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ASSESSMENT OF WATER QUALITY IN LAKSHMINARAYANA LAKE, EDULABAD: A PHYSICO-CHEMICAL APPROACH

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ABSTRACT

Urban lakes face increasing environmental pressures due to urbanization, population growth, and pollution. Lakshminarayana Lake in Edulabad, Hyderabad, Telangana, is no exception. Understanding its water quality is crucial for sustainable management. This study aims to assess the physicochemical parameters of Lakshminarayana Lake, focusing on pH, dissolved oxygen, heavy metals, and nutrient levels. Water samples were collected from six different sites within the lake during winter and monsoon seasons in 2023 and 2024. Fourteen Parameters such as pH, conductivity, turbidity, BOD, COD, and nutrient concentrations were analyzed following standard protocols. The lake exhibited seasonal variations in pH, conductivity, and nutrient levels. BOD and COD exceeded permissible limits, indicating organic pollution. Nitrate concentrations were elevated. Total coliform bacteria counts consistently exceeded safe levels. Lakshminarayana Lake requires targeted management strategies to mitigate pollution, safeguard ecosystem health, and protect public well-being.

Keywords: Lakshminarayana Lake, Edulabad, COD, BOD, pH, Coliform bacteria.

1. INTRODUCTION

Environmental pollution is one of the major challenges for human society nowadays (Dwivedi et al., 2007). Due to the fast-growing industries, increased energy demand and careless destruction of natural resources from the last few decades environmental pollution is increasing day by day (Lakherwal, 2019). Different organic and inorganic toxic materials are constantly releasing from various natural and anthropogenic sources in the soil and aquatic ecosystem. Among them, heavy metals are playing a major role in environmental pollution, not only for their toxic nature but also possessing the potentiality of bioaccumulation in the food chain (Li et al., 2013). Heavy metals are mostly releasing from domestic and agricultural waste products, industrial waste materials, combustion of fossil fuels, mining, waste water treatment plants to the natural ecosystem (Prasad et al., 2020).

Before using water for drinking, residential, industrial or agricultural purposes, it must first be tested. Different biological, physical and chemical factors must be used to test water. The only factors considered when selecting water testing parameters are the envisioned use of the water and the level to which its purity and quality are required (Ptashyanski et al., 2002). Different kinds of microbiological, dissolving, suspended, floating, and bacteriological pollutants are present in water. Physical tests should

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be conducted to evaluate the substance's odor, colour, temperature, pH, TDS, turbidity and further physical characteristics. Chemical tests should be conducted to evaluate the substance's COD, BOD, alkalinity, hardness, DO and other characteristics (Rajagopal et al., 2023).

Laxminarayna lake, located in Edulabad village in Ghatkesar, is covered under the HMDA Lake Protection Committee. It was reported that, this pollution from Hyderabad's main dumpyard at Jawahar Nagar which caused the death of the fish. There is a large amount of leachate that flows out of Jawahar Nagar, and it has polluted three lakes in the process, as it flows through Dammaiguda, Rampally, Ghatkesar, before it reaches Edulabad (Shahjahan et al., 2022). Because of all the liquid discharged into it, the water has become dark and black in colour. It is observed that, the all corners of the water body, with dead fish.According to environmental norms, a dumping yard should recycle most of the waste and have zero discharge, which is possible with the help of today's technology. Instead of that, the people polluting and poisoning multiple lakes. In Hyderabad. To trace the source of the lake's pollution, one must look at the four nalas going into Hussain Sagar in Hyderabad, through which effluents are allegedly released into the water body - the Kukatpally Nala, Balkapur Nala, Banjara Nala and the Picket Nala (Sharma et al, 2011).

Therefore, this research work fills critical data gaps, contributes valuable insights, and serves as a foundation for lake management and public health in the Lakshminarayana Lake region. The objective of the study is to evaluate and understand the physico-chemical characteristics of the lake water to asses quality of water.

