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Physical and chemical characteristics of Paraliyar river in Kanyakumari district, Tamil Nadu, India

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ABSTRACT:

The physico-chemical parameters of the Paraliyar River in Kanyakumari District, Tamilnadu were studied for a period of six months from July to December 2010. The pH of the water varied from 5.62 and 8.67. The dissolved Oxygen content of the river water ranges between 3.57 and 7.20. The nutrients such as Nitrate, Nitrite, Phosphate, Calcium and Magnesium are also showed temporal variations. The Alkalinity and acidity of the river water showed the maximum value of 152 mg/l, 132mg/l and 292mg/l, 198mg/l respectively. In general, all the physical and chemical parameters of the river water showed strong temporal variations in relation to sampling months.

Keywords:
water quality, hydrology, river ecosystem; western Ghats, water pollution.

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INTRODUCTION

In India ponds, rivers and ground water are used for domestic and agricultural purposes. The quality of water may be described according to their physico - chemical and micro-biological characteristics. For effective maintenance of water quality through appropriate control measures, continuous monitoring of large number of quality parameters are essential (Bhandari and Nayal, 2008). The usual source of drinking water is from streams, rivers, wells and boreholes which are usually not treated (Agbaire and Obi, 2009).

Rivers are subjected to various natural processes taking place in the environment, such as the hydrological cycle. As a consequence of unprecedented development, human beings are responsible for choking several lakes to death. Storm water runoff and discharge of sewage into rivers are two common ways that various nutrients enter the aquatic ecosystems resulting in the pollution (Sudhira and Kumar, 2000; Adeyemo, 2003; Adeyemo *et al*., 2008).

Water quality deals with the physical, chemical and biological characteristics in relation to all other hydrological properties. Any characteristic of water that effects the survival, reproduction, growth and production of aquaculture species, influences management decision, causes environmental impacts or reduces product quality and safety can be considered a water quality variable (Iqbal *et al*., 2004). Water quality provides current information about the concentration of various solutes at a given place and time. Water quality parameters provide the basis for judging the suitability of water for its designated uses and to improve existing conditions. Rivers and lakes are very important part of our natural heritage. They have been widely utilized by mankind over the centuries, to the extent that very few; if any are now in a natural condition (Leonard, 1971). A continuous monitoring of water quality is very essential to determine the state of pollution in our rivers. In the present study an attempt has been made to analyse the physical and chemical parameters of the Paraliyar river in Kanyakumari District, Tamilnadu.

MATERIALS AND METHODS

The present study was carried out at selected locations of Paraliyar river. The Paraliyar rises in the Mountain north of Mahendrahiri and flows generally in the south, south-westerly direction through Kalkulam and Vilavancode taluks of Kanyakumari district. Near Ponmana, it is interouted by Perunchanidam. It receives water from Pechiparai reservoir through the left bank channel, before the weir called Puthandam. Six stations Movattumukku (station I), Puthan Dam (station II), Villukuri station III), Aloor(Alanvilai) (station IV), Vellamody (station V), Pillaithoppu (stationVI) were selected for the collection of water samples. The water samples were collected at monthly intervals during early hours of the day for a period of six months from July to December 2010.

The pH of water sample was measured with a pH meter previously calibrated with buffer solutions. Conductivity was measured with a conductivity meter calibrated with potassium chloride solution. Temperature was measured with a thermometer. Alkalinity was determined by titrating a known volume of water sample with 0.02 M HCl. Dissolved oxygen (DO) was determined by Winkler's titration. Total dissolved solid (TDS) was determined gravimetrically by evaporating a known volume of water to dryness in a pre-weighed crucible on a steam bath. Total hardness was determined by titrating with EDTA using Erichrome black T as indicator. The salinity was determined using a Refractometer (ATAGO). Flame photometer (Model Systronic 128) was used for determination of metal ions Na^+, K^+ and Ca^{2+}. Silver nitrate method was used to estimate the chloride present in water samples. Sulphate was determined by turbidimetric method. Total hardness was calculated by complexometric titration using EDTA

(Vogel, 1978). Nessler's method was used for ammonia, brucine method was used for nitrate, nitrite and nitrate-nitrogen, reactive phosphate (by using spectrophotometric methods) and calcium ion content (by using titrimetric methods) were measured according to A.P.H.A (1998).

RESULTS

pH

The pH of the water samples varied from 5.65 to 8.64 at Station 1. The lowest value was observed in July and the highest pH was recorded during October. At station II, the pH was varied between 5.62 and 8.29. The pH was high during October and low in July at Station II. The pH of the water samples collected from the Station III, varied from 5.92 (July) to 8.67 (November). At station IV, the pH of the water samples ranged between 5.72 and 8.54. The lower value was observed in July and higher was during December. pH values ranged between 5.68 and 8.27 were observed at Station V. The lowest value was observed in July and the highest value was observed in December. The pH of the water samples collected from station VI showed a Maximum pH value of 8.64 (December) and minimum of 5.85 during July. In general, the pH of the water samples showed lower values in July (Fig 1).

Temperature

The temperature of the water samples varied from 25.4 °C to 29.8°C at station I. The lowest value was observed in July and the highest temperature was during October. At station II, the temperature was varied between 25.8°C and 29.4°C. The temperature was high during October and low in July at station II. The temperature of the water samples collected from the station III, varied from 25.6 (July) to 29.8 (December). At station IV, the temperature of the water samples ranged between 25.6 and 29.6. The lower value was observed in July and higher during October. Temperature value ranged between 25.8 and 28.9 were, observed at station V. The lowest value was observed in July and highest value was in October. The temperature of the water samples collected from station VI showed a maximum temperature value of 29.4 (December) and minimum of 25.3 during July. In general, the temperature of the water samples showed lower values in July and higher values in October (Fig 2).

