PHYSICO-CHEMICAL PARAMETERS OF THAMIRABARANI RIVER IN KANNIYAKUMARI DISTRICT

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Abstract : The analysis of the physical, chemical, and biological characteristics of the water through time is typically involved in hydro biological studies. Regular water quality monitoring studies are required because aquatic ecosystems are dynamic and are vulnerable to changes related to environmental factors and climate change-induced factors. In this study, the water quality parameters were determined in Thamirabarani River, Kanniyakumari District, Tamilnadu, India. The physico-chemical parameters were analyzed by collecting water from six sites of Thamirabarani River. The maximum temperature was recorded during the month of March 2017. The maximum pH (7.11) was recorded during the month of April 2017 in Site - V and the minimum (5.55) was recorded in July 2016 from Site – I. The maximum EC (4.032 µS) was recorded during the month of December 2016 in Site - V and the minimum (1.013 µS) was recorded during the month of October 2016 in Site – I. The maximum alkalinity (300 mg/L) was recorded in April 2017 in Site - II and the minimum (126 mg/L) was recorded in November 2016 in Site – V. The acidity values were within the permissible limit in all the sampling months.

***IndexTerms*–River; Thamirabarani; Kanniyakumari; Water quality**

1. Introduction

In order to evaluate the level of pollution and preserve the water resources, hydrobiological research on freshwater bodies is routinely conducted in India and other countries. The biodiversity of freshwater bodies like lakes, ponds, and rivers was under threat by numerous anthropogenic sources, according to Bronmark and Hansson (2002). Monitoring is an intentional, sporadic surveillance process used to gauge how much something is conforming to a standard or how much it is deviating from the norm. Controlling pollution is a goal. The analysis of the physical, chemical, and biological characteristics of the water through time is typically involved in hydro biological studies. Regular water quality monitoring studies are required because aquatic ecosystems are dynamic and are vulnerable to changes related to environmental factors and climate change-induced factors. The cumulative disaster that man is causing on the environment on a daily basis justifies routine research employing new science and technology. To reduce the degree of pollution, it is crucial to conduct biomonitoring in these degraded ecosystems. Proper resource management for the benefit of people is important for the conservation of this ecosystem. Living (biotic) and non-living (abiotic) elements make up an ecosystem. The biotic factors, which include competing species, parasites, predators, and people, include living things including animals, plants, and bacteria. Each organism has the ability to endure a variety of environmental conditions, yet it can only exist in environments that fall within certain tolerance thresholds. Abiotic components refer to the physico-chemical environment, which includes things like light, air, water, temperature, minerals, and soil. The governing forces of the environment are typically abiotic factors. The organisms that often grow in them have the capacity to change themselves to fit the abiotic environment. The health and distribution of organisms as well as the ecosystem's activities are influenced and governed by the abiotic variables of the environment. Freshwater ecosystems and organisms are affected by pollution in physico-chemical variables (Aykulu, 2005). The main aim of the study was to determine physical factor of water in Thamirabarani River, Kanniyakumari district, India.

2. Materials and methods

2.1. Samples

Water samples were collected from six different stations from July 2016 to June 2017 at 6 sites at Thamirabarani River, Kanniyakumari District, India and the following parameters were analyzed.

2.2. Temperature (°C)

All biological and metabolic processes are governed by temperature. Therefore, it is a key component that affects the water's quality. When collecting water samples, the temperature of the water was measured using a thermometer in Celsius. A value of °C (celsius) was used to express the results. Surface waters at a depth of 2 meters were the only ones included in the study. A digital thermometer was used.

2.3. pH

When evaluating the hydrogen ion concentration of the medium, pH is a crucial factor. As the pH value rises, alkaline conditions will rule and acidic conditions will be more prevalent. With the use of pH indicator sheets, it was noted on the collection site itself, and later in the lab, it was compared with the readings from the pH meter (a pH 211 Microprocessor pH meter).

2.4 Electrical conductivity (μS)

A solution's ability to conduct an electrical current is determined by the migration of solutes and is reliant on the types and quantities of ionic species that are present in the solution; this attribute is known as electrical conductivity. It is a handy tool for determining the water's purity and provides information on the amount of soluble salts contained in the water samples. Using the EC-TDS Analyzer (Elico CM 183), electrical conductivity was measured.

