Advances in Bioresearch
Adv. Biores., Vol 1 (1) January 2025: 78-91

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.16.1.7891

Advances in Bioresearch

ORIGINAL ARTICLE

Seasonal Variations in Physico-chemical parameters of Cauvery delta region in Thanjavur, Tamilnadu, India.

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ABSTRACT
This study's goal is to evaluate the physico-chemical properties of lentic and lotic water bodies, such as the Cauvery River, the Coleroon River, the Ayyanar Temple tank, and the Perumal Kovil tank, between July 2021 and June 2022. Analysis was done on the following parameters: temperature, transparency, total hardness, pH, DO_2, BOD, phosphate, nitrate, ammonia, silicate, and CR, NPP, and GPP. Comparing these reservoirs, the Cauvery and Coleroon rivers might be considered to have acceptable water quality that is appropriate for human consumption. The water in the Ayyanar Temple tank and the Perumal Kovil tank is heavily polluted. The main signs are lower levels of dissolved oxygen, nitrate, and sulfate, as well as higher pH levels at the investigation sites. The pollution at two locations is particularly severe due to man-made sources such as open defecation, cleaning practices, and the leachates of solid waste products such as paper, polythene bags, plastic cups, sachets, straws, fabrics, and leaves. Additionally, non-point pollution, such as sewage from settlements, is present.
Keywords: *Physico-chemical, Cauvery River, water quality, sewage discharges*

Received 09.11.2024 Revised 21.11.2024 Accepted 25.12.2024

How to cite this article:
M.Sachidhanandham and S.Pazhanisamy. Seasonal Variations in Physico-chemical parameters of Cauvery delta region in Thanjavur, Tamilnadu, India. Adv. Biores. Vol 16 [1] January 2025. 78-91

INTRODUCTION

Freshwater is a vital resource for the advancement of the environment and life. A healthy climate and better quality of water (WQ) make life better for people [1]. Rivers, lakes, and wetlands serve as the primary water sources for drinking, farming, and industry in India [2]. Currently, irrigation accounts for over 80% of freshwater resources, with the remaining 20% designated for various other needs. This freshwater resource further underpins the multifaceted dimensions of human development, encompassing social, cultural, economic, and political aspects. Most of these activities primarily relate to the accessibility and allocation of riverine systems [3-5].

The wastewater from these sources contains toxic inorganic and organic compounds, as well as contaminants such as heavy metals [6-9], which can lead to eutrophication and serious health problems. According to Miller [10], this issue is becoming increasingly problematic in many developing nations, India included. In addition to the persistent release of slightly treated wastewater from industries, urban runoffs, and sewages from both point and non-point sources, the water quality (WQ) of many Indian rivers, including the Cauvery, has been gradually declining over the past few decades [11]. There is a worrying trend of increasing pollution in several of the Cauvery's tributaries and distributaries. Heavy pollution with chemicals from the Tirupur manufacturing region has rendered River Noyyal a "dead river" [12]. The present study has been taken up with the objective of physicochemical characteristics of two lentic and two lotic water bodies. Four sampling stations were Chosen: Station 1: Cauvery River, Station 2: Coleroon River, Station 3: Perumalkoil Tank, and Station 4: Ayyanar Temple Tank in Umbalapadi village, Papanasam TK, Thanjavur district, Tamil Nadu. The selection of sampling spots depends upon riverfront accessibility and local human activities (bathing, washing, cleaning, dumping, burning of solid waste, open defecation, and soaking of materials).

MATERIAL AND METHODS

Research design

Four distinct stations are identified (two lentic, two lotic): Cauvery River (Station 1), Coleroon River (Station 2), Perumalkoil Tank (Station 3), and Ayyanar Temple Tank (Station 4). The study area is located in Kumbkonam, Thanjavur District, Tamil Nadu, and is defined by the geographic coordinates of Latitude 10.930185° and Longitude 79.214165° (station 1) within the Govindanallucheri panchayat, Lat 10.967928° Long 79.2252026° (station 2) within the Umbalapadi panchayat and Latitude 10.954974° and Longitude 79.256751° (station 3) within the Umbalapadi panchayat, Lat 10.930286° Long 79.213759° (station 4) within the Govindanallucheri panchayat (Figure 1). The agricultural activities in these taluks account for 50% of the area, thereby contributing to the economy. The current research aims to analyze the physical and chemical characteristics of Cauvery River and tank water.

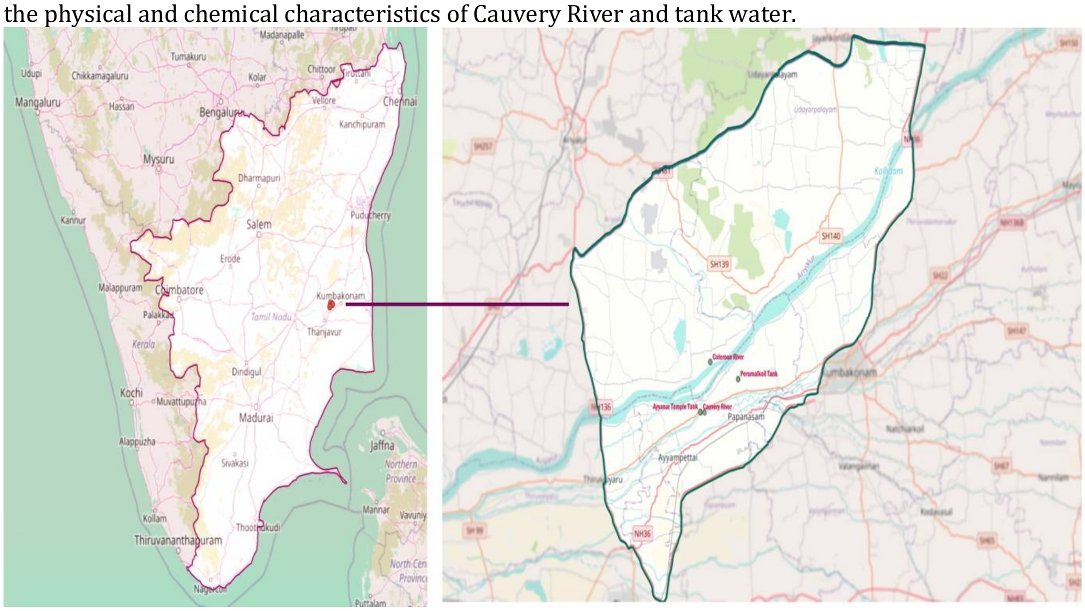

Figure 1: Sampling locations in the Cauvery Delta region, Thanjavur district.

Laboratory analysis

The water samples were tested for total hardness using Strickland and Parsons' [13] method, dissolved oxygen using Wrinkler's method, biological oxygen demand using APHA [14], and nutrients such as phosphate, nitrate, ammonia, and silicate using Strickland and Parsons' [13] method. Primary productivity was evaluated immediately. in the field in accordance with the methodology established by Gaarder *et al.,* [15].

Samples were promptly taken to the Department of Zoology laboratory at Government Arts College (Autonomous), Kumbakonam, Thanjavur District, after being protected from the sun. The samples have been collected over a period of one years, specifically from July 2021 to June 2022, at four designated stations in Tamil Nadu. A mercury-filled Celsius thermometer with an accuracy of 0.5°C was used to test the water's temperature, and a Secchi disk (in centimeters) was used to measure its transparency. The dissolved oxygen content of the bottom water was assessed using Winkler's method in accordance with the procedure outlined by Strickland and Parsons [13]. The pH of the water sample was measured utilizing a digital pH meter.

