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ASSESSMENT OF PHYSICOCHEMICAL PARAMETERS AND WATER QUALITY OF SATHNALA POND OF ADILABAD DISTRICT, TELANGANA STATE, INDIA

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ABSTRACT

This study investigates the physicochemical parameters of Sathnala Pond in Adilabad District, Telangana, to evaluate its water quality and ecological health across different seasons. The objective of this study is to assess the variations in physicochemical parameters of Sathnala Pond and determine their impact on water quality and aquatic life. Water samples were collected monthly from two sites in Sathnala Pond between February and July 2023, using sterilized bottles and maintaining stringent contamination controls. Key parameters such as temperature, pH, electrical conductivity, turbidity, hardness, alkalinity, chloride, nitrate, phosphate, dissolved oxygen, BOD, and COD were analyzed using standard methods. Statistical analysis was performed using Pearson's correlation to identify relationships between parameters. Water temperature ranged from 22.8°C to 35.2°C, with pH values fluctuating between 7.5 and 9.1, indicating increased alkalinity in July. Dissolved oxygen levels were low in March and April, while COD consistently exceeded standard limits, highlighting significant organic and inorganic pollution. Other parameters remained within acceptable ranges, but seasonal variations and high COD levels suggest ongoing water quality concerns. The study reveals significant seasonal variations and persistent pollution issues in Sathnala Pond, underscoring the need for enhanced monitoring and management practices.

Kew words: Sathnala, Adilabad, Physicochemical, BOD, COD, DO.

1. INTRODUCTION

Freshwater lakes play a crucial role in maintaining ecological balance, providing habitat for aquatic species, and supporting human activities such as agriculture, fishing, and recreation. However, these water bodies are increasingly threatened by anthropogenic activities, including agricultural runoff, industrial effluents, and urbanization, which introduce various pollutants into the water (Kannel et al., 2020). Monitoring the physicochemical parameters of lakes is essential for assessing their health and ensuring sustainable use of these resources. By understanding seasonal variations and the impact of human activities on water quality, management strategies can be developed to protect these vital ecosystems (Varol, 2021).

In the context of Lake Sathnala, a crucial water body in Adilabad, India, understanding the dynamics of water quality is particularly important due to its role in supporting local biodiversity and livelihoods. Previous studies have highlighted the significant influence of seasonal changes on water quality parameters, such as pH, dissolved oxygen (DO), and nutrient levels (Zhou et al., 2022). These fluctuations are often exacerbated by local human activities, leading to periods of increased pollution, particularly during the dry and rainy seasons. Therefore, this study aims to evaluate the seasonal variations in key physicochemical parameters in Lake Sathnala and assess the impact of these changes

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on the lake's overall water quality.

The methods employed in this study, including systematic sampling across different months and comprehensive analysis of parameters such as COD, BOD, EC, and nutrient levels, provide a detailed understanding of the lake's health. By comparing the observed values with standard limits and correlating them with temperature and other environmental factors, this research offers insights into the current state of Lake Sathnala. The results highlight areas of concern, such as elevated COD and fluctuating DO levels, which are indicative of organic pollution and oxygen depletion, respectively. These findings are crucial for informing future conservation efforts and ensuring the sustainable management of the lake (Patil & Kumar, 2023).

2. MATERIALS AND METHODS

The present investigation was carried out in Sathnala-Mavala ponds of Adilabad District, Telangana State.

2.1 Sampling Sites:

The sampling sites at Sathnala Lake were chosen randomly based on the input of effluents from the watershed and other human activities around the lake's shoreline from February 2023 to July 2023, covering both the dry and rainy seasons. Water samples were gathered monthly from two specific locations: Site-A (19°38'59"N 78°40'24"E), and Site-B (19°38'26"N 78°41'04"E). These sites were selected with input from local fishermen, who identified them as key fishing zones for the species under study.

Figure 1. Sampling sites localization in Sathnala Lake, Adilabad, Telangana. The blue colour location sites indicates the sample collection sites.

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2.2 Study Site Description

Sathnala Lake, located in the Adilabad district of Telangana, India, is a vital water body fed by a network of streams from the surrounding watershed. The lake plays a crucial role in supporting the local ecosystem, providing habitat for various fish species and serving as an important resource for local communities. Its shores are influenced by both natural inputs from the watershed and anthropogenic activities, making it an ideal location for studying the effects of environmental factors on aquatic life. The lake's varying conditions during different seasons, particularly the contrast between the dry and rainy periods, offer a diverse set of data points for research on water quality and species distribution.