2.5 Alkalinity (mg/L)

Alkalinity of the water is defined as its ability to neutralize a strong acid and is characterized by the existence of all hydroxyl ions capable of mixing with the hydrogen ions. Free hydroxyl ions are what cause alkalinity in natural water. The alkalinity of the water sample was determined using a titrmetric technique. For this, 100 ml of the sample was placed in a conical flask along with a few drops of phenolphthalein, and the color of the sample was observed. By titrating with 0.1 N HCl, the pink hue that was produced following the addition of phenolphthalein vanished. Its name is PA, or phenolphthalein alkalinity. A few drops of methyl orange were then added to the original sample, and the titration was repeated until the yellow hue turned pink. The following formula was used to calculate the alkalinity, which is known as total alkalinity (TA);

$$\text{PA as } CaCO_3 \text{ (mg/L)} = \frac{(A \times N) \text{ of } HCl \times 1000 \times 50}{\text{mL/sample}}$$

$$\text{TA as } CaCO_3 \text{ (mg/L)} = \frac{(B \times N) \text{ of } HCl \times 1000 \times 50}{\text{mL/sample}}$$

Where, A = mL of HCl used only with phenolphthalein
B = mL of HCl used with phenolphthalein and methyl orange

2.6 Acidity (mg/L)

The titrimetric method of Gupta (1999) was used to determine acidity. 100 cc of the sample were obtained, placed in a volumetric flask with 3 drops of methyl orange added as an indicator, and titrated with 0.05 N sodium hydroxide. The turning of pink into yellow was the tested. Phenolphthalein was assed as an indicator and watched as the color changed from yellow to pink. The following formula was used to determine the acidity:

$$Methyl\,orange\;\;acidity = \frac{m \times 0.05N\;\;of\;\;NaOH \times 50{,}000}{Volume\;\;of\;\;sample}$$

$$Phenolpthalein\;\;acidity = \frac{p \times 0.05N\;\;of\;\;NaOH \times 50{,}000}{Volume\;\;of\;\;sample}$$

$$Total\ acidity = \frac{(m+p) \times 0.05N\ of\ NaOH \times 50,000}{Volume\ of\ sample}$$

3. Results

3.1. The physico-chemical characteristics of Thamirabarani River water

The physico-chemical parameters were analyzed by collecting water from six sites of Thamirabarani River. The maximum temperature (30.2 °C) was recorded during the month of April 2017 in Site-IV and the minimum (24.2 °C) was recorded during the month of December 2016 in site VI. The temperature values were within the permissible limit in all the sampling months (Table 1).

Table 1. Monthly variations of temperature in water of Thamirabarani River from July 2016 to June 2017 at 6 Sites.

Month	Temperature in °C					
	I	II	III	IV	V	VI
July-2016	24.5	24.6	26.2	24.7	25.8	25.4
August-2016	25.3	26.4	25.6	28.3	27.6	27.4
September-2016	27.6	27.7	26.4	27.2	28.5	27.3
October-2016	28.3	28.2	28.4	28.5	27.7	28.4
November-2016	30.6	29.3	28.4	27.7	26.4	24.3
December-2016	26.1	26.7	28.5	28.2	27.4	24.2
January-2017	26.4	27.5	28.8	25.6	27.2	28.7
February-2017	25.2	26.5	27.6	27.4	28.8	28.3
March-2017	26.3	38.6	26.9	27.2	26.6	27.4
April-2017	26.4	27.2	27.5	30.2	29.9	28.7
May-2017	27.2	28.3	27.7	28.8	98.5	28.8
June-2017	26.7	26.4	25.2	25.8	26.7	26.5

3.2 pH

The maximum pH (8.98) was recorded during the month of April 2017 in Site - VI and the minimum (5.29) was recorded in July 2017 from Site – V (Table 2).