Statistical analysis

Triplicate measurements were made for all analyses of water samples. Statistical processed.

RESULT AND DISCUSSION

Physical parameters such as air temperature (AT), water temperature (WT), conductivity, and transparency organize the results into categories. Chemical parameters include pH, total hardness (TH), total suspended solids (TSS), dissolved oxygen (DO), biological oxygen demand (BOD), and chemical oxygen demand (COD). Nutrient parameters consist of phosphate (PO_4), nitrate (NO_3), ammonia (NH_3), and silicate (SiO_2). Primary productivity indicators include gross primary productivity (GPP), net primary productivity (NPP), and cross productivity (CR).

Air Temperature

At station 2 Coleroon River, the maximum air temperature (40±0.713°C) was recorded in the month of May 2022, and the minimum (28±0.673°C) was in December 2021. Station 3 showed a minimum value of temperature (28±0.673ºC) in December 2021, and a maximum of 37±0.856°C (May 2022) was recorded. Figure 1a displays the average temperature readings. In station 4 Perumal kovil tank, the maximum air temperature (36±0.421°C) was recorded in the month of April 2022, and the minimum (29°C) was in December 2021. As the primary determinant of water's inherent physical characteristics, temperature also has a major impact on the water's chemical and biological characteristics, which makes it one of the most crucial elements in the aquatic environment, especially in freshwaters.

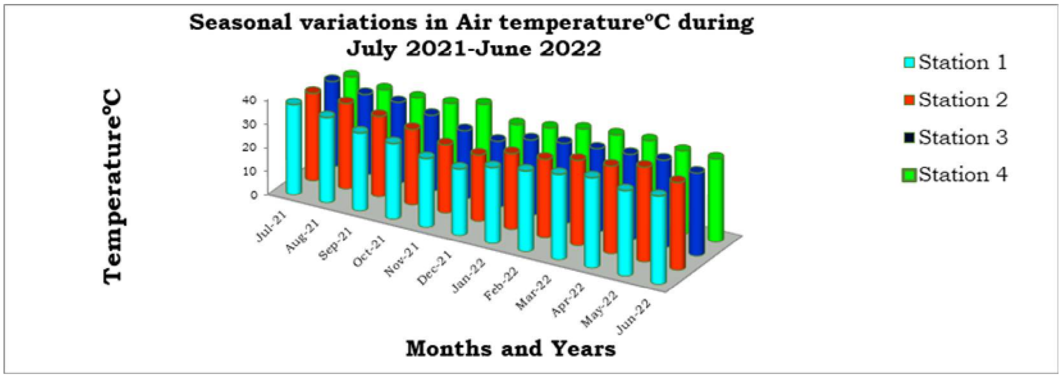

Figure 1a: Seasonal variation of Air Temperature during July 2021-June 2022

Water Temperature

Figure 2 shows the monthly change in water temperature at four reservoirs throughout the course of the year (July 2021–June 2022). Temperature serves as a critical physical parameter that affects various other hydrological factors. At station 1, the lowest temperature recorded during November and December 2021 was 25±0.121°C, while the highest temperature observed in June 2022 was 33±0.154°C. The maximum water temperature reported at Station 2 was 40±0.365°C in March 2022, while the minimum was 28±0.548°C in November 2021. The observation demonstrates that the surface water temperature is lower and closely correlated with humidity and moisture, as illustrated in Figure 2. At station 3, the lowest temperature recorded was 25±0.121°C during November and December 2021, while the highest temperature observed was 33±0.154°C in June 2022. At Station 4, the minimum recorded temperature was 22±0.410°C in October, while the maximum recorded temperature was 33±0.154°C in June. Temperature serves as a critical factor within the coastal ecosystem, potentially affecting the distribution and abundance of both flora and fauna [16]. The temperature of water significantly influences the solubility of salts and gases. The recorded water temperature exhibited a minimum value of 22±0.410°C in October at Station 4, while the maximum value reached 33±0.154°C in June at Stations 1, 3, and 4.

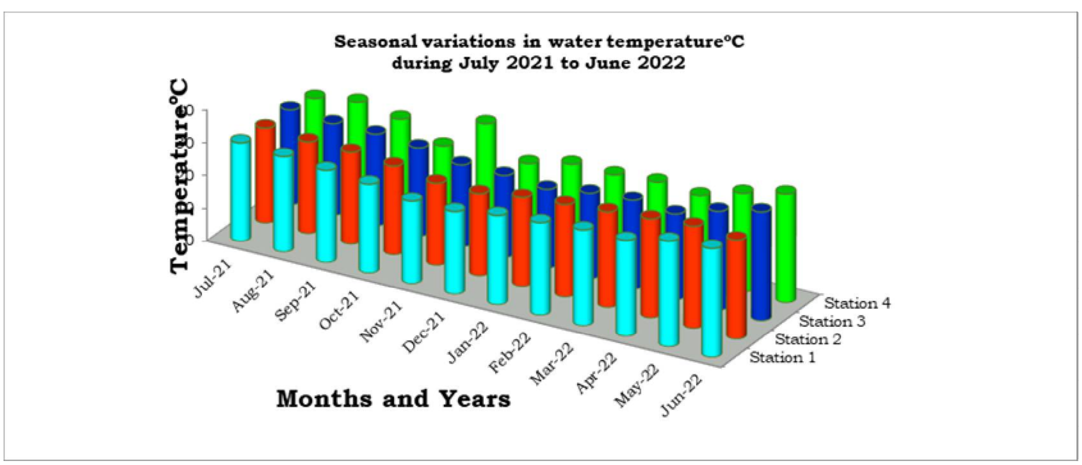

Fig. 2: Seasonal variation of water temperature during July 2021-June 2022

Seasonal variations in pH

Figure 3 illustrates the mean pH values for four distinct stations—Station 1, Station 2, Station 3, and Station 4—highlighting the observed monthly variations. The pH levels of freshwater exhibited minimal seasonal variations. The pH represents a critical parameter in hydrology. The amount of hydrogen ion concentration was consistently measured as neutral, with values slightly higher than 7.0±0.314. A highest pH level of 8.3 was determined at station 1 in July 2021, while the lowest pH value of 7.2±0.212 was observed in January 2022. The monthly pH values observed at stations 2, 3, and 4 were the lowest (7.2±0.291; 7.2±0.294; 7.2±0.212) in March 2022 and the highest (8.4±0.632; 8.5±0.658; 8.0±0.147) in July 2021 and November 2021. The pH levels exhibited a statistically significant difference across the various stations analyzed ($P<0.001$).

