S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II	S-I	S-II
Turbidity	NTU	4.45	6.78	3.04	5.2	12.0	3.0	2.4	1.5	5.4	6.2	3.2	4.8
Total Dissolved Solids	ppm	701	1099	679	988	690	947	448	1061	527	1180	987	2660
Electrical conductivity	Cm⁻¹	597	1293	870	1397	640	3800	755	1515	687	1469	563	856
pH		8.9	8.4	9.01	6.19	6.6	7.8	8.1	6.6	7.9	7.1	6.7	7.4
Total Alkalinity	mg/l	151	301	160	309	367	459	201	396	330	401	190	367
Total Hardness	mg/l	120	380	100	310	220	320	320	840	200	726	110	252
Calcium	mg/l	51	208	30	101	71	203	24	85	69	91	48	109
Magnesium	mg/l	0.37	2.01	0.47	1.5	Nil	Nil	5.0	10	1.2	2.78	3.0	7.9
Iron	mg/l	0.51	1.03	0.53	0.8	Nil	Nil	0.27	0.27	1.2	2.3	0.35	0.82
Free Ammonia	mg/l	0.72	1.8	0.47	1.5	1.20	0.72	0.48	0.60	0.9	1.60	0.79	1.61
Nitrite	mg/l	0.50	2.8	0.91	0.59	1.1	0.85	0.11	0.60	4.0	2.7	1.9	0.60
Nitrate	mg/l	4.0	5.0	6.8	10.5	4.5	5.7	7.99	9.1	6.29	11.5	9.29	11.3
Chloride	mg/l	180	201	154	266	84	266	231	313	114	935	161	258
Fluoride	mg/l	0.1	0.1	0.45	0.51	0.83	0.1	0.45	1.3	0.6	1.2	0.63	1.2
Sulphate	mg/l	68	98	43	64	29	124	78	43	86	108	72	104
Phosphate	mg/l	1.03	0.6	0.18	2.55	1.1	0.8	0.87	3.0	2.81	3.7	1.91	4.89

The Total Dissolved Solids values recorded to be 987 ppm which is maximum during June, 2013 whereas, a minimum value of 448 ppm is observed during April, 2013 at Station I. The total dissolved solids is observed to be 2660 ppm which is maximum during June, 2013 whereas, a minimum value of 947 ppm at Station II during March,2013 (Table 1 and Fig.2).
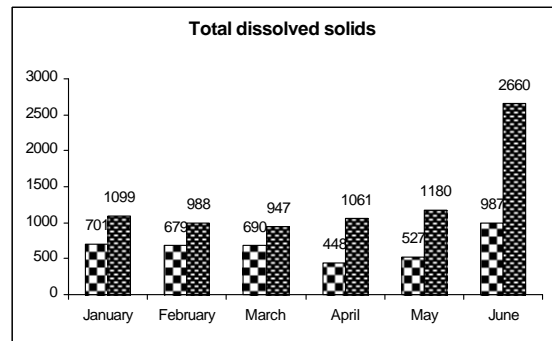

Fig. 1

Fig. 2

The Electrical Conductivity of the sample is found to be 870 Cm⁻¹ which is maximum during February, 2013 whereas, a minimum value of 563 Cm⁻¹ is observed during June, 2013 at Station I. The electrical conductivity of the sample is recorded 3800 Cm⁻¹ in March, 2013 whereas,a minimum value 856 Cm⁻¹ June,2013 at Station II (Table 1 and Fig.3).

Fig. 3

The pH values recorded to be 9.01 which is maximum during February, 2013 whereas, a minimum value of 6.6 is observed during March, at Station I. The pH value is observed to be 8.4 which is maximum during January, 2013 whereas, a minimum value of 6.1 at Station II during March, 2013 (Table 1 and Fig.4).
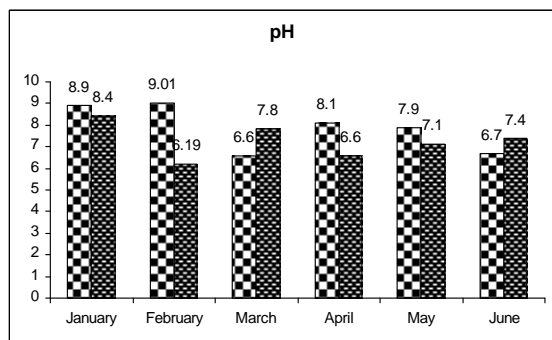