2. MATERIALS AND METHODS

2.1 Study Area

The study area was selected to assess the water quality in Lakshminarayana Lake, Edulabad, Hyderabad, Telangana. Lakshminarayana Lake, also known as Laxminarayna Cheruvu, is situated in Edulabad village, Ghatkesar, Telangana. The coordinates are Latitude 17°25'26"N and Longitude 78°41'47"E (Figure-1) (Hans India, 2015). Constructed in the 16th century, it spans approximately 5 square kilometers and serves as a favorite spot for bird-watching, camping, and enjoying sunrise and sunset views. The lake hosts a diverse range of bird species, with a recorded count of 152 (Prasad et al., 2020). However, pollution from industrial waste has become a significant concern. Covering an area of 317 acres, the lake boasts a tank area of 596 acres and a Full Tank Level (FTL) set at 100 meters above sea level. Its perimeter stretches for 12,500 meters, with a bund length of 2,400 meters. Notably, it lies 27 km away from Secunderabad Railway Station and 50 km away from Rajiv Gandhi International Airport. Nearby villages include Marripalli Guda, Bokkoini Guda, Sanadu Patla Guda, and Ghanapur.

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Figure-1. Lakshminarayana Lake in Edulabad

2.2. Analysis of Water Physico-Chemical Parameters

2.2.1. Collection of Water Samples

The study involved collecting water samples from six distinct points within the lake. These samples were carefully preserved in pre-cleaned polyethylene bottles, each appropriately labeled for identification. The research spanned a duration of two years, covering two distinct seasons: Winter (January 2023 and January 2024) and Monsoon (June 2023 and June 2024). To assess the water quality, various physico-chemical parameters were analyzed using standard methods. These parameters play a crucial role in understanding the lake's environmental health and potential impacts on aquatic life.

The samples of subsurface water were collected during middle of the week of selected months at 8 a.m. to 9 a.m. winter and monsoon seasons in clean plastic air tight bottles. Particularly for DO analysis, water sample was collected in clean 100 ml bottles of glass. The air and water temperature were recorded by minimum – maximum hydro-thermometer and thermometer respectively. pH by pH meter (Systronics Model-362), conductivity by conductivity meter (Labtronics model – LT16), dissolved oxygen by Winkler's volumetric method, photic depth by Secchi disc method, free alkalinity, chloride, salinity, phosphorus, total inorganic nitrogen and hardness and other parameters are measured by APHA (2005). Each parameter and every of water samples were collected from six study sites and analysed the mean values were detected in (Table-1).

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3. RESULTS

3.1. Analysis of Physico-Chemico Parameters

To Assess the Physico-Chemical Parameters of water of Lakshminarayana Lake, a detailed analysis of the physico-chemical properties of the water was conducted, including measurements of pH, dissolved oxygen, electrical conductivity, turbidity, alkalinity, hardness, nitrates, sulphates, phosphates and other relevant parameters (Table-1). This analysis established a baseline understanding of the lake's water quality and its suitability for supporting aquatic life and human use. Each parameter provides insights into the lake's water quality and environmental conditions during different seasons:

1. **pH (Potential of Hydrogen):** The pH values for Lakshminarayana Lake vary across seasons. During winter (January 2023), the mean pH was 8.65±1.01, while in the monsoon (June 2023), it decreased to 7.05±2.76. Similarly, in January 2024 (winter), the pH was 8.5±1.44, and during the monsoon (June 2024), it was 7.9±2.11. These fluctuations may impact aquatic life and nutrient availability.

2. **Conductivity:** Conductivity measures the lake's ability to conduct electricity. Higher conductivity values indicate greater dissolved ions. In Lakshminarayana Lake, the mean conductivity during winter (January 2023) was 1352±3.45 µS/cm, decreasing to 1268±4.21 µS/cm during the monsoon (June 2023). Similar trends were observed in subsequent years (winter 2024: 1216±6.12 µS/cm, monsoon 2024: 989±4.80 µS/cm).

3. **Total Dissolved Solids (TDS):** TDS levels remained relatively stable. The mean TDS values were 849±2.55 mg/L (winter 2023), 844±2.98 mg/L (monsoon 2023), 972±4.81 mg/L (winter 2024), and 956±3.11 mg/L (monsoon 2024). Elevated TDS may affect water quality and aquatic organisms.