2.3 Sampling and Sample Collection Methods

To prevent contamination during both sample collection and laboratory work, non-powder vinyl clean gloves and masks were consistently used. For all analyses, distilled deionized water was employed to ensure accuracy. Sterilized sampling bottles were carefully rinsed three times with lake water before collecting the actual samples, ensuring any potential contaminants were removed. Water samples were collected from a depth of approximately 15 cm below the water surface. After collection, each sampling bottle was clearly labeled and promptly transported to the laboratory. To preserve the integrity of the samples, they were stored at 4˚C in a refrigerator until laboratory analysis was conducted, following the protocols outlined by Mbalassa et al. (2014).

2.4 Physicochemical Parameters Estimation:

To estimate the physicochemical parameters, various chemical and physical measurements were conducted following established standard methods. Key parameters such as electrical conductivity (EC), total hardness (TH), dissolved oxygen (DO), and major anions including chloride (Cl−), nitrate (NO3−), and phosphate (PO4^3−) were analyzed using protocols from the APHA (2005) and Khadka et al. (2021). In the field, pH, EC, and turbidity were measured using a multi-parameter instrument for accuracy. Biological Oxygen Demand (BOD) was determined by measuring the reduction in DO after incubating samples in the dark at 20°C for five days, with the BOD value calculated by subtracting the DO concentration in the incubated samples from the initial concentration, as per the method outlined by Olompande et al. (2011). Chemical Oxygen Demand (COD) was measured using potassium dichromate as the oxidizing reagent, following the procedure described by Bagalwa et al. (2006). After collection, water samples were transported to the laboratory in a cooler box with ice to maintain their integrity. If immediate analysis was not possible, samples were stored in a refrigerator at 4˚C to prevent any alterations in their chemical composition.

2.5 Statistical Data Analysis:

For the statistical analysis of the data, Microsoft Excel was utilized to perform various computations and generate visual representations. Pearson's correlation method was applied to determine the relationships between different physicochemical parameters across the various sampling stations. This statistical approach allowed for the identification of potential correlations between variables, providing insights into how they might influence one another. The results of the analysis were presented in multiple formats, including text descriptions, graphs, and statistical tables, which effectively illustrated the interrelationships among the parameters measured at the different stations. These visual and textual representations were crucial in highlighting trends, patterns, and any significant correlations observed

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in the study.

3. RESULTS

3.1 Analysis of Physicochemical Parameters:

Mean physicochemical parameters of two sites of Sathnala Lake water in different months are presented in Table-1 and Figure-1.

Temperature: The temperature of the water increased from 22.8 ± 1.4°C in February to a peak of 35.2 ± 1.5°C in May, before dropping to 28.4 ± 2.1°C in July. All recorded temperatures were below the standard threshold of 37°C, indicating that the water was within safe thermal limits for aquatic life. However, the sharp rise in May could potentially stress sensitive species, especially as it approaches the upper limit of their tolerance.

pH: The pH values fluctuated between 7.5 ± 0.2 in March and 9.1 ± 0.2 in July. While the pH in February, May, and June remained within the acceptable range of 6.5-8.5, the July value exceeded this range, indicating increased alkalinity. Such a high pH level may negatively impact aquatic organisms by altering their metabolic processes and the solubility of nutrients and toxins in the water.

Electrical Conductivity (EC): EC values ranged from 154.5 ± 11.7 µS/cm in February to 180.7 ± 13.8 µS/cm in May, all well within the standard range of 20-500 µS/cm. These values suggest a stable and moderate level of dissolved salts and ions throughout the study period, reflecting relatively consistent water quality. The slight increase in May could be linked to higher temperatures, which may concentrate salts through increased evaporation.

Turbidity: Turbidity levels decreased from 24.4 ± 3.8 NTU in February to 16.3 ± 4.1 NTU in July, indicating clearer water as the months progressed. While no strict standard is provided, lower turbidity generally suggests better water clarity and fewer suspended particles, which can improve light penetration and benefit aquatic plants. The decrease could be attributed to reduced runoff and sedimentation during these months.