EC (Electrical Conductivity)

The EC of the water samples varied from 1.205 µS to 3.502 µS at station I. The lowest value was observed in October and the highest value was during December. EC value ranged between 1.204 µS and 3.602 µS were observed at station II. The lowest value was observed in July and highest value was observed in December. At station III, the EC was varied between 1.206 µS and 2.911 µS. The EC value was high during December and low in October. The EC of the water

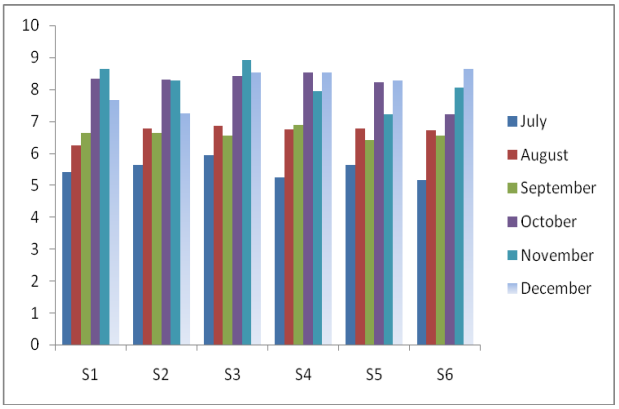

Fig 1. pH of the water samples collected from six selected stations of river Paraliyar.

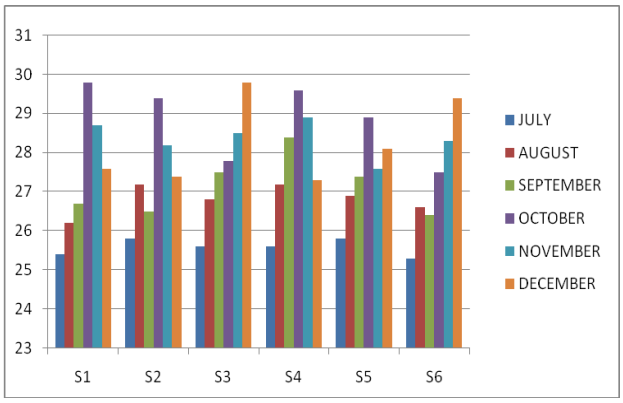

Fig2.Surface water temperature (^{o}C) of the water samples collected from the river Paraliyar during the study period.

samples collected from station IV, showed a maximum value of 3.234 µS (December) and minimum of 1.205 µS during October. At station V, the EC of the water samples ranged between 1.204 µS and 3.234 µS. The low value was observed in October and high during December. The EC of the water samples collected from the station VI, varied from 1.573 µS (July) to 3.921 µS (December). In general, the EC of the water samples showed lower values in October and higher values in December (Fig 3).

Total Dissolved Solids

At station I, the TDS of the water samples varied from 0.602 ppm to 0.745 ppm. The TDS value was high during September and low in July. The TDS of the water samples varied between 0.654 ppm and 0.798 ppm at station II. The lowest value was observed in July and the highest value was during December.TDS value ranged between 0.611ppm and 0.755 ppm was observed in station III. The TDS value was high during December and low in August. At station IV, the TDS was varied between 0.608 ppm and 0.784 ppm . The TDS was high during August and low in July. The TDS of the water samples collected from the station V, varied from 0.664ppm (July) to 0.792 ppm (September) At station VI, the TDS of the water samples showed a maximum value of 0.791ppm in November and minimum value of 0.638 ppm during December. In general the TDS of the water samples showed lower values in July. (Fig 4).

Dissolved Oxygen

The DO of the water samples varied between 3.98 mg/l and 5.18 mg/l at station I. The lowest value was observed in July and highest value was observed in October. The DO of the water samples collected from the station II, varied from 3.57 mg/l (July) to 5.06 mg/l (October). At station III, the DO of the water samples varied from 4.28 mg/l to 5.24 mg/l. The DO was high during October and low in July. DO values ranged between 4.52 mg/l and 6.54 mg/l were observed in station IV. The DO was high during October and low in September. At station V, the DO was varied between 4.59 mg/l and 5.22 mg/l. The DO was high during October and low in September. At station V, the DO of the water samples showed a maximum value of 7.20 mg/l (October), minimum value of 4.27 mg/l during July. In general, the DO of the water samples showed lower values in July (Fig 5).

Alkalinity

The alkalinity of the water samples collected from station I, varied from 154 mg/l (November) to 292 mg/l (December). At station II, the alkalinity of the water samples varied from 162 mg/l to 282 mg/l. The alkalinity value was high during August and low in October. The alkalinity of the water samples varied between 174 mg/l and 283 mg/l at station III. The lowest value was observed in November and the highest value was during December. At station IV, the alkalinity of the

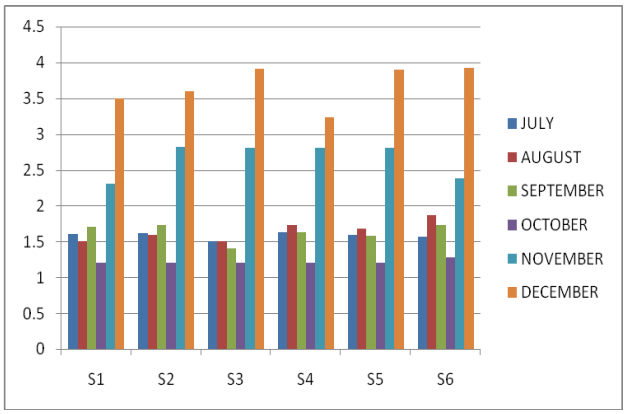

Fig 3. Electrical conductivity (µS) values observed in Paraliyar river from July 2010 to December 2010.

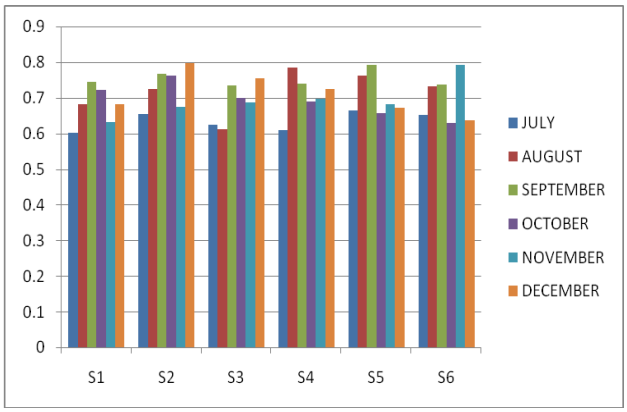

Fig 4. Total Dissolved Solids (ppm) values observed in Paraliyar river from July 2010 to December 2010.

water samples showed a maximum value of 281 mg/l (December) and minimum value of 152 mg/l during (October). Alkalinity value ranged between 162 mg/l and 277 mg/l were observed in system V. The alkalinity value was high during December and low in November. At station VI, the alkalinity was varied between 154 mg/l and 265 mg/l. The alkalinity was high during August and low in November. In general, the alkalinity of the water samples, showed lower values in November and higher values in December (Fig 6).