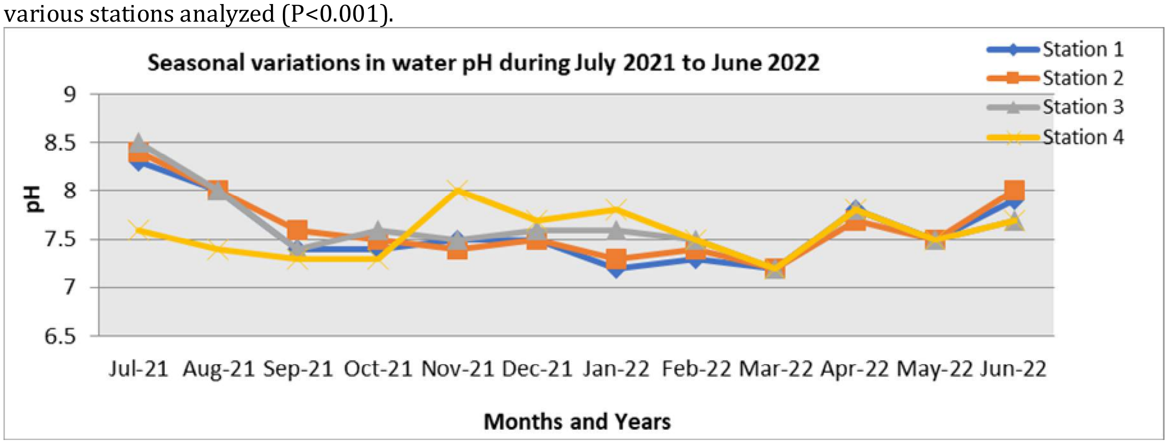

Figure 3: Seasonal variation of water pH during July 2021-June 2022

Water Conductivity

The conductivity measurements were recorded within the following ranges: Station 1 exhibited values from 790 ±11.21 to 1200 ±10.91 μ sie, Station 2 ranged from 790 ±11.21 to 1180 ±09.27 μ sie, Station 3 showed values between 830 ±08.56 and 1200 ±10.47 μ sie, and Station 4 recorded a range of 830 ±10.74 to 1110 ±10.86 μ sie. The monsoon season recorded the highest conductivity, while the pre-monsoon season recorded the lowest (Figure 4). The conductivity levels exhibited a significant difference between the various stations examined ($P<0.001$).

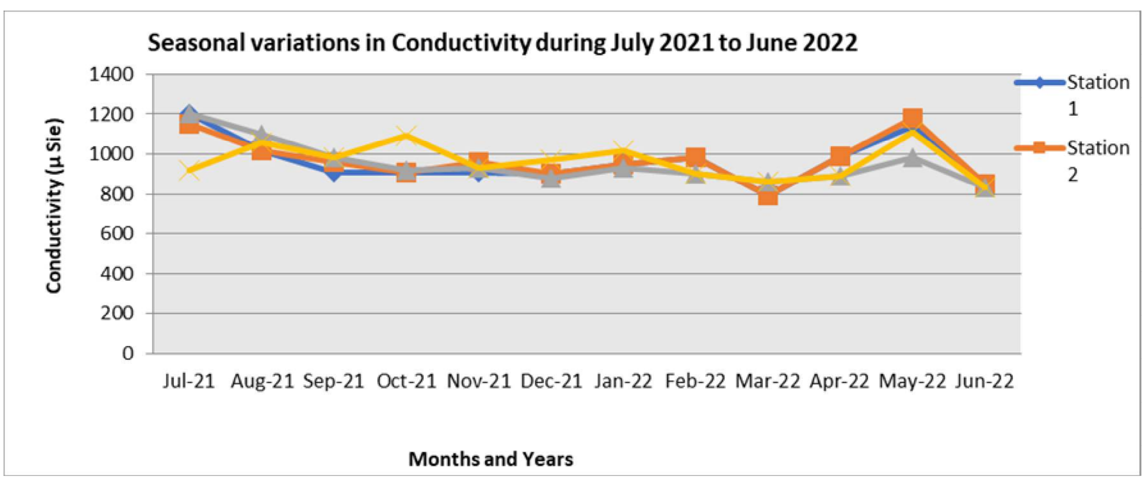

Figure 4: Seasonal variation of water Conductivity during July 2021-June 2022

Water Transparency

Figure 5 showed the monthly changes in transparency for four reservoir waters from July 2021 to June 2022. The highest and lowest mean values of transparency were recorded at Station 1 and Station 2 (26±0.12 cm to 90±0.23 cm), at Station 3 (26± 0.12 cm to 85±0.36 cm), and at Station 4 (53 ± 0.22 cm to 80± 0.11 cm). Throughout the study period, the highest mean value of transparency was recorded during the month of May at Stations 1 and 2 (121 ± 0.32 cm), while the lowest mean value was observed in December 2021 at Stations 1, 2, and 3 (26 ± 0.02 cm). The current investigation revealed that the four stations observed the highest transparency during the month of May. The degree of transparency exhibited a notable variation across the various stations analyzed (P<0.001).

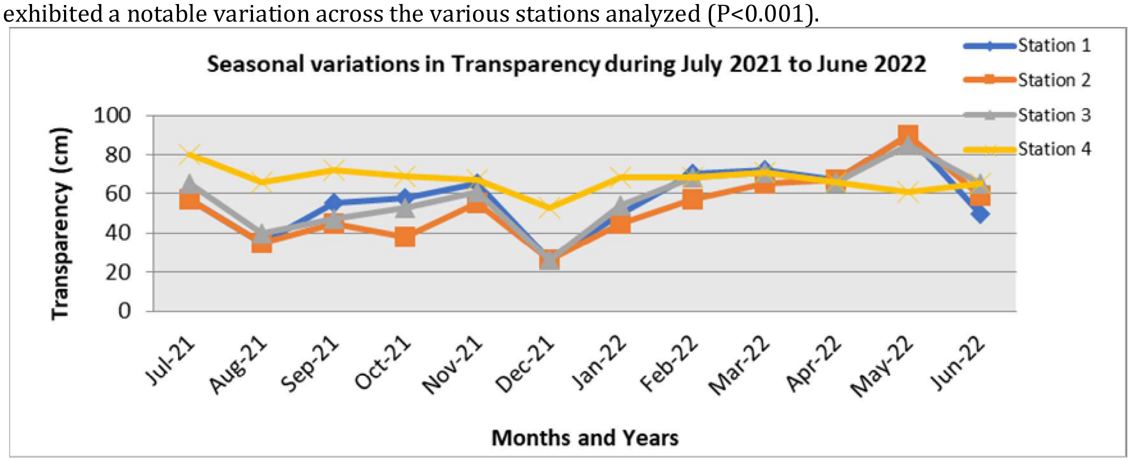

Figure 5: Seasonal variation of water Transparency during July 2021-June 2022

Dissolved Oxygen

Aquatic species are impacting dissolved oxygen, a crucial chemical component for respiration. The variation in the concentration of dissolved oxygen content ranged from 6.3±0.715 mg/L to 9.67±0.542 mg/L. At station 1, the highest recorded value was 9.67 ±0.542 ml/l in December 2021, while the lowest value of 6.9 ±0.21 mg/l was noted in May 2022 (Figure 6).The highest mean dissolved oxygen level was observed in December at 9.67±0.542 mg/l, while the lowest was recorded in May at 6.3 mg/l. The highest levels of dissolved oxygen were observed at Station 2 (9.67±0.542 mg/l), Station 3 (8.4±0.641 mg/l), and Station 4 (8.42±0.112 mg/l) in December 2021. The minimum values recorded were at Station 2 (6.3 ±0.715 mg/l), Station 3 (6.41 ±0.951 mg/l), and Station 4 (6.3 ±0.715 mg/l) in May 2022, as illustrated in Figure 6. The concentration of dissolved oxygen exhibited a significant difference between the various stations analyzed (P<0.001).