Total Hardness (TH): TH values varied from 108.3 ± 9.4 mg/L in July to 160.5 ± 7.4 mg/L in April, well below the standard limit of 300 mg/L. These low to moderate hardness levels indicate that the water is relatively soft, which is generally beneficial for most aquatic life and reduces the risk of scale formation in pipes and other infrastructure.

Total Alkalinity (TA): TA ranged from 100.5 ± 9.4 mg/L in June to 190.1 ± 6.4 mg/L in April, all below the standard value of 250 mg/L. These results suggest the water has a good buffering capacity, with the ability to neutralize acids and maintain pH stability. However, the variability across months indicates fluctuations in carbonate and bicarbonate levels, likely influenced by natural processes and seasonal changes.

Chloride: Chloride levels remained relatively stable, ranging from 66.7 ± 9 mg/L in February to 75.5 ± 9.2 mg/L in May, all well within the standard limit of 250 mg/L. This consistency suggests that there is no significant chloride pollution, which is important for maintaining the water's taste, preventing corrosion, and protecting aquatic life from toxic effects.

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Table-1. Mean physicochemical parameters of Sathnala Lake water in different months.

Physicochemical Parameters (Standard Values)	Physicochemical Parameters in Different Months (Feb 2023-July 2023)					
	February	**March**	**April**	**May**	**June**	**July**
Temperature (<37)	22.8 ± 1.4	28.4 ± 2.5	31.7 ± 1.8	35.2 ± 1.5	33.5 ± 2.9	28.4 ± 2.1
pH (6.5-8.5)	8.5 ± 0.6	7.5 ± 0.2	7.7 ± 0.8	8 ± 0.6	8.3 ± 0.3	9.1 ± 0.2
EC (uS/cm) (20-500)	154.5 ± 11.7	155.6 ± 8.9	170.3 ± 12.8	180.7 ± 13.8	175.6 ± 12.8	178.6 ± 8.4
Turbidity (NTU)	24.4 ± 3.8	18.7 ± 5.9	22.6 ± 2	21.3 ± 3.7	19.9 ± 2.9	16.3 ± 4.1
TH (mg/L) (300)	128.7 ± 10.4	148.7 ± 8.4	160.5 ± 7.4	134 ± 8.2	116.9 ± 11	108.3 ± 9.4
TA (mg/L) (250)	178.5 ± 11.5	155.6 ± 9.2	190.1 ± 6.4	110.9 ± 10.5	100.5 ± 9.4	187.8 ± 5.9
Chloride (mg/L) (250)	66.7 ± 9	71.4 ± 7.4	74.3 ± 4	75.5 ± 9.2	67.2 ± 4.5	69.7 ± 10.5
Nitrate (mg/L) (<45)	1.1 ± 0.03	1.4 ± 0.2	0.4 ± 0.01	0.49 ± 0.003	0.47 ± 0.001	0.48 ± 0.01
Phosphate (mg/L) (<4)	0.89 ± 0.04	1.5 ± 0.05	2.7 ± 0.08	3.2 ± 0.09	1.6 ± 0.07	1.1 ± 0.03
DO (mg/L) (6)	7.4 ± 1.3	2.2 ± 0.3	4.05 ± 0.5	5.15 ± 1.33	6.17 ± 1.2	6.8 ± 0.5
BOD (mg/L) (0-50)	11.6 ± 2.8	9.3 ± 1.98	13.8 ± 2.6	12.4 ± 1.8	14 ± 2.8	13.4 ± 1.8
COD (mg/L) (10-20)	32.5 ± 4.4	21.6 ± 3.9	37.8 ± 1.89	32.3 ± 4.9	26.5 ± 6.4	20.6 ± 2.8

Values are presented in mean ± SD.

Nitrate: Nitrate concentrations were consistently low, ranging from 0.4 ± 0.01 mg/L in April to 1.4 ± 0.2 mg/L in March, far below the standard limit of 45 mg/L. These low levels indicate minimal agricultural runoff or other sources of nitrate pollution, which is beneficial for preventing eutrophication and maintaining overall water quality.

