Seasonal Dynamics of Organic Pollution and Oxygen Stress in an Urban Lake of Dhaka, Bangladesh

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Abstract

Urban lakes in rapidly expanding megacities are increasingly exposed to severe organic pollution due to untreated sewage discharge and unmanaged solid waste. This study investigates seasonal variations in physicochemical water quality and associated socio-environmental responses in Dhanmondi Lake, an urban lake located in Dhaka, Bangladesh. Water samples were collected from twelve representative locations during two seasonal monitoring campaigns conducted in April 2025 (pre-monsoon) and July 2025 (monsoon), with one sampling event performed per season, and analyzed following standard methods. Key parameters included dissolved oxygen (DO), biochemical oxygen demand (BOD_5), electrical conductivity, turbidity, color, alkalinity, carbon dioxide, salinity, and iron. A structured questionnaire survey involving 200 residents was conducted to contextualize the laboratory findings. Results indicate chronic organic contamination during both monitoring periods, with mean BOD_5 concentrations of 23.33 mg/L in the pre-monsoon season and 17.0 mg/L during the monsoon season, substantially exceeding national drinking water and fisheries standards. Although monsoonal dilution reduced conductivity and alkalinity, dissolved oxygen declined to near-critical levels during the monsoon season, with a mean of 5.63 mg/L, indicating increasing oxygen stress in the lake ecosystem. Turbidity, color, and carbon dioxide concentrations consistently exceeded recommended limits, reflecting persistent organic loading. Public perception was consistent with the observed environmental degradation patterns, identifying sewage inflow and waste disposal as the dominant pollution sources. The findings indicate that Dhanmondi Lake is experiencing severe organic pollution under sustained anthropogenic pressure and provide a seasonal empirical baseline to support pollution control and restoration planning for urban lakes in rapidly urbanizing regions.

Keywords: Bangladesh; biochemical oxygen demand; dissolved oxygen; organic pollution; sewage pollution; urban lake; water quality

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1. Introduction

Urban lakes are increasingly exposed to severe environmental pressures driven by rapid urbanization, untreated sewage discharge, and unmanaged solid waste. As global populations continue to urbanize, pressure on freshwater systems has intensified, requiring improved monitoring and management of urban water bodies [1–5]. Urban lakes represent important ecological and hydrological components of freshwater systems and contribute to urban biodiversity, climate regulation, and recreational services [6]. However, increasing anthropogenic pressure has resulted in the widespread degradation of urban aquatic ecosystems worldwide [7,8].

Cities in the Global South frequently experience rapid urban growth that outpaces infrastructure development, resulting in severe environmental stress on urban water bodies. This phenomenon has been described as an "urban hydro-social transition," in which population growth, informal settlements, and inadequate wastewater management lead to increasing water vulnerability [9,10]. Sustainable urban water management frameworks emphasize the need for resilient and adaptive water governance systems capable of addressing both environmental and social dimensions of water security [11–13]. Achieving such resilience requires a comprehensive understanding of the uncertainties inherent in urban water systems and the development of integrated approaches to water quality monitoring and management [14–16].

Shallow lakes are particularly vulnerable to organic pollution resulting from excessive organic loading and urban runoff [17]. Such processes can lead to severe ecological consequences, including reduced water transparency, altered nutrient cycling, and oxygen depletion in aquatic ecosystems [18,19]. Recent studies have increasingly used integrated monitoring approaches, including geospatial analysis, remote sensing, and multi-source environmental data, to better understand the dynamics of lake ecosystems and the long-term impacts of pollution [20–23]. Seasonal environmental variability also plays an important role in shaping lake water quality dynamics, influencing parameters such as nutrient transport, sediment interaction, and biological activity [24–26].

In Bangladesh, particularly in rapidly urbanizing Dhaka, water quality degradation remains a major environmental and public health challenge. Numerous studies have reported elevated levels of chemical and microbial contaminants in surface water bodies, posing risks to both ecosystems and human populations [27,28]. Urban lakes in Dhaka, including Dhanmondi Lake and Hatirjheel Lake, have been reported to experience increasing pollution pressure from untreated sewage inflow, urban runoff, and solid waste disposal [29,30]. In addition, industrial effluents and inadequate waste management practices further contribute to environmental deterioration across the Bengal Delta region [31,32]. Effective monitoring of physicochemical water quality parameters remains essential for understanding the ecological status of these urban aquatic systems and supporting sustainable resource management [33–35]. Among Dhaka's urban lakes, Dhanmondi Lake represents a highly stressed aquatic system influenced by untreated sewage inflows, urban runoff, and intensive human activity [36,37].