Acidity

At station I, the acidity of the water samples showed a maximum value of 187 mg/l (July) and minimum value of 134 mg/l during October. The acidity of the water samples collected from station II, varied from 136 mg/l (October) to 177 mg/l (November). The acidity of the water samples varied between 132 mg/l and 198 mg/l at station III. The lowest value was observed in October and the highest value was observed in July. At station IV, the acidity of the water samples varied from 131 mg/l to 191 mg/l. the acidity value was high during July and low in October. At station V, the acidity was varied between 138 mg/l and 176 mg/l. The acidity was high during July and low in October. Acidity value ranged between 135 mg/l and 181 mg/l were observed in station VI. The acidity value was high during December and low in October. In general, the acidity, of the water samples was low in October and high during July (Fig 7).

Ammonia

At station I the ammonia of the water samples varied from 0.54 mg/l to 1.98 mg/l. The ammonia was high during November and low in August. The ammonia of the water samples varied between 0.62 mg/l and 1.82 mg/l at station II. The lowest value was observed in August and highest value was observed in November. The ammonia of the water samples collected from the station III, Varied from 0.69 mg/l (August) to 1.92 mg/l (November). At station IV, the ammonia was varied between 0.47 mg/l and 1.45 mg/l. The ammonia was high during November and low in August. At station V, the ammonia of the water samples, showed a maximum value of 1.79 mg/l (September) and minimum value of 0.59 mg/l (August). Ammonia value ranged between 0.35 mg/l and 1.64 mg/l were observed in station VI. The ammonia concentration was high during November and low in October. In general, the ammonia concentration of the water samples showed lower values in August and higher value in November (Fig 8).

Total Hardness

The total hardness of the water samples varied between 238 mg/l and 547 mg/l at station I. The lowest value was observed in July and highest value was observed in December. Total hardness value ranged

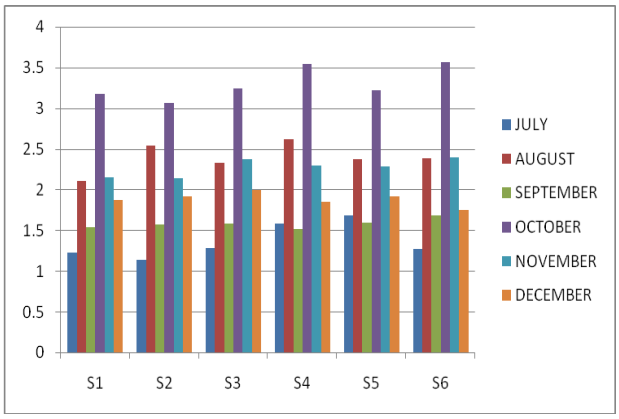

Fig 5. Dissolved Oxygen (mg/l) content of the water samples collected from 6 sampling sites in Paraliyar river.

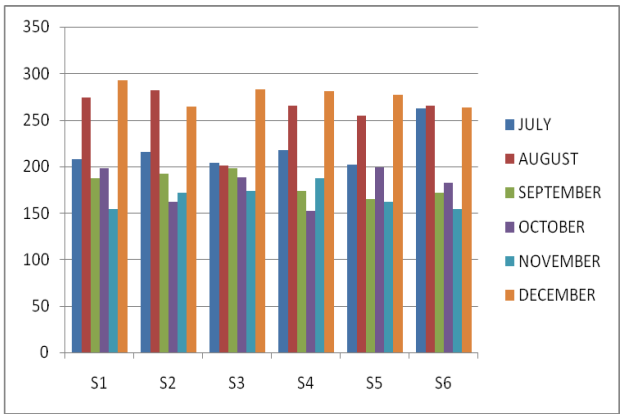

Fig 6.Akalinity values (mg/l) observed in Paraliyar river from July 2010 to December 2010.

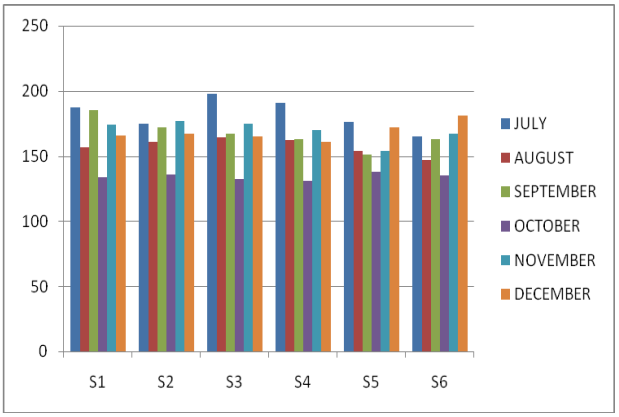

Fig 7. Acidity Level(mg/l) of the water samples collected from the river Paraliyar during the study period.

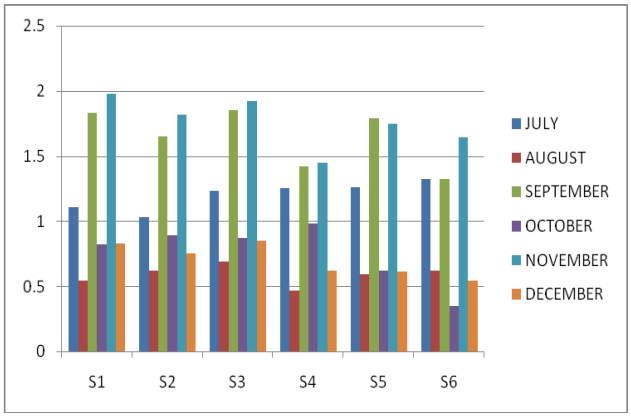

Fig 8. Ammonia Concentration(mg/l) of the water samples collected from 6 sampling sites in Paraliyar river.

between 236 mg/l and 545 mg/l were observed in station II. The total hardness was high during December and low in July. At station III, the total hardness of the water samples showed a maximum value of 564 mg/l (December) and minimum value of 240 mg/l during (July). At station IV, the total hardness was varied between 225 mg/l and 554 mg/l. The total hardness was high during November and low in July. At station V the total hardness of the water samples varied form 247 mg/l to 527 mg/l. The total hardness was high during November and low in July. The total hardness of water samples collected from station VI, varied from 258 mg/l (July) to 549 mg/l (December). In general, the total hardness of the water samples was low in July and high in December (Fig 9).

