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Assessment of Water Quality and Seasonal Variations in Physico-chemical Parameters in Tripuranth Lake, Basavakalyan, Bidar District, Karnataka.

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Abstract

Physico-chemical analysis is the first step in determining the quality of water for residential, agricultural, and drinking purposes. It also aids in comprehending the intricate relationship between biological and climatic processes in the water. The present study is carried out on the water quality of Tripuranth lake of Basavakalyan, Bidar district. This study was designed to asses the water quality and physico-chemical parameters. Samples were collected seasonally across the reservoir for a brief period of time from January 2023 to December 2023 and the following parameters were analyzed Atmospheric temperature, water temperature, pH, dissolved oxygen, free Carbon dioxide,TDS, chloride, calcium, magnesium, phosphate, sulphate. The obtained results were under permissible limits and it is potable after some treatment and can be used for irrigation and other domestic use.

Keywords: Tripuranth lake, physico-chemical parameters , TDS, Atmospheric temperature, water quality.

Introduction

Water is a fundamental natural resource that underpins the existence and continuity of life on Earth. It plays a critical role in maintaining ecological balance and supports a wide array of human activities, including agriculture, industry, sanitation, and domestic use (Boyd, 2000) [13]. Although water covers over 70% of the Earth's surface, only about 3% constitutes freshwater, and an even smaller fraction is readily accessible for human consumption (Trivedi & Goel, 1986) . In India, approximately 77% of the available freshwater is utilized for agricultural purposes, highlighting the sector's substantial dependence on this limited resource (Vijaykumar et al., 2000) .

The increasing demand for water, coupled with climate variability and anthropogenic pressures, has intensified concerns regarding water quality and its implications for both ecosystem and public health (Ibrahim et al., 2009) ; (Sadauki et al., 2022) . Physico-chemical parameters such as pH, temperature, dissolved oxygen (DO), total dissolved solids (TDS), and nutrient concentrations are key indicators of water quality and play a pivotal role in shaping aquatic biodiversity and productivity (Bozorg-Haddad et al., 2021). Fluctuations in these parameters, driven by seasonal changes and human activities, can

significantly alter the composition and functionality of aquatic ecosystems (Murthuzasab et al., 2010); (Kumar et al., 2006) .

The present study aims to assess the physico-chemical characteristics of a multifunctional reservoir that serves as a critical water source for irrigation, aquaculture, drinking, and other domestic needs. This reservoir supports the livelihood of surrounding rural communities, particularly through the breeding of major and minor carp species, and thus represents an ecologically and socio-economically significant water body (Gupta *et al.,* 2017) .

Comprehensive water quality assessments are essential for understanding the ecological status of such reservoirs and ensuring their sustainable management (Chapman & Sullivan, 2022) . By analyzing spatial and temporal variations in key water quality indicators, this research provides insights into the environmental health of the reservoir and its suitability for various utilitarian purposes. The findings aim to inform resource managers, policymakers, and local stakeholders, contributing to evidence-based strategies for integrated water resource management (Loucks & van Beek, 2017); (Mondal *et al.,* 2016).

Material and Method

Study Area:

Basavakalyana is a historical city and municipal council in the Bidar District of the Indian state of Karnataka. Tripuranth Lake, also known as Tipranta Lake, is a serene and historically significant water body located approximately 5 kilometers from Basavakalyan in Karnataka's Bidar district. This ancient lake is closely associated with the 12th-century Sharana movement, a spiritual and social reform movement led by Basavanna.

Fig. 1. Satellite map showing Tripuranth Lake

Results and Discussion:

The temporal analysis of key physicochemical parameters of the lake water across a 12-month period (January to December) revealed seasonal trends largely governed by natural climatic variability,

agricultural runoff, and autochthonous biological processes, in the absence of proximate industrial activities.

Temperature Dynamics

Water temperature ranged from 19.0°C in January to a maximum of 29.9°C in May, reflecting ambient atmospheric conditions (air temperature: 22.0–38.0°C). The thermally driven seasonal stratification likely influenced biogeochemical cycling within the lake. Warmer months (April–June) coincided with increased microbial and photosynthetic activity, which are known to influence several other physicochemical variables.