Table 2. Variation of pH in Thamirabarani River during the study period (2016-2017)

	pH					
Month	**I**	**II**	**III**	**IV**	**V**	**VI**
July-2016	5.55	5.24	5.33	5.42	6.18	6.55
August-2016	6.45	6.75	7.03	6.82	6.56	6.64
September-2016	6.64	6.62	6.94	6.86	7.02	6.45
October-2016	8.34	8.29	8.40	8.53	8.21	7.01
November-2016	8.64	8.27	8.67	7.10	7.04	8.06
December-2016	7.07	7.06	8.54	8.45	8.37	8.54
January-2017	8.26	8.56	7.08	8.36	8.97	8.53
February-2017	8.87	7.03	8.56	8.36	7.10	8.24
March-2017	7.03	8.57	8.87	7.01	8.43	7.02
April-2017	8.86	8.45	8.23	8.54	7.11	8.98
May-2017	8.65	8.31	8.24	8.15	8.34	8.26
June-2017	5.36	5.27	5.37	5.53	5.54	5.23

3.3 Electrical conductivity (EC)

The maximum EC (4.032 µS) was recorded during the month of December 2016 in Site - V and the minimum (1.013 µS) was recorded during the month of October 2016 in Site – I (Table 3). The electrical conductivity values were within the permissible limit in all the sampling months.

Table 3 EC µS of Thamirabarani River during the study period (2016-2017)

	EC µS					
Month	**I**	**II**	**III**	**IV**	**V**	**VI**
July-2016	1.507	2.021	1.553	1.687	2.027	1.584
August-2016	1.203	1.867	1.300	1.122	1.644	1.665
September-2016	1.222	1.734	2.042	1.724	1.973	1.274
October-2016	1.013	1.224	1.354	1.723	1.834	2.378
November-2016	2.518	2.243	3.703	2.212	2.623	3.381
December-2016	3.622	3.782	3.974	3.372	4.032	3.748
January-2017	3.764	3.824	4.021	3.923	3.251	3.365
February-2017	3.984	3.275	3.356	3.267	3.278	2.812
March-2017	2.758	2.826	2.764	3.434	2.217	2.346

April-2017	2.768	2.735	2.289	2.402	2.857	2.208
May-2017	2.377	2.039	2.785	2.786	2.287	1.162
June-2017	2.092	1.281	1.516	1.418	1.665	1.762

3.4. Alkalinity

The maximum alkalinity (300 mg/L) was recorded during the month of April 2017 in Site - II and the minimum (126 mg/L) was recorded during the month of November 2016 in Site - V (Table 4).

Table 4 Alkalinity (mg/L) of Thamirabarani River during the study period (2016-2017)

	Alkalinity mg/L					
Month	**I**	**II**	**III**	**IV**	**V**	**VI**
July-2016	236	267	213	217	243	212
August-2016	246	267	228	276	153	164
September-2016	182	194	188	164	175	192
October-2016	191	169	178	158	159	183
November-2016	156	171	173	185	126	158
December-2016	274	234	267	283	275	264
January-2017	277	138	273	212	215	219
February-2017	217	223	254	276	251	245
March-2017	195	197	214	233	196	191
April-2017	252	300	268	245	236	248
May-2017	244	256	251	267	270	284
June-2017	268	271	266	254	260	275

The maximum alkalinity (300 mg/L) was recorded during the month of April 2017 in Site - II and the minimum (126 mg/L) was recorded during the month of November 2016 in Site - V (Table 4). The alkalinity values were within the permissible limit in all the sampling months.

3.5 Acidity

The maximum acidity (199 mg/L) was recorded during the month of June 2017 in Site - V and the minimum (127 mg/L) was recorded during the month of August 2016 in Site - III (Table 5). The acidity values were within the permissible limit in all the sampling months.