Nitrate

The nitrate of the water samples varied between 2.1 and 5.4 mg/l at station I. The lowest value was observed in September and highest value was observed in August. At station II, the nitrate of the water samples varied from 2.8 to 5.7 mg/l. The nitrate was high during November and low in September. At station III, the nitrate was varied between 2.5 and 4.8 mg/l. The nitrate content was high during November and low in July. The nitrate concentration of the water samples collected from the station IV, varied from 6.8 (August) to 2.8 mg/l (September). Nitrate value ranged between 3.9 mg/l and 6.4 mg/l were observed in station V. The nitrate content was high during November and low in September. At station VI, the nitrate of the water samples showed a maximum value of 3.2 mg/l (September) and minimum value of 7.3 mg/l (November). In general, the nitrate of the water samples showed lower values in September and higher values in November (Fig 10).

Sulphate

The sulphate of the water samples collected from the station I, varied from 23 (July) to 37 mg/l (October). At station II, the sulphate was varied between 29 and 35 mg/l, The sulphate was high during November and low in July. The sulphate of the water samples varied between 26 and 38 mg/l. at station III. The lowest value was observed in July and highest value was observed in October. At station IV, the sulphate of the water samples varied from 25 to 47 mg/l. The sulphate was high during November and low in July. At station V, the sulphate of the water samples showed a maximum value of 37 (November) and minimum value of 21 mg/l (July). Sulphate value ranged between 29 and 31 mg/l were observed in station VI. The sulphate was high during November and low in July. In general, the sulphate of the water samples showed lower values in July and higher values in November (Fig 11).

Nitrite

At station I, the nitrite of the water samples

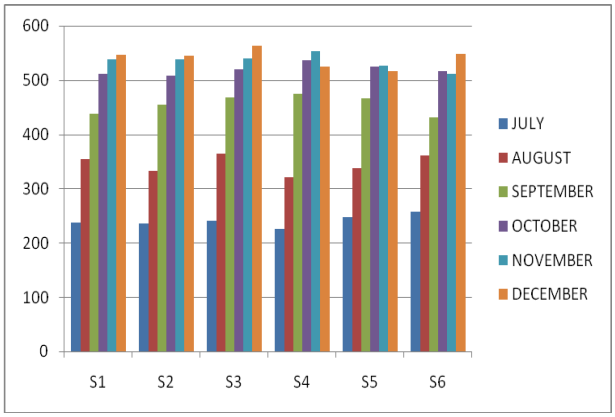

Fig 9. Total Hardness(mg/l) of the water samples collected from six selected stations of river Paraliyar.

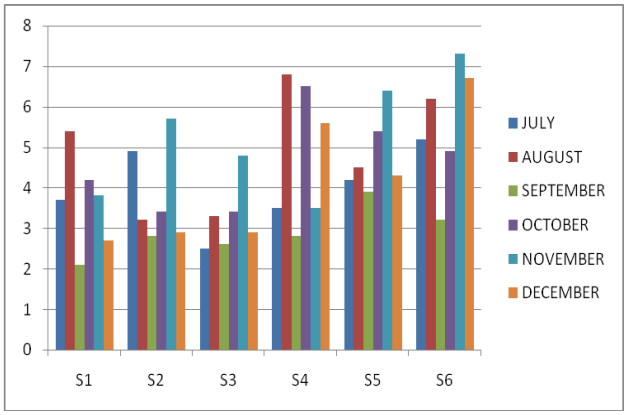

Fig 10. Nitrate concentration (mg/l) of the water samples collected from the paraliyar river.

varied from 0.51 to 0.92 mg/l. The nitrite was high during December and low in September. The nitrite of the water samples varied between 0.49 and 0.85 mg/l at station II. The lowest value was observed in September and highest value was observed in December. At station III, the nitrite of the water samples showed a maximum value of 0.97 (December) and minimum value of 0.49 mg/l during (July). Nitrite value ranged between 0.31 and 0.69 mg/l were observed in station IV. The nitrite was high during December and low in August. At station V, the nitrite was varied between 0.38 and 0.72 mg/l. The nitrite was high during October and low in November. The nitrite of water samples collected from station VI, Varied from 0.45 (September) to 0.98 mg/l (December). In general, the nitrite of the water samples showed lower in September and higher in December (Fig 12).

Sulphite

The sulphite of the water samples varied between 19.1 and 23.4 mg/l at station I. The lowest value was observed in July and highest value was observed in September. At station II, the sulphite of the water samples showed a maximum value of 25.6 (September) and minimum value of 19.8 mg/l (July). The sulphite of the water samples collected from the station III, varied from 19.1 (November) to 20.9 mg/l (December). At station IV, the sulphite was varied between 17.6 and 24.3 mg/l. The sulphite was high during September and low in November. At station V, the sulphite of the water samples varied from 17.2 to 21.7 mg/l. The sulphite was high during September and low in November. Sulphite value ranged between 17.3 and 22.4 mg/l were observed in station VI. The sulphite was high during September and low in November. In general the sulphite of the

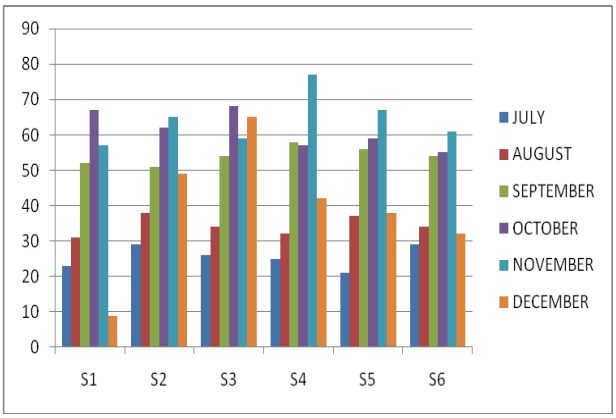

Fig 11. Sulphate level of the water samples collected from the river Paraliyar during the study period.

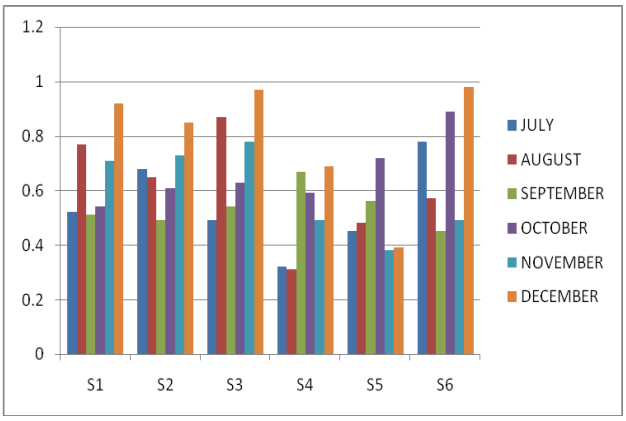

Fig 12. Nitrate level (mg/l) observed in Paraliyar river from July 2010 to December 2010.

water samples showed lower values in November and higher values in September. (Fig 13).