Despite growing recognition of the environmental importance of urban lakes in Dhaka, recent seasonally resolved datasets describing organic pollution dynamics and oxygen-related stress in Dhanmondi Lake remain limited. Previous studies have examined broader water resource management issues, groundwater buffering systems, and spatial frameworks for resilience in Bangladesh [38–42]. However, there remains a need for updated empirical datasets that directly assess seasonal variability in key physicochemical indicators and their implications for urban lake ecosystems [43–46].

This study addresses this gap by evaluating seasonal variation in selected physicochemical parameters of Dhanmondi Lake using standardized analytical methods for water and wastewater assessment [47–50], with reference to national and international water quality guidelines [51–55]. By focusing on parameters such as biochemical oxygen demand (BOD_5) and dissolved oxygen (DO), the study examines the extent of organic pollution and associated oxygen stress conditions affecting the lake ecosystem [56–60]. In addition, the study incorporates a socio-environmental survey to contextualize the laboratory findings with community perceptions of water quality degradation.

The objectives of this research are: (1) to evaluate seasonal variation in key physicochemical water quality parameters of Dhanmondi Lake; (2) to assess the magnitude of organic pollution using BOD_5 and related indicators; and (3) to examine how measured water quality conditions correspond with public perceptions of lake pollution and environmental health risks.

2. Methodology

This study was conducted to investigate seasonal variation in the physicochemical characteristics of water in Dhanmondi Lake and to compare the results with standard water quality parameter levels to determine whether the lake water is suitable for fisheries and other aquatic flora and fauna. A questionnaire survey and water sample collection were conducted during the pre-monsoon season, or dry season, from March to May 2025, and the monsoon season, or wet season, from June to October 2025. The questionnaire survey was completed by 200 participants. Twelve water samples were collected for laboratory analysis as part of this study.

2.1 Study Design

Dhanmondi Lake is a shallow urban lake located in central Dhaka, Bangladesh, receiving mixed inputs from rainfall, surface runoff, and untreated domestic sewage. The lake is subject to strong seasonal hydrological variation associated with the pre-monsoon, or dry, and monsoon, or wet, periods.

2.2 Sampling Design

Water sampling was conducted during two distinct seasonal monitoring campaigns representing the pre-monsoon and monsoon periods. Each seasonal campaign consisted of a single sampling event, during which water samples were collected from all twelve monitoring locations (n = 12 samples per season). Twelve representative sampling locations were selected across the lake to capture spatial variability influenced by inflow points, human activity, and shoreline conditions. Water samples were collected using pre-cleaned polyethylene sampling bottles. All samples were collected as surface grab samples from approximately 20–30 cm below the water surface. Sampling was conducted during the afternoon, between 14:00 and 18:00, to maintain temporal consistency across sampling locations. Collected samples were transported immediately to the laboratory under controlled conditions for physicochemical analysis.

2.3 Physicochemical Analysis

Physicochemical parameters, including pH, temperature, electrical conductivity, salinity, turbidity, color, alkalinity, free CO_2, dissolved oxygen (DO), biochemical oxygen demand (BOD_5), and iron (Fe), were analyzed following standard procedures described in the Standard Methods for the Examination of Water and Wastewater [47]. Dissolved oxygen (DO) measurements were conducted in situ at each sampling location using a calibrated portable dissolved oxygen meter. Parameters including pH, temperature, electrical conductivity, and salinity were measured using portable field instruments.

Biochemical oxygen demand (BOD_5) analysis was performed according to APHA standard procedures using the five-day incubation method at 20°C in a dark incubator. Turbidity, color, alkalinity, carbon dioxide, and iron concentrations were determined using standard laboratory analytical methods, including titrimetric and spectrophotometric techniques, where applicable. All collected water samples were transported to the laboratory immediately after sampling and analyzed within approximately two hours of collection to minimize potential physicochemical changes during storage and transport.

2.4 Socio-Environmental Survey

A structured questionnaire survey was conducted involving 200 residents and visitors around Dhanmondi Lake to evaluate public perceptions of lake water quality and environmental conditions. The survey included questions regarding perceived water quality, seasonal variation, pollution sources, and possible health concerns associated with lake water use. Responses were compiled and summarized as percentage distributions to facilitate interpretation of socio-environmental perceptions in relation to the laboratory-based water quality results.

2.5 Data Analysis and Benchmarking

Seasonal water quality results were expressed as mean values derived from the twelve sampling locations. The measured physicochemical parameters were compared against national water quality standards provided in the Bangladesh Environment Conservation Rules (ECR, 1997) [52], World Health Organization (WHO) guidelines [51], and relevant fisheries standards. Seasonal variations were interpreted in relation to hydrological dilution, organic pollution loading, and anthropogenic environmental pressures affecting the lake ecosystem.