Fig. 4

The Total Alkalinity values are found high (201 mg/l), during the month of April, 2013 whereas, a minimum value (151 mg/l) at Station I during January, 2013. Total alkalinity values are found to be (459 mg/l) which is maximum during March, 2013 whereas, a minimum value of (301 mg/l) during January, 2013 at Station II (Table 1 and Fig.5).
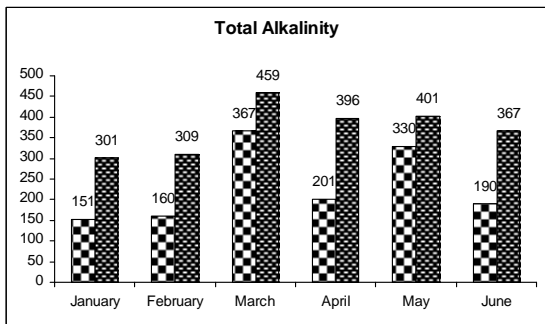

Fig. 5

The Hardness of water sample is recorded as 320 mg/l which is maximum value during April, 2013 whereas, a minimum value of 110 mg/l is observed during June, 2013 at Station I. The hardness of sample is found to be 840 mg/l which is maximum during April,2013 whereas, 252 mg/l a minimum in June, 2013, at Station II (Table 1 and Fig.6).
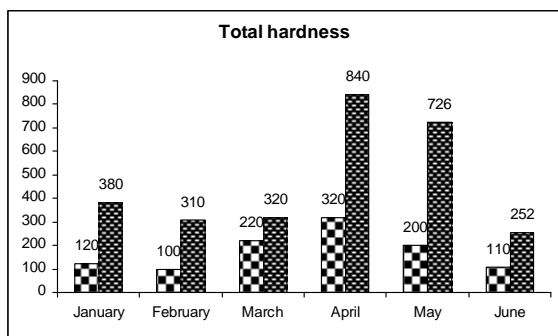

Fig. 6

The Calcium values are recorded to be 71 mg/l which is maximum during March 2013, whereas, a minimum value 24 mg/l is observed during April 2013, at Station I. The Ca value is observed to be 208 mg/l which is maximum during January 2013, whereas, a minimum of 85 mg/l during April, at Station II (Table 1 and Fig.7).
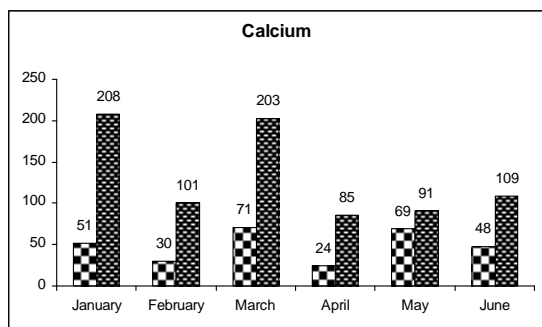

Fig. 7

The Magnesium values are recorded to be 5 mg/l which is maximum during April, 2013, whereas, minimum value 0.37 mg/l is observed during April, 2013, at Station I. The Mg value is observed to be 10 mg/l which is maximum during April,

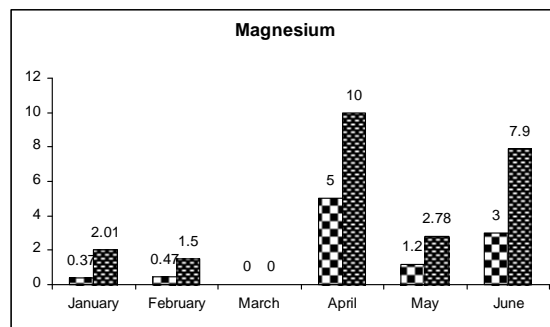2013, whereas, a minimum of 1.2 mg/l at Station II during February, 2013 (Table 1 and Fig.8).

Fig. 8

The Iron values are recorded to be 1.2 mg/l which is maximum during May 2013, whereas, minimum value 0.27 mg/l is observed during March 2013, at Station I. The iron of the sample is found 2.3 mg/l which is maximum during May 2013, whereas, a minimum of 0.27 ppm during April 2013, at Station II (Table 1 and Fig.9).
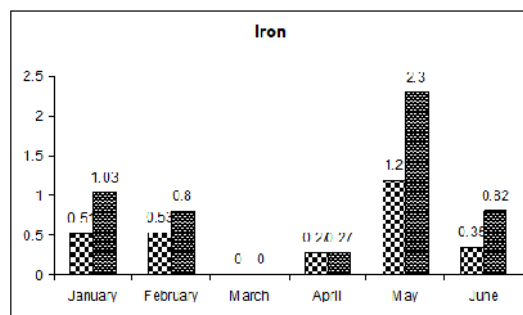