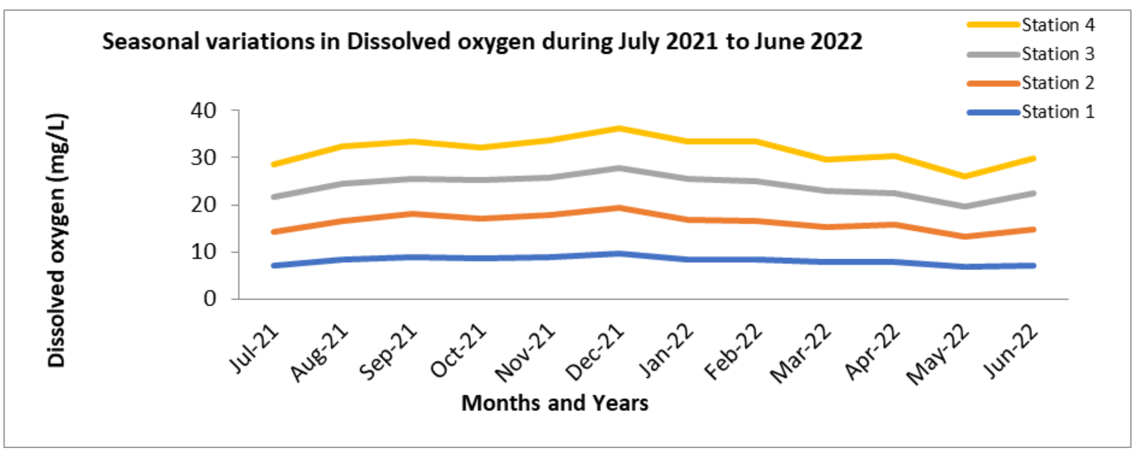

Figure 6: Seasonal variation of Dissolved oxygen during July 2021-June 2022

Total Suspended Solids

Total suspended solids were measured in July 2021 at a maximum of 1300±10.34 mg/L and in September at a minimum of 210±09.45 mg/L (Figure 7). The total suspended solids (TSS) values were measured at their highest in Station 2 (1300±10.56 mg/l), subsequently followed by Stations 1 and 3 (1200±10.36 mg/l), with the lowest value noticed at Station 4 (210±09.45 mg/l). Notably, Stations 1, 2, and 3 exhibited a substantial rise in TSS compared to Station 4 (Figure 7). It was also found that the highest level of total suspended solids (TSS) at Station 4 was 730±08.01 mg/l, indicating a significant (p<0.01) variation in concentration. The lowest total suspended solids (TSS) recorded was 310±08.11 mg/l. At Station 2, the maximum TSS was noted in July 2021, while the minimum TSS was 220±10.01 mg/l in September 2021.

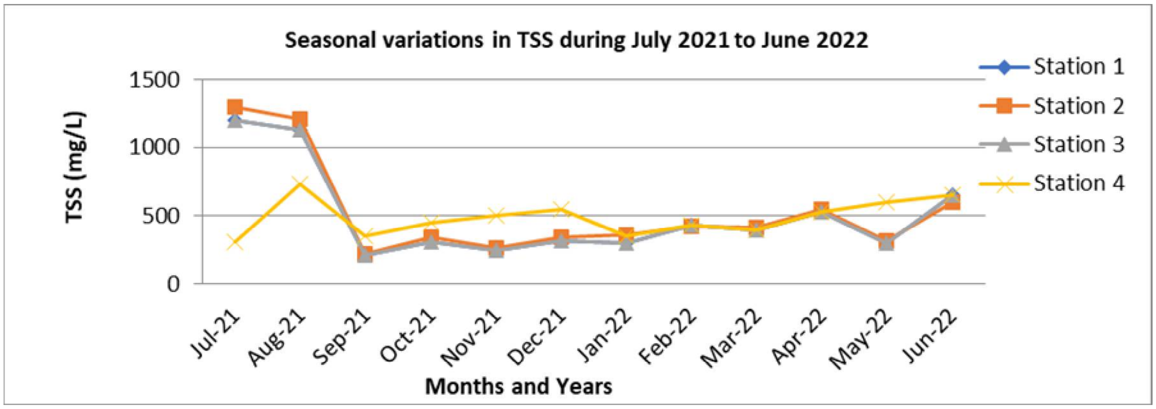

Figure 7: Seasonal variation of Total suspended solid during July 2021-June 2022

BOD (mg/l)

Biological oxygen demand was found to be lower in the months of April and June 2022 (6.48±0.05 mg/l) and greater in July, October, and December (22.96±0.25 mg/l) in Station 4, 3, and 1, accordingly, throughout the investigation's period (Figure 8). Human activities and poorer photosynthesis processes increase the oxidation rate and enhance microorganism metabolism processes, leading to a greater discharge of organic matter and a higher oxygen demand. However, all samples show minimal BOD, indicating a favorable sanitary state of the water [17].

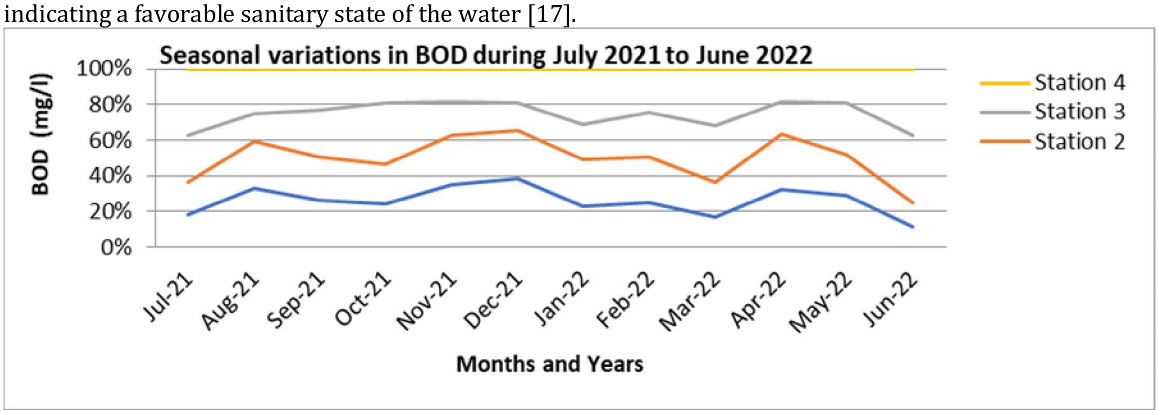

Figure 8: Seasonal variation of BOD during July 2021-June 2022.

COD (mg/l)

Using a strong chemical oxidant, the chemical oxygen demand (COD) of water measures how much oxygen is needed to break down all organic matter, including things that don't break down and things that do. The Chemical Oxygen Demand (COD) measures the oxygen equivalent of organic materials that a chemical oxidant can oxidize (Figure 9).

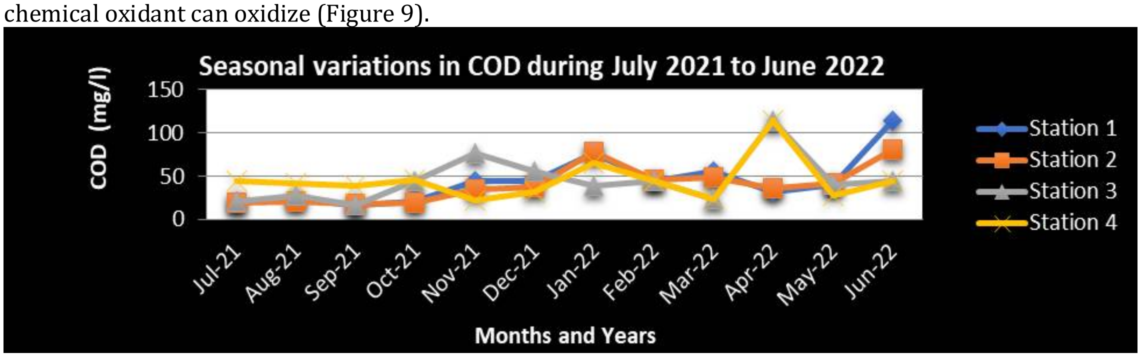

Figure 9: Seasonal variation of COD during July 2021-June 2022.