Chloride

The chloride of water samples collected from station I, varied from 154 (August) to 281 mg/l (December). Chloride value ranged between 162 and 254 mg/l were observed in station II. The chloride was high during December and low in August. At station III, the chloride was varied between 139 and 287 mg/l. The chloride was high during December and low in August. At station IV, the chloride of the water samples varied from 137 to 289 mg/l. The chloride was high during December and low in July. The Chloride of the water samples varied between 142 and 265 mg/l at station V. The lowest value was observed in August and highest value was observed in November. At station VI, The chloride of the water samples showed a maximum value of 254 (November) and minimum value of 131 mg/l during (August). In general, the chloride of the water samples showed lower in August and higher in December. (Fig 14).

Fluoride

The fluoride content of the water samples collected from the station I, varied from 0.4 (July) to 3.5 mg/l (December). At station II, the fluoride content of the water samples varied from 0.6 to 3.1 mg/l. The fluoride was high during December and low in July. The fluoride of the water samples varied between 0.8 and 3.2 mg/l at station III. The lowest value was observed in July and highest value was observed in December. At station IV, the fluoride concentration of the water samples showed a maximum value of 3.9 (December) and minimum value of 0.7 mg/l (July). At station V, the fluoride was varied between 0.8 and 3.7 mg/l. The fluoride was high during December and low in July. Fluoride value ranged between 0.5 and 2.9 mg/l were observed in station VI. The fluoride content was high during December and low in July. In general, the fluoride of the water samples showed lower values in July and higher values in December. (Fig 15).

Phosphate

At station I, the phosphate of the water samples varied from 0.54 to 2.4 mg/l. The phosphate was high during October and low in September. The phosphate of the water samples varied between 0.17 and 2.6 mg/l at station II. The lowest value was observed in September and highest value was observed in October. The phosphate of water samples collected from station III, varied from 0.15 (September) to 2.8 mg/l (October). Phosphate value ranged between 0.32 mg/l and 3.2 mg/l were observed in station IV. The phosphate was high during October and low in September. At station, V, the phosphate of the water samples showed a maximum value of 3.1 mg/l during August and minimum value of 0.40 mg/l during September. At station VI, the phosphate was varied between 0.41 mg/l and 2.7 mg/l. The

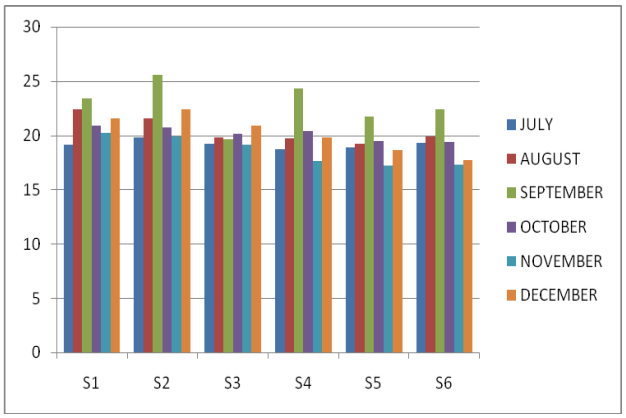

Fig 13. Sulphite level (mg/l) of the water samples collected from 6 sampling sites in Paraliyar river.

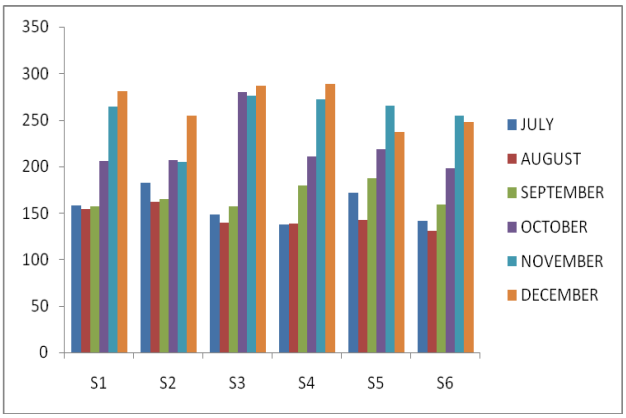

Fig 14. Chloride level (mg/l) of the water samples collected from the paraliyar river.

phosphate was high during October and low in September. In general, the phosphate of the water samples showed lower in September and higher in October (Fig 16).

Silicate

At station I, the silicate of the water samples varied from 15 mg/l to 38 mg/l. The silicate was high during December and low during August. The silicate of the water samples collected from the station II, varied from 13 mg/l (August) to 32 mg/l (December). The silicate of the water samples varied between 18 mg/l and 42 mg/l at station III. The lowest value was observed in August and highest value was observed in December. Silicate value ranged between 11 and 37 mg/l were observed in station IV. The silicate was high during December and low during August. At station V, the silicate of the water samples showed a maximum value of 41 (December) and minimum value of 19 (August). At station VI, the silicate was varied between 17 mg/l and 39 mg/l. The silicate was high during December and low during August. In general, the silicate of the water samples showed lower values in August and higher values in December. (Fig 17).

Sodium

At station I, the sodium of the water samples showed a maximum value of 647 (December) and minimum value of 267 mg/l during (July). The sodium of the water samples varied between 254 and 652 mg/l at station II. The lowest value was observed in July and highest value was observed in December. Sodium value ranged between 255 mg/l and 654 mg/l were observed in station III. The sodium was high during December and low during July. The sodium of water samples collected from station IV, varied from 247 mg/l (July) to 649 mg/l (December). At station V, the sodium of the water samples varied from 282 mg/l to 651 mg/l. The sodium was high during December and low during July. At station VI, the sodium was varied between 295 mg/l and 632 mg/l. The sodium was high during December and low during July. In general, the sodium of the water samples showed lower in July and higher in December (Fig 18).