Phosphate: Phosphate levels varied from 0.89 ± 0.04 mg/L in February to 3.2 ± 0.09 mg/L in May, all below the standard threshold of 4 mg/L. These values suggest moderate phosphate presence, likely due to agricultural or domestic runoff. Although the levels are within acceptable limits, the higher values in April and May could contribute to algal blooms, especially when combined with warmer temperatures.

Dissolved Oxygen (DO): DO levels ranged from a low of 2.2 ± 0.3 mg/L in March to a high of 7.4 ± 1.3 mg/L in February. The standard value for DO is 6 mg/L; therefore, the low DO in March and April indicates potential hypoxic conditions, which could stress or harm aquatic life. However, the higher DO in February, June, and July suggests periods of better oxygenation, likely due to cooler temperatures and lower biological activity.

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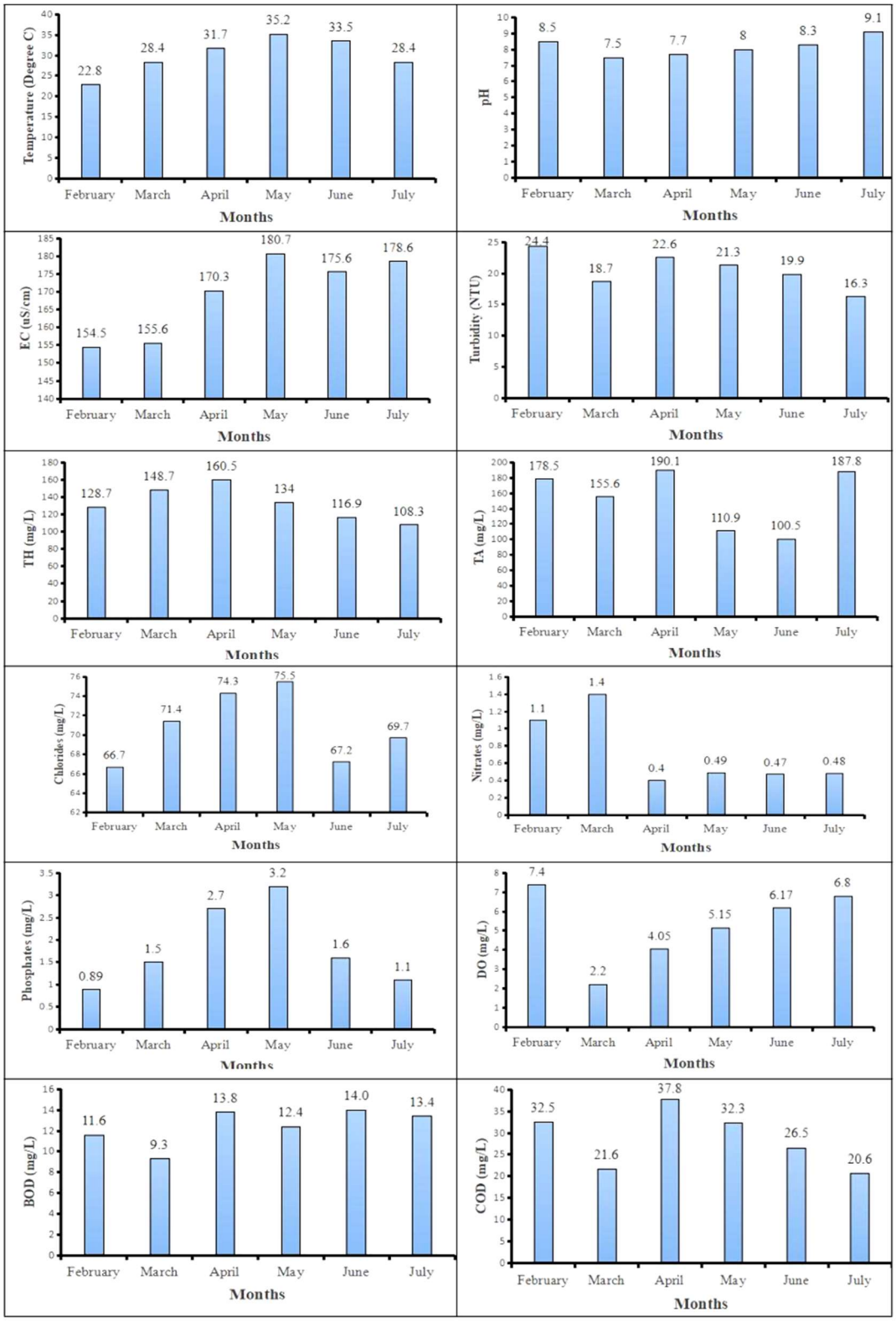