Hardness (mg/l)

The highest total hardness was observed in May at 245±3.41 mg/l, while the lowest was observed in February at 70±1.42 mg/l, as illustrated in Figure10. The total hardness amounts observed during the period from May 2022 to June 2022 ranged from a minimum of 72±1.55 mg/l to a maximum of 239±1.50

mg/l at Station 1. The monthly mean value of total hardness at Station 1 was at its highest in May (204±1.50 mg/l), while the lowest was at Station 3 (70±1.25 mg/l) in February.

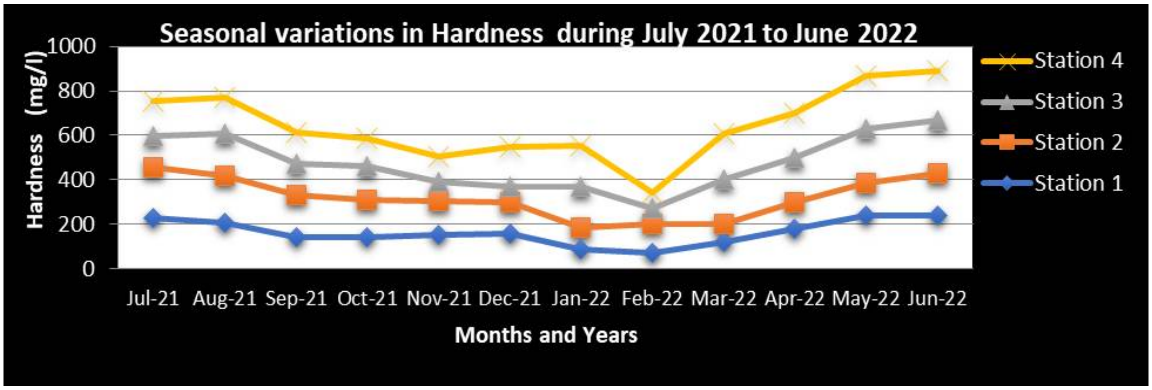

Figure 10: Seasonal variation of hardness during July 2021-June 2022.

Phosphate

The lowest phosphate concentration was observed in July, October, November, and January, measuring 0.2±0.18 mg/l. Conversely, the highest phosphate concentration was noted in April and June, with a value of 1.6±0.44 mg/l. Phosphate concentration reached its maximum value of 1.5±0.44 mg/l at Station 1 in June, while the minimum concentration recorded was 0.2±0.18 mg/l during December and January. The absolute maximum phosphate concentration shown was 1.6±0.46 mg/l, while the lowest was 0.2±0.18 mg/l, both observed at Station 3, as illustrated in Figure 11.

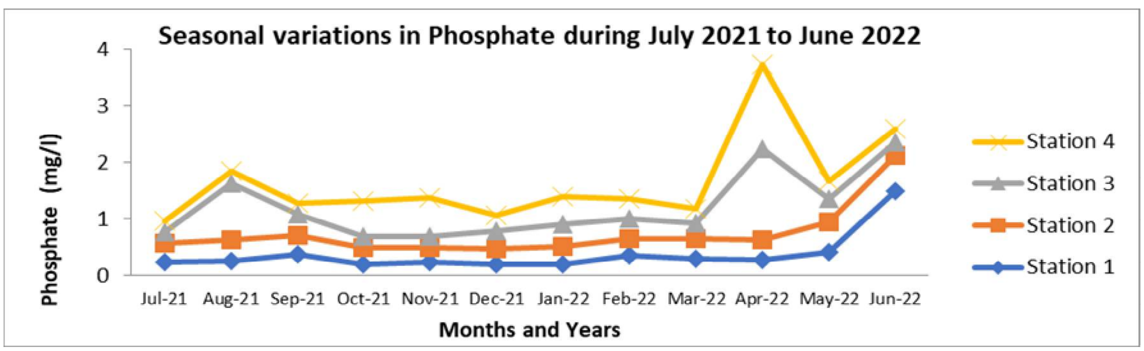

Figure 11: Seasonal variation of phosphate during July 2021-June 2022.

Nitrate

The highest nitrate concentration recorded was 4.56±0.88 mg/l in Station 3 during August, while the lowest concentration was 0.5±0.34 mg/l in Station 3 during July, as illustrated in Figure 12. The data indicated that the nitrite concentration reached its peak in August at 4.56±0.88 mg/l, while the lowest concentration was recorded in July at 0.5±0.31 mg/l in station 3. The maximum nitrate concentrations recorded were 3.47± 0.58 mg/l at Station 1, 1.8± 0.55 mg/l at Station 2, and 1.9± 0.52 mg/l at Station 4. The minimum nitrite contents were 0.5±0.34 mg/l at Station 1, 0.6± 0.43 mg/l at Station 2, and 0.6±0.31 mg/l at Station 4 in the study area for the year 2022, respectively.

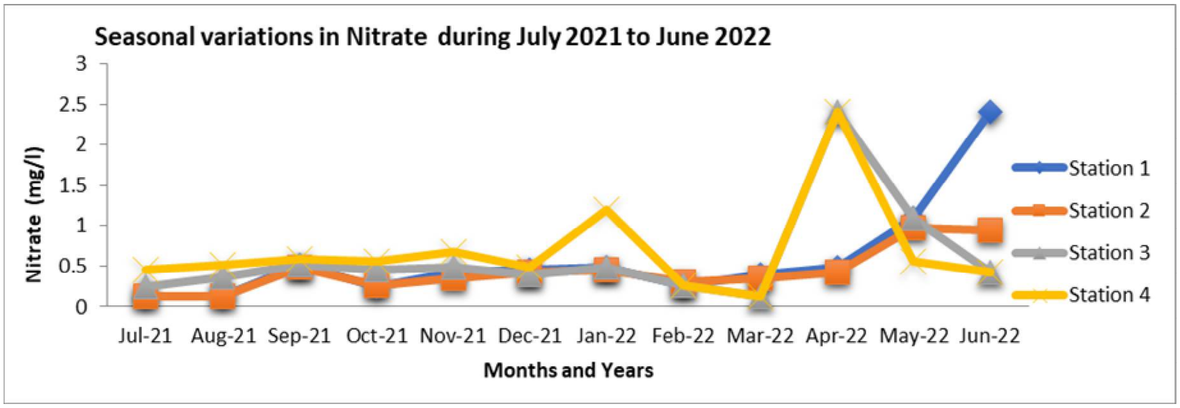

Figure 12: Seasonal variation of Nitrate during July 2021-June 2022.

Ammonia

The minimum ammonia values recorded at Station 1, Station 2, Station 3, and Station 4 were 0.12±0.19 mg/l during the months of July 2021, August 2021, and March 2022. The maximum ammonia values recorded were 2.4±0.42 mg/l, 0.98±0.48 mg/l, 1.09±0.48 mg/l, and 1.2±0.35 mg/l during the months of June 2022, May 2022, and January 2022, respectively, as illustrated in Figure 13. The maximum ammonia value was observed at Station 1 in May (2.4 ±0.48 mg/l), and the lowest was measured in May (0.12 ± 0.28 mg/l).