Potassium

The potassium of the water samples varied between 23.5 mg/l and 73.9 mg/l at station I. The lowest value was observed in September and highest value was observed in December. The potassium of the water samples collected from the station II, varied from 24.9 mg/l (September) to 77.6 mg/l (December). At station III, the potassium of the water samples showed a maximum value of 78.3 mg/l (December) and minimum value of 24.3 mg/l (September). Potassium value ranged between 26.7 mg/l and 78.7 mg/l were observed in station IV. The potassium was high during December

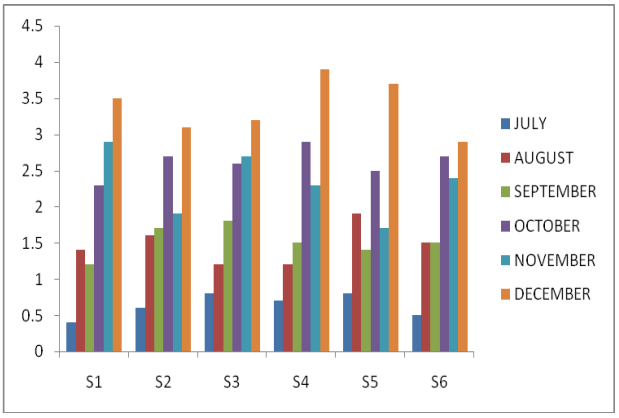

Fig 15. Fluoride concentration (mg/l) of the water samples collected from six selected stations of river Paraliyar.

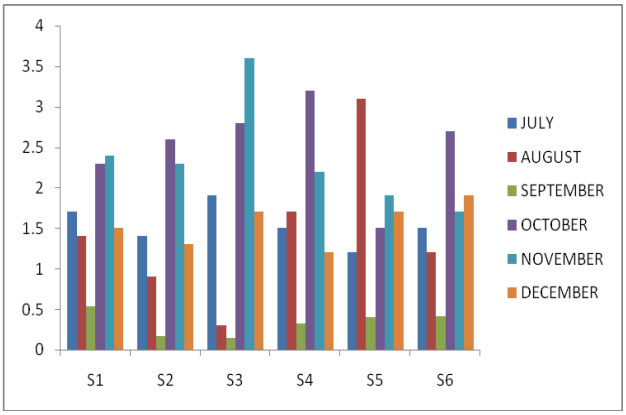

Fig 16. Phosphate level (mg/l) of the water samples collected from the river paraliyar during the study period.

and low in September. At station V, the potassium was varied between 24.7 mg/l and 77.5 mg/l. The potassium was high during December and low in September. At station VI, the potassium of the water samples varied from 25.2 mg/l to 77.6 mg/l. The potassium was high during December and low during September. In general, the potassium of the water samples showed lower values in September and higher values in December (Fig 19).

Calcium

The calcium of water samples collected from station I, varied from 41.9 (September) to 61.9 mg/l (October). Calcium value ranged between 42.9 mg/l and 62.7 mg/l were observed in station II. The calcium was high during August and low in September. At station III, the calcium of the after samples varied from 42.8 to 63.5 mg/l. The calcium was high during August and low in September. At station IV, the calcium was varied between 47.8 mg/l and 67.8 mg/l. The calcium was high during October and low in September. At station V, the calcium of the water samples showed a maximum value of 67.9 mg/l (October) and minimum value of 45.4 mg/l during September. The calcium of the water samples varied between 44.6 mg/l and 65.4 mg/l at station VI. The lowest value was observed in September, and highest value was observed in October. In general, the calcium of the water samples showed lower in September and higher in October (Fig 20).

COD

At station I, the COD of the water samples showed a maximum value of 3.1 mg/l (October) and minimum value of 1.7 mg/l (November). COD value ranged between 1.5 and 2.9 mg/l . The COD was high during October and low in November. At station III, the COD was varied between 1.6 and 3.2 mg/l. The COD was high during October and low in November. The COD of water samples collected from station IV, varied from 1.5 (November) to 3.8 mg/l (October). At station V, the COD of the water samples varied from 1.2 and 3.7 mg/l. The COD was high during October and low in November. The COD of the water samples varied between 1.5 and 3.6mg/l at station VI. The lowest value was observed in November and highest value was observed in October. In general, the COD of the water samples showed lower value in November and higher values in October (Fig 21).

BOD

At station I, the BOD of the water samples varied from 1.92 and 3.87 mg/l. The BOD was high during December and low in September. At station II, the BOD was varied between1.09 and 3.75 mg/l. The BOD was high during December and low in September. BOD value ranged between 1.99 and 3.98 mg/l. The BOD was high during December and low in September. At station IV, the BOD of the water samples showed a maximum value of 3.92 mg/l (December) and minimum value of

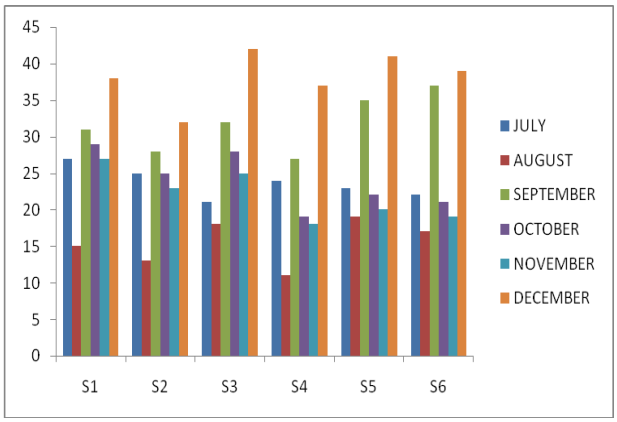

Fig 17. Silicate level (mg/l) observed in Paraliyar river from July 2010 to December 2010.

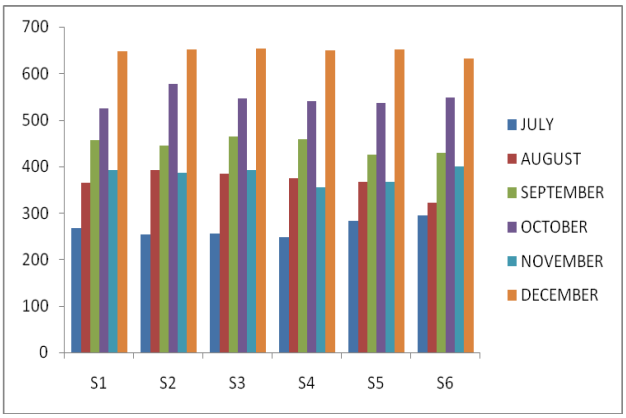

Fig 18. Sodium value (mg/l) of the water samples collected from 6 sampling sites in Paraliyar river.