Figure-1. Monthly variation of physicochemical parameters of water quality in Sathnala Lake water

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Biological Oxygen Demand (BOD): BOD values ranged from 9.3 ± 1.98 mg/L in March to 14 ± 2.8 mg/L in June, all within the acceptable range of 0-50 mg/L. These values suggest moderate organic pollution, with the highest demand in June likely due to increased microbial activity. Elevated BOD can lead to reduced DO levels, which could further stress aquatic organisms, particularly in warmer months when oxygen solubility decreases.

Chemical Oxygen Demand (COD): COD values fluctuated from 20.6 ± 2.8 mg/L in July to 37.8 ± 1.89 mg/L in April, consistently exceeding the standard range of 10-20 mg/L. These elevated COD levels indicate significant levels of organic and inorganic pollutants, particularly in April, which could reduce water quality and harm aquatic ecosystems. The consistently high COD across all months highlights ongoing pollution issues that may require intervention.

4. DISCUSSION

The physicochemical parameters of Lake Sathnala from February to July 2023 reveal significant temporal variations, which align with findings from other studies on seasonal changes in freshwater bodies. The pH values fluctuated between 7.5 and 9.1, with the highest pH observed in July, indicating increased alkalinity. This pattern mirrors the findings of Shrestha and Kazama (2007), who noted similar pH trends in response to seasonal changes in temperature and biological activity. Additionally, the electrical conductivity (EC) values, ranging from 154.5 to 180.7 µS/cm, showed a positive correlation with temperature, which is consistent with studies by Suthar et al. (2010) that highlight the influence of temperature on ionic concentrations in freshwater lakes.

Dissolved oxygen (DO) levels in the lake varied significantly, with the lowest concentration of 2.2 mg/L in March and the highest at 7.4 mg/L in February. The drop in DO during the warmer months could be attributed to increased microbial activity and higher water temperatures, which reduce the solubility of oxygen, a phenomenon also observed by Wetzel (2001) in his study of oxygen dynamics in lakes. The elevated Biological Oxygen Demand (BOD) levels, which peaked at 14 mg/L in June, further support this observation, indicating a higher organic load in the lake, likely due to increased algal growth and decomposition during warmer months.

The Chemical Oxygen Demand (COD) values exceeded the standard limits throughout the study period, with a maximum of 37.8 mg/L in April. This persistent high COD is indicative of significant organic and inorganic pollution, potentially from agricultural runoff and effluents. This finding aligns with the work of Mishra et al. (2009), who also reported elevated COD levels in Indian lakes exposed to anthropogenic activities. The correlation between turbidity and COD suggests that particulate matter, likely from runoff during the rainy season, is a major contributor to the organic load in the lake, emphasizing the need for better watershed management practices.

The analysis of physicochemical parameters in Sathnala Pond reveals significant impacts on water quality. The temperature fluctuations, ranging from 22.8°C to 35.2°C, and varying pH levels, peaking at 9.1 in July, suggest potential stress on aquatic life, especially during warmer periods. Low dissolved oxygen in March and April indicates possible hypoxic conditions that could adversely affect aquatic organisms. Elevated Chemical Oxygen Demand (COD) consistently exceeding standard limits highlights substantial organic and inorganic pollution, which could compromise water quality and ecosystem health. Although other parameters like turbidity, chloride, and nitrate were stable, the persistent high COD and seasonal variations in temperature and pH suggest a need for improved water

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quality management to address these pollution challenges.

5. CONCLUSION

The study of physicochemical parameters in Lake Sathnala from February to July 2023 reveals significant seasonal variations influenced by both natural processes and anthropogenic activities. Elevated pH, electrical conductivity, and chemical oxygen demand (COD) levels, particularly during the warmer months, suggest increased pollution and organic load in the lake. The fluctuation in dissolved oxygen (DO) and biological oxygen demand (BOD) levels highlights the impact of temperature and biological activity on water quality. These findings underscore the need for improved watershed management to mitigate pollution and protect the lake's ecosystem.

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