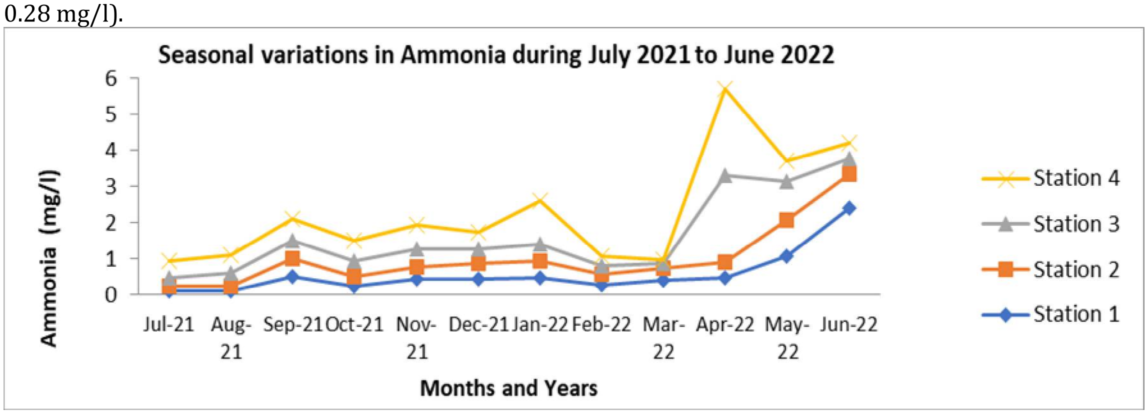

Figure 13: Seasonal variation of Ammonia during July 2021-June 2022.

Silicate (mg/l)

In March 2022, December 2021, and January 2022, the highest silicate concentration was measured at 6.4±0.88 mg/l in Station 1, 4.2±0.98 mg/l in Station 2, 6.4±0.98 mg/l in Station 3, and 5.2±1.02 mg/l in Station 4. Seasonal data indicate that the highest silicate concentration was measured in May at Station 2, measuring 11.5±0.88 mg/l. Conversely, the lowest silicate concentration occurred in March at Stations 1 and 3, with a measurement of 6.4±0.73 mg/l. Silicate content was recorded at a minimum level of 0.4±0.78 mg/l at Station 1, Station 3, and Station 4 during the month of December. In October and July 2021, the concentration measured was 0.8±0.81 mg/l at Station 2, while during December; it was recorded at 7.4±0.73 mg/l, as illustrated in Figure 14.

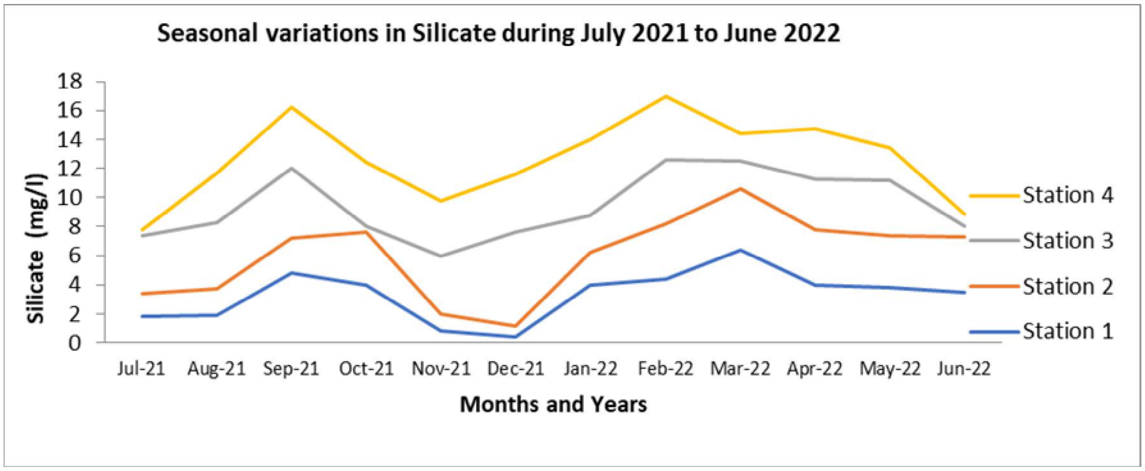

Figure 14: Seasonal variation of Silicate during July 2021-June 2022.

Gross Primary Productivity (GPP) (mg C/m³/ hr)

In four reservoirs, the monthly recorded GPP (mg C/m^3/hr) was greater in December (3303.8±0.44 mg C/m^3/hr) at Station 1 during the month of October in Station 3 and lower in April and June (1036.3±0.25 mg C/m^3/hr) in Station 4. The maximum GPP at Station 2 was recorded at 2420±0.47 mg C/m^3/hr during December, while the minimum GPP was noted at 1255±0.24 mg C/m^3/hr during June and July. The current study indicates that GPP (Figure 15) recorded a peak value in May (3.3±0.32 mg C/m^3/hr) and a lowest value in January (1.8±0.13 mg C/m^3/hr) at Station 1 and Station 2.

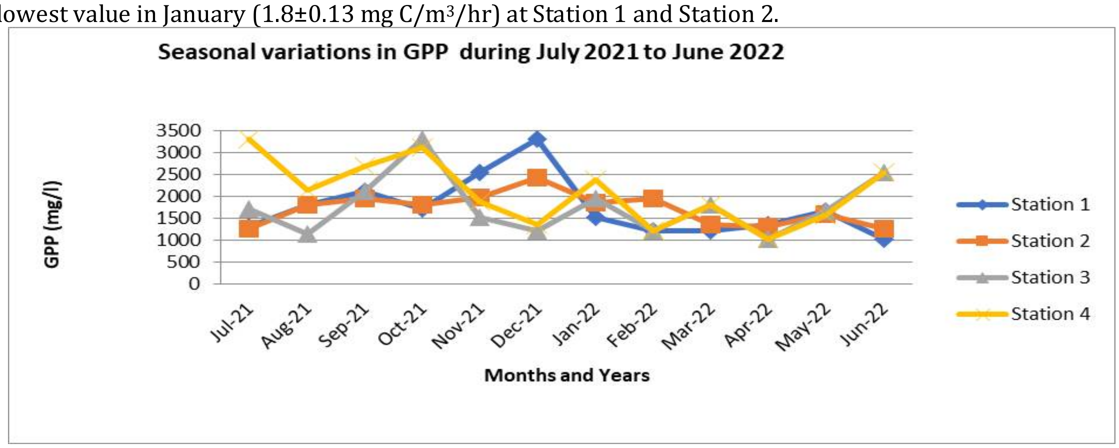

Figure 15: Seasonal variation of GPP during July 2021-June 2022.

Net Primary Productivity (NPP) (mg C/m³/ hr)

It was found that the net primary productivity of four reservoirs varied monthly. The highest net primary productivity recorded was 2272.5±0.44 mg C/m^3/hr in July, October, and December, while the lowest was 527.5±0.25 mg C/m^3/hr (Figure 16).