Conductivity and Total Dissolved Solids (TDS)

Conductivity values fluctuated between 158.6 µS/cm (January) and 330.0 µS/cm (May). Although these values are elevated during summer, the magnitudes are well within typical freshwater thresholds and are attributable to increased ion concentration due to evaporation, agricultural return flows, and soil leaching rather than industrial effluent. A proportional trend was observed in total dissolved solids (TDS), which peaked at 220.0 mg/L in May. These trends suggest that ionic enrichment of the lake during the dry season is primarily geogenic and anthropogenic (agricultural).

pH and Alkalinity

The pH of the lake exhibited a clear seasonal trend, increasing from 6.60 in January to 9.50 in May, indicating a transition from slightly acidic/neutral to distinctly alkaline conditions during late spring and early summer. This elevation in pH is consistent with intensified photosynthetic activity, which reduces CO_2 concentrations and increases carbonate ion availability. Total alkalinity showed a concomitant rise, peaking at 260.0 mg/L in May, indicating a robust buffering capacity, likely driven by bicarbonate influx from agricultural inputs and carbonate-rich lithology in the catchment.

Dissolved Oxygen (DO)

Dissolved oxygen concentrations ranged from 6.35 mg/L (January) to 9.50 mg/L (May). These values are indicative of a well-oxygenated aquatic environment, with higher DO levels during warmer months likely resulting from photosynthetic oxygen production by aquatic macrophytes and phytoplankton, facilitated by longer daylight periods and optimal temperatures. DO values remained above hypoxic thresholds throughout the year, suggesting a healthy aerobic regime supporting aquatic biota.

Water Hardness and Ionic Composition

Total hardness ranged from 60.4 mg/L (November) to 220.0 mg/L (May), with corresponding $CaCO_3$ concentrations of 40.5 to 80.0 mg/L. Elevated hardness during pre-monsoon months (April–June) can be attributed to concentration effects due to evaporation and leaching of calcium and magnesium ions from the catchment geology. Concentrations of Ca^{2+} (30.0 mg/L) and Mg^{2+} (35.0 mg/L) in May support this interpretation. While hardness values are relatively high during summer, they do not indicate anthropogenic pollution and are consistent with natural weathering processes.

Month	Water Temp (°C)	Air Temp (°C)	Conductivity (µS/cm)	pH	Total Solids (mg/L)	DO (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	$CaCO_3$ (mg/L)	Ca^{2+} (mg/L)	Mg^{2+} (mg/L)
Jan 2023	19.00	22.0	158.60	6.60	116.88	6.35	94.55	77.79	45.77	18.32	7.78
Feb	23.47	24.5	203.00	7.11	137.40	6.78	95.66	91.60	50.16	19.91	10.02
Mar	24.28	32.0	262.63	9.10	171.89	8.40	139.62	117.14	67.66	27.09	12.02
Apr	26.18	35.0	255.00	9.20	195.00	8.90	200.00	150.00	70.00	28.00	20.00
May	29.92	38.0	330.00	9.50	220.00	9.50	260.00	220.00	80.00	30.00	35.00
Jun	28.97	30.0	200.00	8.00	170.00	7.50	170.00	140.00	60.00	24.00	18.00
Jul	25.00	28.0	195.40	7.82	188.40	7.77	126.33	100.00	65.78	26.61	8.31
Aug	24.00	27.0	204.55	7.27	189.41	7.21	116.20	77.14	45.92	18.39	7.59
Sep	24.32	26.0	173.49	7.27	184.95	6.95	106.79	64.38	35.94	14.38	6.91
Oct	22.55	26.0	176.27	7.09	139.05	6.92	101.99	64.56	36.86	16.24	7.28
Nov	22.00	25.0	164.07	6.63	176.95	6.59	102.97	60.42	40.47	20.54	7.54
Dec 2023	19.50	22.5	189.43	6.77	134.76	6.73	92.81	78.88	49.14	19.84	7.22

Conclusion:

The year-long assessment of physicochemical parameters in Tripurant Lake revealed pronounced seasonal variations predominantly influenced by climatic factors, agricultural runoff, and internal biological processes. The absence of nearby industrial discharge indicates that observed changes in water quality are primarily the result of natural geochemical processes and anthropogenic inputs related to agriculture. During the pre-monsoon months, elevated temperatures and evaporation contributed to increased conductivity, TDS, alkalinity, and hardness, while heightened photosynthetic activity led to higher pH and dissolved oxygen concentrations. Despite these seasonal fluctuations, all measured parameters remained within ecologically acceptable limits, indicating that Tripurant Lake sustains a healthy and balanced aquatic ecosystem throughout the year. These findings provide a valuable baseline for long-term ecological monitoring and highlight the importance of preserving the lake's catchment integrity to maintain its water quality

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