4. **Turbidity:** Turbidity reflects water clarity. Lakshminarayana Lake exhibited seasonal variations. Turbidity values were 9.7±1.34 NTU (winter 2023), 8.6±1.88 NTU (monsoon 2023), 7.8±1.40 NTU (winter 2024), and 9.2±1.80 NTU (monsoon 2024). Higher turbidity can hinder light penetration and impact aquatic ecosystems.

5. **Dissolved Oxygen (DO):** DO levels were close to the recommended threshold. Mean DO concentrations were 4±0.22 mg/L (winter 2023), 3.2±0.21 mg/L (monsoon 2023), 3.9±0.32 mg/L (winter 2024), and 3.2±0.50 mg/L (monsoon 2024). Adequate DO is essential for aquatic organisms.

6. **Biochemical Oxygen Demand (BOD):** BOD values were elevated, exceeding the recommended limit of 5 mg/L. Mean BOD levels were 47±2.55 mg/L (winter 2023), 65.2±3.90 mg/L (monsoon 2023), 62±3.55 mg/L (winter 2024), and 59±2.83 mg/L (monsoon 2024). High BOD indicates organic pollution.

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Table-1. Analysis of Physicochemical parameters of Lakshminarayana Lake, Edulabad, Hyderabad, Telangana

Sl.No	Physico-Chemical Parameters	BIS limits	Physico-chemical parameter values of Lakshminarayana Lake of Edulabad, Hyderabad dyring different seasons during 2023 & 2024			
			Winter (Janauary 2023)	Monsoon (June 2023)	Winter (January 2024)	Monsoon (June 2024)
1	pH	6.5-8.5	8.65±1.01	7.05±2.76	8.5±1.44	7.9±2.11
2	Conductivity	300 micromhos/cm	1352±3.45	1268±4.21	1216±6.12	989±4.80
3	TDS	500 mg/l	849±2.55	844±2.98	972±4.81	956±3.11
4	Turbidity	<1.0 NTU	9.7±1.34	8.6±1.88	7.8±1.40	9.2±1.80
5	DO	>4 mg/l	4±0.22	3.2±0.21	3.9±0.32	3.2±0.50
6	BOD	5 mg/l	47±2.55	65.2±3.90	62±3.55	59±2.83
7	COD	<4 mg/l	144±4.54	186.4±5.22	173±5.77	165±5.20
8	Total hardness	<200 mg/l	440±6.11	328±4.98	352±6.10	496±6.55
9	Alkalinity	200 mg/l	320±2.80	300±4.71	401±3.81	312±3.56
10	Nitrates	<45 mg/l	48±2.54	55.8±3.88	62±1.45	50.2±2.90
11	Sulphates	<200 mg/l	89±3.07	72±2.90	86±3.80	67±3.80
12	Flouride	<1 mg/l	1.6±0.22	1.2±0.12	1.3±0.23	1.5±0.21
13	Phosphates	1.0 mg/l	0.9±0.36	1.1±0.70	1.4±0.55	1.3±0.80
14	Total coliform bacteria	<10	860	902	798	862

(Values are presented in Mean ± SD; Mean valus were calculated for each parameter from the six samples collected from 6 different cites of lake)

7. **Chemical Oxygen Demand (COD):** COD values were consistently above the permissible limit (<4 mg/L). Mean COD concentrations were 144±4.54 mg/L (winter 2023), 186.4±5.22 mg/L (monsoon 2023), 173±5.77 mg/L (winter 2024), and 165±5.20 mg/L (monsoon 2024). Elevated COD suggests pollution from organic and inorganic sources.

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8. **Total Hardness:** Total hardness values exceeded the recommended limit (<200 mg/L). Mean hardness levels were 440±6.11 mg/L (winter 2023), 328±4.98 mg/L (monsoon 2023), 352±6.10 mg/L (winter 2024), and 496±6.55 mg/L (monsoon 2024). High hardness may affect water quality and aquatic organisms.

9. **Alkalinity:** Alkalinity levels fluctuated. Mean alkalinity values were 320±2.80 mg/L (winter 2023), 300±4.71 mg/L (monsoon 2023), 401±3.81 mg/L (winter 2024), and 312±3.56 mg/L (monsoon 2024). Alkalinity influences pH stability and buffering capacity.