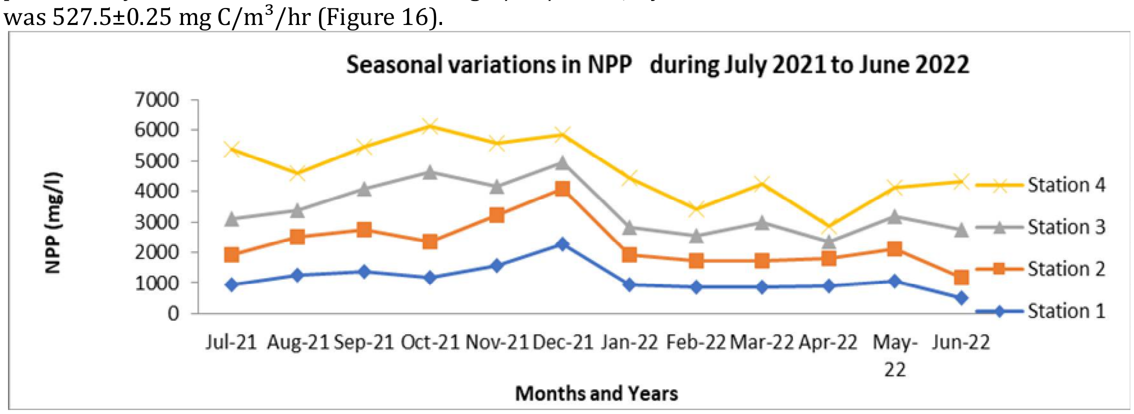

Figure 16: Seasonal variation of NPP during July 2021-June 2022.

Cross Reproduction (CR) (mg C/m3/ hr)

The current study found that community respiration (CR) (Figure 17) was lowest in April and June, at 485±0.04 mg C/m³/hr for Station1, Station 3, and Station 4. It was highest in July, October, and December, at 1968.8±0.21 mg C/m³/hr. Throughout the study period, Station 1 and Station exhibited the highest productivity at 1968.8±0.04 mg C/m³/hr, followed by Station 2 at 1476±0.3 mg C/m³/hr. The current study documents the seasonal records of primary productivity, including gross primary productivity, net primary productivity, and community respiration. Low nutrient content, along with several influencing factors such as ultraviolet radiation, nutrient availability, seasonal fluctuations in water levels, and high flushing rates of discharges, contribute to the variations in productivity levels of water bodies. All these elements collectively impact the rate of primary production in freshwater environments. Koli *et al.,* [18] and Misra *et al.,* [19] examined the primary productivity of various water bodies in India in relation to water quality. found monthly variations in the net primary productivity of four reservoirs. The highest net primary productivity recorded was 2272.5±0.44 mg C/m³/hr in July, October, and December, while the lowest was 527.5±0.25 mg C/m³/hr.

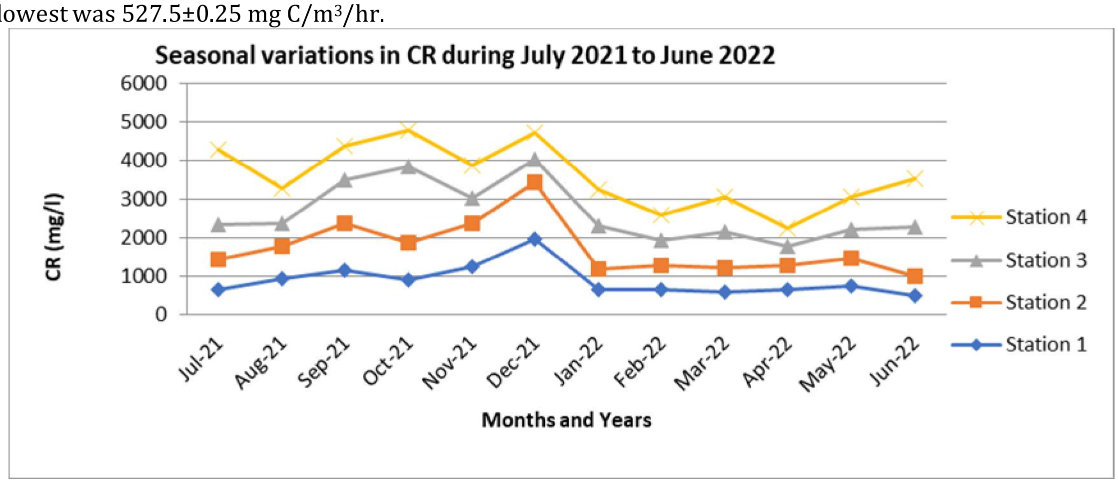

Figure 17: Seasonal variation of CR during July 2021-June 2022.

All locations observed the highest temperatures in the air and water throughout the summer, which they attributed to prolonged solar radiation, low water levels, high temperatures, and clear atmospheric conditions [20, 21]. Temperature is an important physical factor that influences the other hydrological parameters. Figure 2 presents the monthly variation in air temperature at three reservoirs during the year (July 2021–June 2022). Conversely, minimum temperatures occurred during the monsoon due to reduced temperatures associated with cloud cover and rainfall, which lowered temperatures to their lowest levels [22]. Results indicated that water temperature consistently remained lower than air temperature throughout the study period. El Badaoui *et al.,* [23] reported analogous observations with comparable trends in their study of various water bodies. The amount of bicarbonates and carbonates in the form of alkali and alkaline earth metals could be the cause of the highest pH recorded in summertime. Zingde *et al.,* [24] found a lower pH level in the post-monsoon period, potentially due to new water inflow, lake water dilution, decomposing organic waste, and decaying aquatic weeds. The variations in pH values noted across the chosen sites could be ascribed to alterations in both biotic and abiotic factors, potentially resulting from dilution caused by the influx of runoff and the presence of macrophyte cover [25].

According to Bhatt *et al.,* [26], Taudaha lake conductivity was maximum in May and minimal in December. Summer conductivity could increase because inadequate levels of water absorb huge amounts of salt from nearby agricultural areas [27]. The post-monsoon period's elevated conductivity results from the limiting mixing of freshwater inputs from rivers. The reduction in conductivity values during the monsoon season can be attributed to rainfall and the influx of freshwater from rivers. Conductivity values exhibited a decline as rainfall increased. Rain significantly diluted the water [28, 29]. Summertime water's elevated transparency appears to correlate with increased sunshine, enhanced light penetration, moderate wind velocity, calm water conditions, and lower levels of dissolved oxygen, all of which contribute to the sedimentation of suspended material [30, 31]. On the other hand, there was less transparency in December. This was likely due to cloudy weather, insufficient sunlight, and surface runoff containing silt and other organic materials. The breakdown of organic debris, higher water temperatures, and slower flow led to the accumulation of suspended material, which induced turbidity.

Nithya *et al.,* [16] suggest that biota breakdown and marine creature oxygen consumption may lower summer dissolved oxygen. The highest levels of dissolved oxygen were observed during the monsoon, likely attributable to the cooling of lake water from rainfall, which enhances the solubility of oxygen at reduced atmospheric and water temperatures. The solubility of oxygen diminishes as the salinity of water increases. The atmosphere or photosynthetic organisms like algae and aquatic plants can source or generate oxygen in water. Water temperature and partial pressure affect oxygen solubility. In 1971, Vijayaraghavan [32] demonstrated a direct correlation between photosynthesis and dissolved oxygen. Solids denote the suspended and dissolved substances present in water. The parameters are essential for describing the different chemicals that make up water. It also shows how the land and water are connected in ways that make the aquatic environment more productive [33]. Plankton, fine clay or silt particles, organic and inorganic substances, and other kinds of microbes are the usual components of TSS. Changes in pH can alter the solubility of the suspended material or cause part of the solutes to precipitate. The total suspended solids (TSS) value was observed to be highest during the post-monsoon period and lowest during the monsoon season. Low stream velocities may cause the suspended solids, found on a water filter, to settle out into the water column and reach the river level. Clay, silt, plankton, biological waste, and mine drainage acid precipitates are examples zoobenthos [34].