Fig. 9

The Free Ammonia values are recorded to be 1.20 mg/l which is maximum during March 2013, whereas, minimum value 0.72 mg/l is observed during January 2013, at Station I. The free ammonia of the sample recorded are 1.81 mg/l which is maximum during January 2013, whereas, minimum of 0.60 mg/l found during April 2013, at Station II (Table 1 and Fig.10).
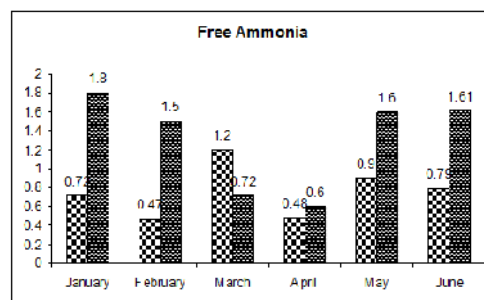

Fig. 10

The Nitrite values are recorded to be 4 mg/l which is maximum during May, 2013, whereas, minimum value 0.5 mg/l is observed during January, 2013, at Station I. The nitrite of the sample is found 2.8 mg/l which is maximum during

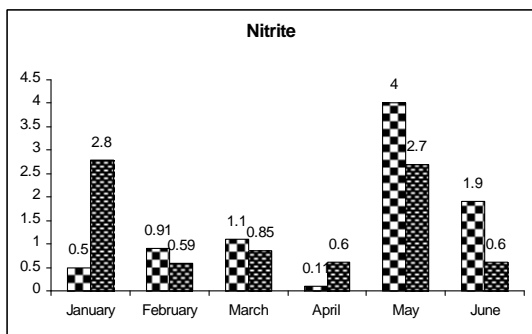January, 2013, whereas, a minimum of 0.6 mg/l during March and April, 2013 at Station II (Table 1 and Fig.11).

Fig. 11

The Nitrate values are recorded to be 9.29 mg/l which is maximum during June, 2013, whereas, minimum value 4 mg/l is observed during January, 2013, at Station I. The NO_3 of the sample found 11.5 mg/l which is maximum during May, 2013, whereas, a minimum of 5 mg/l is found in during January, 2013, at Station II (Table 1 and Fig.12).
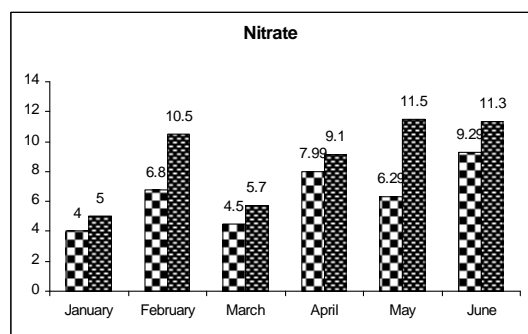

Fig. 12

The Chloride values are recorded to be 231 mg/l which is maximum during April, 2013, whereas, minimum value 84 mg/l during March, 2013, at Station I. The maximum chloride values of the sample is found 935 mg/l during May, 2013, whereas, a minimum of 201 mg/l found during January, 2013 at Station II (Table 1 and Fig.13).
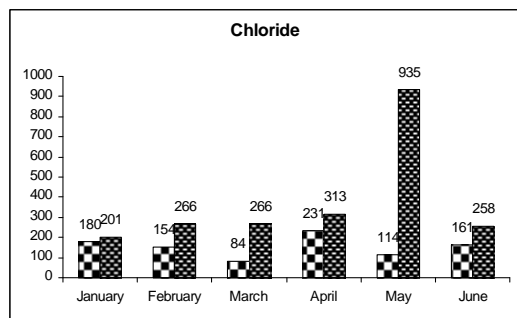

Fig.13

The Fluoride of the sample is recorded about 0.83 mg/l which is maximum value during March, 2013, whereas, a minimum value of 0.1 mg/l is found during January, 2013 at Station I. The fluoride of the sample is found 1.3 mg/l which is maximum during April, 2013, whereas, 0.1 mg/l is a minimum found during January and March, 2013, at Station II (Table 1 and Fig.14). The Sulphate of the sample is recorded of about 86 mg/l which is maximum during May, 2013, whereas,
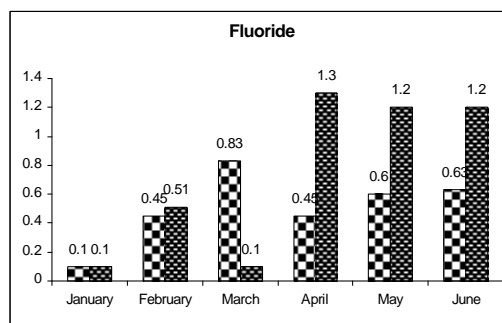