Table 5 Acidity (mg/L) of Thamirabarani River during the study period (2016-2017)

	Acidity mg/L					
Month	**I**	**II**	**III**	**IV**	**V**	**VI**
July-2016	185	177	192	190	175	145

August-2016	158	163	127	166	159	142
September-2016	182	174	163	165	150	168
October-2016	138	134	133	132	137	136
November-2016	154	167	155	171	104	137
December-2016	168	166	163	160	162	171
January-2017	152	164	166	153	168	150
February-2017	166	168	167	163	164	168
March-2017	154	162	163	150	164	162
April-2017	173	170	175	176	174	179
May-2017	173	176	175	172	178	177
June-2017	192	191	197	195	199	194

4. Discussion

Humans depend on fresh water resources because they offer the water needed for drinking, industry, and agriculture. The fresh water bodies are important for maintaining ecosystems and a variety of plants and animals in addition to supplying potable water. Rivers, lakes, dams, and ponds all have different causes affecting their water quality, including pollution, agricultural runoff, and influences brought on by climate change. Rivers and other sources of fresh water are crucial for the recharge and discharge of ground water. As a result, studies on the physical, chemical, and biological characteristics of nearby wells and rivers have become more important in recent years, and significant focus has been given to determining the potability of the water. In India about 53% of people depend on ground water for potable purposes and this value is high (about 65%) in rural parts (Chaudhuri and Roy, 2017). Throughout the world fresh water resources are under severe threats due to the climate change-induced factors. Hence, continuous monitoring studies are required to create awareness about the quality of water resources in India. According to Chaudhuri and Roy (2017), the drinking water sources in India can be classified into 8 categories. They are tap water, well water, hand pump, bore well, spring, river/canal, tank pond and others. In this study, the water quality parameters of Thamirabarani River were monitored for a period of one year and brought to light the levels of nutrients. Results showed that the physical parameters of the Thamirabarani River varied considerably between different sampling sites and months. Water temperature is an important factor which regulates the metabolic activity of the aquatic organisms and their distribution (Wetzel, 2001). In general, the summer months saw high water temperatures for both river and well waters. The high temperatures recorded during the summer months may be a result of rising air temperatures and a decrease in river water levels. Variations in the temperature of the atmosphere have a significant impact on the water temperature (Wetzel, 2001). Another potential explanation for the greater water temperature in river water is the low water level and reduced water flow throughout the summer. According to Bennett and Di Santo (2011), aquatic species will be impacted by higher water temperatures (over 35 °C) that will interfere with crucial enzyme systems and change metabolic activity. The pH of the water samples used in the current study varied greatly. Since the majority of aquatic species' metabolic processes depend on pH, pH generally has an impact on them (Wang et al., 2002). According to Murdock et al. (2001), the ideal pH range for sustained aquatic life is between pH 6.5 and 8.2. The water's dissolved oxygen concentration varied greatly in the current investigation. One of the important indicators of the water's physical, chemical, and biological state is the amount of dissolved oxygen. For the treatment of water wastes and for monitoring pollution, analysis of DO is a crucial test. The direct diffusion of DO from the air and the photosynthetic activity of autotrophs may both be to blame for its presence in the water. The growth of bacteria that absorb the DO of the water is sped up by the addition of a variety of biodegradable contaminants from residential and industrial sources. DO is a reliable indication of water quality and its relationship to the distribution and abundance of diverse algae species, as well as the degree of organic matter pollution and the level of water self-purification. The ability of a substance or solution to carry electrical current is measured by electrical conductivity. The concentration of dissolved solutes affects the river water's electrical conductivity. In the river water during this study period, the EC values differed between the sample sites that were collected. The findings of this study demonstrated that river water's conductivity was at its highest between October and December. The monsoon season may have contributed to the highest EC during this time because runoff from agricultural fields affects EC values (Patil, 1986). There were large variations in the water's hardness. The most productive calcareous water has an alkalinity of more than 50 ppm; lower production requires 0–20 ppm, medium production requires 20–40 ppm, and higher production requires 40–90 ppm. Natural fresh water typically becomes alkaline due to the presence of carbonates, bicarbonates, and hydroxides of Ca, Mg, Na, K, NH_4, and Fe. The two main substances that make up alkalinity, carbonates and bicarbonates, are positively correlated with it. Water colour, suspended particles, and biological production are the key determinants of transparency in water. Turbidity in natural waters is caused by clay, silt, organic debris, plankton, and other microscopic organisms (Kishor et al., 2005). It has been acknowledged that this serves as a valuable constraint on the biological productivity of the water bodies.

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