BOD tests determine streams' self-purification capability and the quality of waste water they may safely absorb [35]. BOD measures biodegradable substances in water; therefore, more matter raises it. The water's oxygen content decreases more quickly with higher BOD levels. Waste water containing biodegradable substances percolates into water samples, causing increased BOD values [36]. BOD values of water samples in this study range from 6.48 ±0.05 mg/l in April and June 2022 and 22.96 ±0.25 mg/l in July, October, and November 2021. These elevated BOD levels imply contamination from home waste, human and animal excrement disposal on river banks, and biodegradable waste water percolation. Consequently, COD serves as a dependable metric for assessing water pollution. The COD values in this study ranged from 16 mg/l in September 2021 to a maximum of 114 mg/l in April and June 2022. Low water levels, elevated temperatures, phytoplankton efficiency, and microbial oxygen consumption during decomposition can all contribute to the measured greatest amount during summer and pre-monsoon [36].

Mohan *et al.,* [37] indicated that the introduction of wastewater, detergents, and extensive human usage could lead to an increase in water hardness. In the current study, the month of May had the highest overall hardness value (245±3.41 mg/l), while the month of February had the lowest value (70±1.42 mg/l). The catchment area's release of rocks during the summer may cause an increase in total hardness due to a decrease in water volume and an increase in evaporation rates. Additionally, the consistent influx of substantial amounts of detergents from adjacent residential areas may contribute to this phenomenon. Throughout the study period, we observed decreased hardness levels in the water of the chosen study area, possibly due to reduced wastewater discharge and the dilution of calcium in wetland water by rainfall. Hujare [38] also reports that total hardness is lower during the monsoon and higher in the summer.

The soluble phosphates found in aquatic environments come from both man-made and natural sources. Cleaning agents and washing powders, which include phosphates, are utilized for water softening, among other applications. These substances are impacting the health of aquatic life [39]. According to the results, which are consistent with those of Chowdhury *et al.,* [40], phosphate showed an inverse relationship with the development rate of planktonic species, suggesting that it is somewhat consumed. In the current study, the minimum organic phosphate concentration recorded was 0.26±0.18±0.46 mg/l at Station 2 during the summer season, while the highest level of concentration was 0.62±0.46 mg/l at the same station while the post-monsoon season. These differences may be attributed to factors that include the immersion of debris and dead bones, rainfall, water runoff from the surface, high rates of decomposition of organic matter, algal blooms, and eutrophication, as reported by Varsha *et al.,* [41]. The rainy season increases phosphate concentrations due to wastewater from human settlement catchments and residential waste. Reduced phosphate levels have been observed in May, attributed to the presence of increased phytoplankton biomass [42].

Station 1, Station 2, and Station 3 exhibited the highest concentration of nitrate. The highest levels of nitrate pollution can result from intensive agricultural practices, particularly in regions recognized for their agricultural focus, as well as from the improper application of chemical fertilizers in proximity to sewage wastewater. Pejavar *et al.,* [43] assert that nitrifying bacteria and the biological oxidation of organic nitrogenous materials in household and commercial sewage contribute nitrates to water bodies. Nitrate is generally considered non-toxic; however, when consumed through food and water, it undergoes bacterial reduction to nitrite and subsequently to ammonia, which are toxic [44]. Reduced water temperature, increased dissolved oxygen, decreased organic deposition, and faster sedimentation can all lead to a reduction in No2-N concentrations [45]. Natural processes that break down organic nitrogen-containing waste in sewage from homes and businesses, along with the work of bacteria that nitrate, add nitrates to bodies of water [43]. Nitrate is generally considered non-toxic; however, when consumed through food and water, it undergoes a reduction process by bacterial action, transforming into nitrite and subsequently into ammonia, which can be toxic. Throughout the study period, the nitrate concentration in the water ranged from 0.5 to 4.56 mg/l.

During pre- and post-monsoon seasons, slower bacterial activity at low temperatures may limit decomposition and delay ammonia-nitrogen release. According to Nithya *et al.,* [16], the combined impact of contaminated materials from the open waste disposal sites resulted in higher ammonia concentrations. Ammoniacal nitrogen serves as an indicator for assessing the quality of pond water in both natural environments, such as rivers and lakes, and in man-made water reservoirs. The atmosphere contains nitrogen in the form of biological nitrogen, ammonium, nitrite, and nitrates, among other chemical forms. Nitrogen is a component of proteins found in biological compounds such as plants and animals. Bacteria initially decompose complex organic matter, converting amino acids into ammonia. In the presence of oxygen, ammonia undergoes oxidation to form nitrite (NO2) and subsequently nitrate (NO3). The amount of ammonia goes up as the alkalinity of the water in streams that contain ammonium rises. As water acidity increases, it generates ammonium ions that interact with the dissolved ammonia present in the aquatic environment. Ammonia poses a toxic threat to both fish and humans. As ammonium converts into ammonia, the toxicity decreases with lower alkalinity and increases with higher alkalinity.

The current research showed that gross primary productivity peaked in the summer (March) and fell to its lowest point after the monsoon, the dilution of water during the rainy season led to a subsequent decrease in phytoplankton density, which in turn caused the decrease in productivity. On the other hand, rising temperatures, which facilitate the release of nutrients from sediments via bacterial decomposition, contribute to the increase in productivity over the summer. The elevated levels of nutrients, combined with increased temperatures, promote optimal growth conditions for aquatic flora, thereby enhancing primary productivity. Vimal *et al.,* [46] pointed out, temperature, solar radiation, and the availability of nutrients can all be big problems for primary production. This can lead to changes in aquatic ecosystems that happen throughout the year.

CONCLUSIONS

Among the many metrics used to assess the state of aquatic ecosystems, water temperature stands out as a crucial one. The main factors contributing to the deterioration of water quality include elevated levels of AT, WT, conductivity, transparency, pH, TH, TSS, DO, BOD, COD, phosphate, nitrate, ammonia, silicate, GPP, NPP, and CR. The analysis reveals important insights into the water quality assessment of four reservoirs: the Cauvery River, Coleroon River, Ayyanar Temple tank, and Perumal Kovil tank. The water quality at both sites in the lotic ecosystem is good. In the future, unapproved garment dyeing and the bleaching unit may release both treated and untreated wastewater into the municipal drain, together with household sewage, further degrading the water quality and perhaps reducing agricultural productivity. Implementing necessary preventive measures is essential to managing the rise in pollution levels. The lentic water bodies are significantly polluted. The alterations in pH and temperature within the water column significantly influence the primary environmental result. Reductions in primary productivity can occur due to nutrient-laden runoff, including fertilizers from agriculture and livestock, or from the release of untreated or raw wastewater. This study investigates the importance of identifying different conservation strategies to assess the biodiversity values of this region. In conclusion, the elevated water quality index demonstrated that the water quality of lentic ecosystems has significantly worsened in comparison to that of lotic ecosystems. Further effectively preserves the revering system for optimal use by implementing suitable conventional water treatment methods and fostering consumer awareness.

ACKNOWLEDGMENT

Authors are thankful to Head, Department of Zoology and Principal, Government Arts College (Autonomous), Kumbakonam, Thanjavur Dist, Tamil Nadu, India, for encouraging us to carry out this research.

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