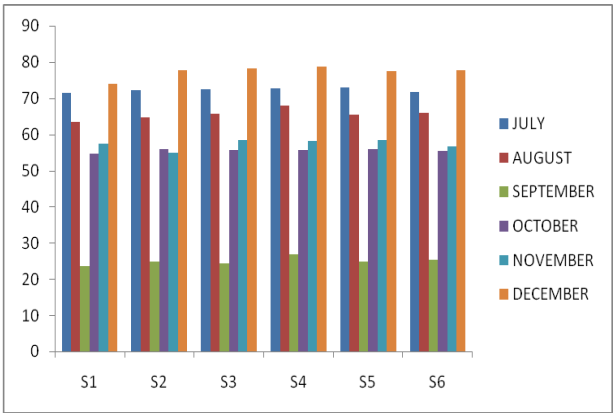

Fig 19. Potassium value (mg/l) of the water samples collected from the paraliyar river.

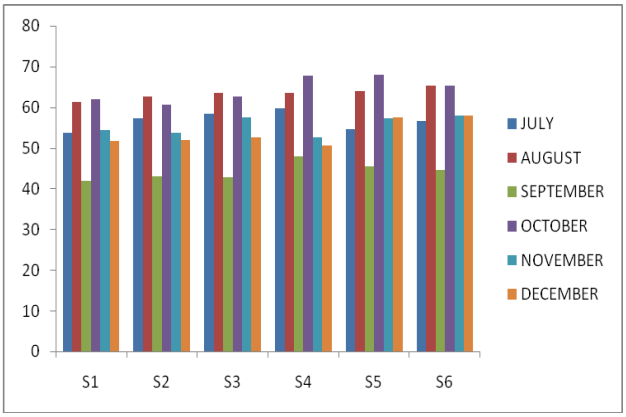

Fig 20. Calcium value (mg/l) of the water samples collected from six selected stations of river Paraliyar.

1.87 mg/l (September). The BOD of water samples collected from station V, varied from 1.54 mg/l (September) to 3.87 mg/l (December). The BOD of the water samples varied between 1.75 and 3.82 mg/l at station VI. The lowest value was observed in September and highest value was observed in October. In general, the BOD of the water samples showed lower values in September and higher values in December. (Fig 22).

DISCUSSION

In the present study pH of the water samples ranged between 5.14 and 8.9. Generally, aquatic organisms are affected by pH because most of their metabolic activities are pH dependent (Wang *et al*., 2002). Optimal pH range for sustainable aquatic life is pH 6.5 - 8.2 (Murdock *et al*., 2001). Sreenivasan (1976) has demonstrated that a large variation in pH of water is an indication of a highly productive nature of the water body. Free carbon dioxide liberated during respiration and decay of organic matter are highly soluble in natural waters. The carbon dioxide content of water depends upon the water temperature, depth, rate of respiration, decomposition of organic matter, chemical nature of the bottom and geographical features of the terrain surrounding the water body (Sakhare and Joshi, 2002).

Temporal variations in aquatic systems can have direct and indirect effects on factors influencing nutrient fluxes (Thayer, 1971) Nutrient concentrations and distributions have therefore been documented as having seasonal patterns (Baird and ulanowicz, 1989; Morris, 2000). Monthly variations are evident in all the physico-chemical parameters examined in this study. Seasonal cycles are due to imbalances in the process of mineralization and consumption (Morris, 2000). Raw sewage is the source of nitrates and phosphates in rivers (Aggarwal *et al*., 2000, Adeyemo, 2003).

The nitrate concentration of the water samples varied between 2.1 and 7.3mg/l. Nitrate is a form of nitrogen and a vital nutrient for growth, reproduction, and the survival of organisms. High nitrate levels (1 mg 1^{-1}) are not good for aquatic life. The high level of nitrate observed during this study is in agreement with Wolfhard and Reinhard (1998) who concluded that nitrates are usually built up during dry seasons and that high levels of nitrates are only observed during early rainy seasons. This is because initial rain flush out deposited nitrate from near-surface soils and nitrate level reduces drastically as rainy season progresses.

The phosphate concentration of the water samples varied between 0.15 and 3.2mg/l. There are various sources of phosphate to rivers, such as firm rock deposit, run off from surface catchments, and interaction between the water and sediment from dead plant and animal remains at the bottom of rivers. Phosphate is considered to be the most significant among the nutrient

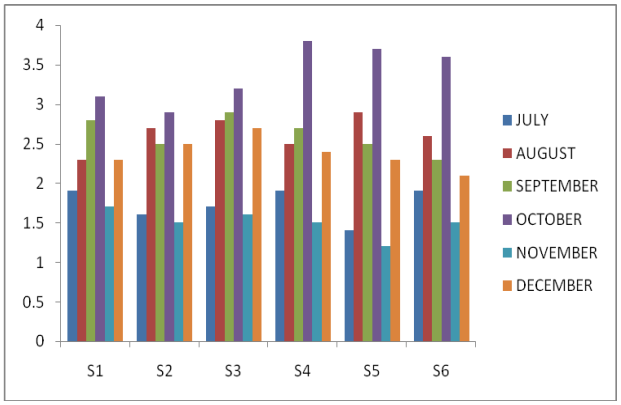

Fig 21.Chemical Oxygen Demand (mg/l) observed in Paraliyar river from July 2010 to December 2010.

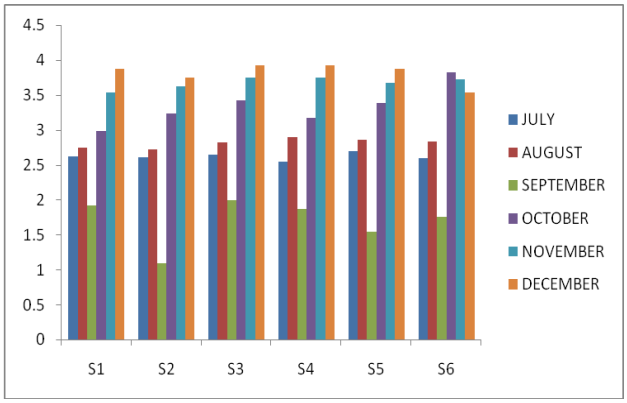

Fig 22. Biological Oxygen Demand (mg/l) of the water samples collected from the river paraliyar during the study period.

responsible for eutrophication of lakes, as it is the primary initiating factor. The result reveals that the nutrient load in the water shed is high; because of nutrient enrichment, productivity, decay and sedimentation (Adeyemo, 2003).