10. **Nitrates:** Nitrates exceeded the recommended limit (<45 mg/L). Mean nitrate concentrations were 48±2.54 mg/L (winter 2023), 55.8±3.88 mg/L (monsoon 2023), 62±1.45 mg/L (winter 2024), and 50.2±2.90 mg/L (monsoon 2024). Elevated nitrate levels may result from agricultural runoff or sewage discharge, potentially impacting water quality and aquatic ecosystems.

11. **Sulfates:** Sulfate levels remained within permissible limits. Mean sulfate concentrations were 89±3.07 mg/L (winter 2023), 72±2.90 mg/L (monsoon 2023), 86±3.80 mg/L (winter 2024), and 67±3.80 mg/L (monsoon 2024). Sulfates are naturally occurring but can contribute to water hardness.

12. **Fluoride:** Fluoride levels were slightly elevated. Mean fluoride concentrations were 1.6±0.22 mg/L (winter 2023), 1.2±0.12 mg/L (monsoon 2023), 1.3±0.23 mg/L (winter 2024), and 1.5±0.21 mg/L (monsoon 2024). Monitoring fluoride is essential for dental health and preventing excess exposure.

13. **Phosphates:** Phosphate levels were close to the recommended limit (1.0 mg/L). Mean phosphate concentrations were 0.9±0.36 mg/L (winter 2023), 1.1±0.70 mg/L (monsoon 2023), 1.4±0.55 mg/L (winter 2024), and 1.3±0.80 mg/L (monsoon 2024). Phosphates influence nutrient availability and algal growth.

14. **Total Coliform Bacteria:** Total coliform bacteria counts were consistently high, exceeding the permissible limit (<10). The counts were 860 (winter 2023), 902 (monsoon 2023), 798 (winter 2024), and 862 (monsoon 2024). Elevated coliform levels indicate fecal contamination and potential health risks.

This comprehensive assessment provides critical data on Lakshminarayana Lake's water quality. The findings underscore the need for targeted management strategies to mitigate pollution, safeguard ecosystem health, and protect the well-being of local communities.

4. DISCUSSION

Swapna et al (2024) reviewed problems related to nutrient enrichment in lakes due to urbanization, population growth, and contamination. Lakshminarayana Lake's fluctuating pH, elevated conductivity,

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and stable TDS align with their observations1. Longer growing seasons and land use changes may contribute to nutrient runoff, impacting eutrophication and biodiversity loss. A comparative study by Vijayagiri et al., (2012) emphasized the importance of monitoring parameters like BOD, TDS, and total suspended solids (TSS). These parameters directly affect water quality and ecosystem health. Lakshminarayana Lake's BOD exceeding limits echoes their findings.

In a similar vein, our study aligns with the work of Gujjeti et al.. (2013), who evaluated water quality using BIS standards. Comparing pond water and potable sources, they emphasized the significance of multiple parameters, including pH, dissolved oxygen, and total hardness. Watershed characteristics play a crucial role in lake water quality. The study by Mamidala et al, (2013) assessed parameters such as temperature, turbidity, and nitrate concentration. Lakshminarayana Lake's seasonal variations in conductivity and nitrate levels resonate with their findings. Our analysis also aligns with the work of Rajagopal et al., (2023), who investigated various physicochemical parameters in water samples. Parameters like total alkalinity, chloride, and calcium were part of their assessment, mirroring our study on Lakshminarayana Lake.

5. CONCLUSION

The physicochemical analysis of Lakshminarayana Lake indicates severe pollution, with Total Dissolved Solids (TDS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Coliform Bacteria levels consistently surpassing permissible limits. Elevated TDS, COD, and BOD values signify high loads of organic and chemical pollutants, adversely affecting aquatic life and overall water quality. The consistently high levels of Total Coliform Bacteria pose significant public health risks. Additionally, elevated hardness, turbidity, nitrate, fluoride, and phosphate levels further underline the extent of contamination, with potential consequences for both the ecosystem and human health.

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