Fig. 14

a minimum value of 29 mg/l is during March, 2013, at Station I. The sulphate of the sample is found to be 124 mg/l which is maximum during March, 2013 whereas, 64 mg/l is a minimum found during February, 2013, at Station II (Table 1 and Fig.15).
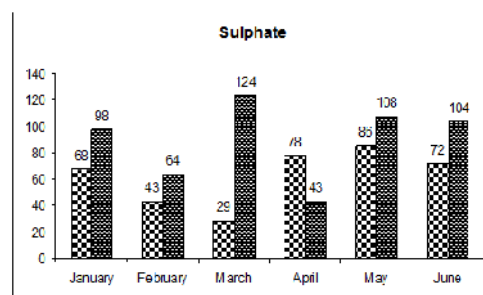
Fig .15

▨ Station I

The Phosphate of the sample is recorded of about 2.81 mg/l which is maximum during May, 2013, whereas, a minimum value of 0.18 mg/l is during Febrauary, 2013, Station I. The phosphate of the sample is found 4.89 mg/l which is maximum during June, 2013, whereas, 0.6 mg/l is a minimum found during January, 2013, at Station II (Table 1 and Fig.16).

Fig .16

▨ Station II

According to the Central Pollutions Control Board (CPCB), 70% of the pollution in rivers is from untreated sewage (Khaiwal Ravindra *et al.*, 2003). Water quality can be expected to differ between ecoregions in terms of major irons, nutrients, organic matter and salt loading because, water quality is a product of atmospheric inputs, climatic conditions, land use practices and specially catchment bedrock (Moreno

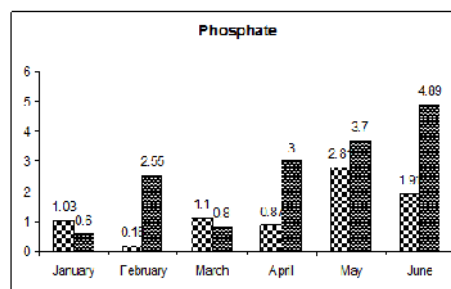*et al.,* 2006). The total dissolved solids in water for most domestic and industrial uses should be below 3,00ppm (Mathivanan *et al.,* 2008). The high values of TDS have been obtained at Station II.The maximum concentration of TDS was recorded during winter which may be due to dilution of river and minimum value were recorded at Station I. Water with solid contents are of inferior palatability and may induce unfavourable physiological reaction in trancient on March (Mathivanan *et al.,* 2005). pH is a term used universally to express the intensity of the acid or alkaline condition of a solution.Most of the water samples are slightly alkaline due to presence of carbonates and bicarbonates The higher range of pH indicates higher productivity of water (Khan *et al.,*1985). It was observed that pH of the water normally remains higher in summer and in rainy seasons. It depends on photosynthetic activity. It was relatively more in winter. It was almost same during summer and monsoon. The variation occurs in the pH values due to change in the values of CO_2, carbonate and bicarbonate in the water (Prasad *et al.,*2008; Agbaire *et al.,* 2009 and Joshi *et al.,* 2009). The reduced rate of photosynthetic activities reduces the assimilation of carbon dioxide and bicarbonates which are ultimately responsible for increase in pH (Mathivanan *et al.,* 2008). The low oxygen values coincided with high temperature during the summer month (Kamble *et al.,* 2009). The factors like air temperature bring about changes the pH of water. Most of bio-chemical and chemical reactions are influenced by the pH. Changes in the pH of river water might be attributed to the climatological and industrial activities as earlier reported by Mathivavan *et al.* (2005). Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts (Sudir *et al,* 1999). The presence of high amount of dissolved inorganic substances in ionized form in and around the city. In the present study, it has been shown that the electrical conductivity at Station I and Station II were varied during different months which indicates the seasonal changes as well as loading of pollutants from th industrial effluents,(Mathivanan *et al.,* 2004). The lower values are observed during winter, which could be due to dilution effect. The higher value may be due to partial stagnation and evaporation of water.