In the present study, dissolved oxygen content of the water ranged from 3.57 to 7.2 mg/l. Analysis of DO is a key test for the monitoring of pollution such as for treatment process of water wastages. The presence of DO in water may be due to direct diffusion from air and photosynthetic activity of autotrophs. The addition of a variety of biodegradable pollutants from domestic and industrial sources stimulates the growth of microorganisms which consume the DO of the water. DO is a good indicator of water quality and its relation to the distribution and abundance of various algal species along with the degree of pollution by organic matter and level of self purification of water.

Conductivity measures the capacity of a substance or solution to conduct electrical current. Olsen (1950) classified the name of water bodies having conductivity volume greater than 500.00 µs/cm as eutrophic. The Electrical conductivity of the river water depends on the concentration of dissolved solutes. The EC values varied between 1.204 and 3.92µs. Several factors influence the conductivity including temperature, ionic mobility and ionic valencies. In turn conductivity provides a rapid mean of obtaining approximate knowledge of total dissolved solids concentration and salinity of water sample (Odum, 1971).

Sawyer (1960) classified water on the basis of hardness in to three categories that is, soft (0.00-75 mgl^{-1}) moderately hard (75.00- 150.00 mgl^{-1}) and hard (151.00-300.00 mgl^{-1}). The hardness of the water varied between 225 and 564. Brown (1993) reported that total hardness act as limiting factor for alkalinity. Calcareous water with alkalinity more than 50 ppm is most productive, 0 –20 ppm for low production, 20-40 ppm for medium production and 40-90 ppm for higher production. Carbonates and bicarbonates in hydroxides of Ca, Mg, Na, K, NH_4 and Fe generally cause alkalinity of natural fresh water. Carbonates and bicarbonates are the major components of alkalinity; they have positive correlation with alkalinity.

In natural unpolluted waters, the acidity is mainly contributed by dissolved Co_2. In polluted waters weak acids like CH_3COOH may contribute significantly to the total acidity. In some organic waters, Organic acids also contribute to acidity (Brown,1 993). The transparency of water is mainly affected by factors such as biological productivity, suspended particles and water colour. Clay, silt, organic matter, plankton and other microscopic organisms cause turbidity in natural waters (Kishor *et al*., 2005). This has been recognized as a valuable limiting factor in the biological productivity of the water bodies.

In natural waters, dissolved solids are composed mainly carbonates, bicarbonates, chlorides, sulphates, phosphates, nitrates, calcium, magnesium, sodium, potassium, iron and manganese etc. (Esmaeili and Johal, 2005) The salts of sodium, Potassium and Calcium contribute Chlorides in waters. Large contents of Chloride in fresh water is an indicator of organic pollution (Venkatasubramani and Meenambal, 2007).

In aquatic environment, calcium serves as one of the micro – nutrients for most of the organisms. On the basis of calcium richness, Ohle (1934) classified water bodies into (i) poor (ii) Medium and (iii) rich water body. Magnesium is often associated with calcium in all kinds of waters, but its concentrations remains generally lower than the calcium (Venkatasubramani and Meenambal, 2007). Magnesium is essential for chlorophyll growth and acts as a limiting factor for the growth of Phytoplankton (Dagaonkar and Saksena, 1992). Therefore, depletion of Magnesium reduces the phytoplankton population. Dwivedi *et al*., (2000) recorded Magnesium content upto 3.27 mg l^{-1}) in Naktara reservoir. Like, Sodium, Potassium is also a naturally occurring element, but the Concentration in fresh water bodies remain quite louder than the sodium and calcium. Under was potassium concentration the growth rate and photosynthesis of algae especially blue green algae become, poor and respiration in increased (Wetzel, 1983).

The concentration of ammonia in the water samples varied between 0.35 and 1.98 NU. Ammonia higher concentration is harmful to fishes and other life. The toxicity of Ammonia increases with the pH because at higher pH most of the Ammonia remains in the gaseous form. At low pH due to conversion of Ammonia in to Ammonium ions (which are much less toxic than the gaseous form) decreases its toxicity.

Bio-chemical oxygen demand (BOD) in the amount of oxygen utilized by microorganism in stabilizing the organic matter. Chemical organic demand (COD) is a measure of the Oxygen equivalent of the organic matter content of water that is susceptible to oxidation by a strong chemical oxidant.

Sewage or residential waste, consisting largely of phosphate – containing detergents, in a major source of nutrients in bodies of water. The concept nutrient overloading has a great impact on all subsequent eutrophication research and lake management. It's fair to state that nitrates and phosphates are probably the key nutrients in controlling aquatic plant growth. The Nitrate and phosphate are two important constituents that immensely help in the growth of the plants where they are present. If they are present in lake and ponds they are excessively promote the growth of aquatic weeds and polluting our aquatic resources. International studies on the nitrates and phosphates in the surface waters of various bodies of water have expressed their concern and drawn the attention of scientists around the globe. These constituents are immensely help in the growth of the macrophytes like water hyacinth (*Eichhornia crassiper*) which is the most troublesome aquatic weed in the world. The major sources of nitrate in lakes and ponds are from the catchment area by rainfall, sewage effluents, agro waste, suspended organic matter when algae and other suspended micro organisms die and settle down to the bottom. They carry their, Nitrogen and phosphorous with them, during decomposition. This Nitrogen is released and becomes available for subsequent growth of aquatic biota (Singh and Mahajan, 1987). Presence of nitrate in water indicates the final stage of mineralization (Nema *et al*., 1984). Phosphorous is present in many forms among them orthophosphate plays an important role in the aquatic ecosystem. Orthophosphate is the soluble reactive phosphorous which is also termed as inorganic phosphate. It plays a dynamic role in aquatic eco system which is taken up widely by phytoplankton (Goldman, 1965).

CONCLUSION:

In conclusion results of the present study revealed that most of the physical and chemical parameters of the Paraliyar River are within the permissible limit reported for the potable waters. However, in some months, the nutrients and other parameters showed higher values than the permissible limits. The deterioration in the physicochemical quality and rise in the nutrient level observed in this study is alarming, and periodic monitoring and preventative measures are required to save the aquatic system from eutrophication.

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