Alkalinity of water is its capacity to neutralize a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium. This is due to the primarily salts of weak acids or strong bases (APHA, 1998; Ansa *et al.,* 2000). Bicarbonates are formed in considerable amount from the action of carbon dioxide.The alkalinity was maximum value in March (summer) due to increase in bicarbonates in the water. Hujare (2008) has also reported similar results that it was maximum in summer and minimum in winter due to high photosynthetic rate. Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water (Agbaire *et al.,* 2009). Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. Hujare (2008) was reported total hardness was high during summer than monsoon and winter. High value of hardness during summer can be attributed to decrease in water volume and increase of rate of evaporation of water.Similar results were obtained in the present study. The chloride concentration serves as an indicator of pollution by sewage.

High chloride ion concentration indicates organic pollution in the water. The chloride concentration on fresh natural water is quite low generally less than that of sulphate and bicarbonates. Chloride is a natural substance present in all portable water as well as sewage effluents as metallic salt. Many researchers reported that rainfall add chloride directly. It is low in summer as compared to rainy season and occupying the intermediate position in winter (WHO, 1993; Chapman *et al.,* 1996). In the present study, maximum value of chloride reaches in summer. Similar results were reported by Swarnalatha and Narsing rao (1998).Due to sulphate taste of the water is affected. Eye and nose irritation, stomach discomfort, Increase corrosive character of water (Patil *et al.,* 2012). The fluoride content of surface water will be dependent on winter and variety of factors,chief of which will be availability and solubility of parent fluoride minerals with which these water are contact significantly pesticides and fertilizers.In the present study,fluoride seemed to be high during April Station II and low during winter (Mathivanan *et al.,* 2007). No trace of magnesium was found during March and thereafter slowly increased upto June. This may be due to the input of surfactants, anionic emulsifiers, vegetable matter have been reported (Patil *et al.,* 2012). In the present study, the addition of magnesium and sodium salts from detergents and other man made activities and also the river water brings more amount of magnesium (Mathivanan *et al.,* 2008).Magnesium is directly related to hardness (Murhekar, 2011). At Station II, magnesium content of water showed successive increasing trend, which may be due to the decreasing water level on account of rapid evaporation.

Surface water contains nitrate due to leaching of nitrate with the percolating water. Surface water can also be contaminated by sewage and other wastes rich in nitrates. A higher content of nitrate in water may be toxic to babies when used for making up feeds from milk powder (Srikumar Chattopathyay *et al.,* 2005). The minimum concentration of nitrate observed during summer season could be due to its utilization by the phytoplankton and also decreased freshwater flow this period (Mathivanan *et al.,*2004 & 2005). Nitrate has effects on Infants below the age of six months symptoms include shortness of breath and blue baby syndrome (Patil *et al.,* 2012). Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals (Srinivasa *et al.,* 2000). Discharge of industrial wastes and domestic sewage tends to increase its concentration.In the present study, sulphate is high during summer and low during winter season. It is low in monsoon could be due to the dilution effect (Mathivanan *et al.,* 2007). Urban use increased sulphate levels in rivers, agricultural use mainly increased sulphate compound and forest use showed negative correlation supports the opinion that forest catchment periodically retain larger amounts of these compounds (Bellows *et al.,*2006; Moreno *et al.,* 2006 and Mathivanan *et al.,*2007). Phosphate may occur in surface water as a result of domestic sewage, detergents, and agricultural effluents with fertilizers. The high values of phosphate in June month is mainly due to rain, surface water runoff, agriculture run off; washer man activity could have also contributed to the inorganic phosphate content. Similar results reported by Arvindkumar (1995). In the present study, phosphate values were found to be maximum during the summer and minimum during winter and various markers have also been reported by

Rao (2001) and Mathivanan *et al.,* (2004). In the present study, the water quality of river Thamiraparani has been assessed in two Stations namely Naranammal Puram (Station I) and Sutthamalli (Station II). The physicochemical parameters of river Thamiraparani from January 2013 to June 2013 are summarised for selected parameters. From the above mentioned facts, it is true that the river seems to be polluted; but in view of urbanization and industrialization, monitoring of river for various pollutional parameters has to be done to increase the awareness among the people. Hence, it is suggested that this river water is not much suitable for drinking purpose, whereas, it may be acceptable for bathing and irrigation. The water quality of river is deteriorated due to domestic, industrial effluents direct discharge into river and various human activities along the banks of the river. Instead of analysing the single parameter and predicting the quality of river does not define the actual quality of the river for serving required purpose. So, the seasonal river quality monitoring by analysing various physico-chemical parameters and by integrating them is very much necessary in order to determine and maintain the water quality of the rivers.

Acknowledgement

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