Seasonal differences between pre-monsoon and monsoon measurements were evaluated using a paired t-test, since the same twelve sampling locations were measured during both monitoring campaigns. Mean values and standard deviations (SDs) were calculated for each parameter. Statistical significance was evaluated at a 95% confidence level ($p < 0.05$) using paired comparisons between seasonal datasets. Normality assumptions for the paired t-test were considered based on sample size and data distribution. Given the limited sample size ($n = 12$), the results of the paired t-test were interpreted with caution, and statistical findings were supported by consistent trends observed across all sampling locations.

2.6 Quality Assurance and Quality Control

Quality assurance and quality control procedures were implemented to ensure the reliability and accuracy of laboratory measurements. Field instruments, including the portable dissolved oxygen meter and multiparameter probes, were calibrated before sampling according to manufacturer guidelines and standard analytical protocols. All physicochemical analyses were conducted following the procedures outlined in the Standard Methods for the Examination of Water and Wastewater [47].

Glassware and sampling containers were thoroughly cleaned and rinsed before use to prevent contamination. Reagents used for laboratory analyses were prepared using analytical-grade chemicals. Measurements were carefully conducted following standard analytical procedures, and instrument calibration checks were performed periodically during the analysis process. All measurements were performed in accordance with established standard methods and instrument calibration procedures to maintain consistency and analytical reliability throughout the study.

3. Results and Discussion

3.1 Social Perception and Public Health Implications of Dhanmondi Lake Pollution

The socio-environmental status of Dhanmondi Lake was evaluated through a structured questionnaire survey involving 200 local participants to assess public health concerns in relation to anthropogenic stressors. The responses obtained from the socio-environmental questionnaire survey are summarized in Table 1, which presents the distribution of perceptions among the 200 participants regarding lake water quality and pollution sources.

Based on the questionnaire survey of 200 residents and visitors at Dhanmondi Lake, the socio-environmental findings highlight significant public dissatisfaction and ecological distress. The distribution of responses is illustrated in Figure 1 to visually summarize public perception of lake water quality conditions. A vast majority of participants are dissatisfied with the lake's current water condition, noting pervasive issues with smell and taste. Pollution is perceived to be most severe during the summer (90%) and rainy seasons (80%), driven primarily by sewage connections, solid and liquid waste disposal, human ignorance, and falling leaves. Respondents identified rainwater and sewage as the lake's primary water sources and reported facing health-related problems from using the water. To improve these conditions, respondents suggested increased government and NGO involvement, utilizing chemical treatments like $CaCO_3$, and fostering public awareness. Although no formal statistical analysis was conducted, these social views are qualitatively consistent with laboratory observations.

Table 1: Questionnaire survey responses on the water condition of Dhanmondi Lake.

No.	Question	Response
1	Are you satisfied with the present condition of the water in Dhanmondi Lake?	Yes = 5%; No = 95%
2	Do you notice any smell or taste problem in the water of the lake?	Yes = 95%; No = 5%
3	During the summer season, do you notice any problem with the water in the lake?	Yes = 90%; No = 5%; Sometimes = 5%
4	During the rainy season, do you notice any problem with the water in the lake?	Yes = 80%; No = 10%; Sometimes = 10%
5	What are the sources of water for this lake?	Mainly rainwater and sewage water
6	Are you using lake water for any purpose?	Yes
7	Have you faced any health-related problems?	Yes
8	What suggestions do you have for improving the water condition of the lake?	The government should take action to improve the lake's water quality. Calcium carbonate may be used, NGOs should actively participate, and public awareness should be strengthened.
9	What do you think are the major sources of pollution in the lake?	Falling tree leaves; human negligence; connected sewage lines; disposal of solid and liquid waste

3.2 Water Quality Test in the Laboratory

The physicochemical analysis of Dhanmondi Lake across pre-monsoon and monsoon periods reveals significant seasonal fluctuations in organic loading and organic pollution dynamics. The laboratory results are summarized in Table 2. Based on the laboratory results, the physicochemical analysis of Dhanmondi Lake reveals significant seasonal variations and critical organic pollution:

Organic Loading: Biological Oxygen Demand (BOD_5) levels are alarmingly high, averaging 23.33 mg/L in the pre-monsoon and 17 mg/L during the monsoon, both vastly exceeding the national standard of 0.2 mg/L.

Dissolved Oxygen (DO): Mean DO levels drop from 7.25 mg/L (pre-monsoon) to 5.63 mg/L (monsoon).

Physical Parameters: Color (36 to 24.33 Pt-Co) and turbidity (15 to 12 JTU) consistently exceed permissible limits, though they show slight improvement with monsoon dilution.

Stability: Parameters like pH (7.33) and iron (0.30 mg/L) remained stable and within safe limits across both seasons.

3.3 Comparative Assessment of Physicochemical Parameters against International and National Standards

Analysis of the laboratory results for Dhanmondi Lake against national and international benchmarks reveals a water body under

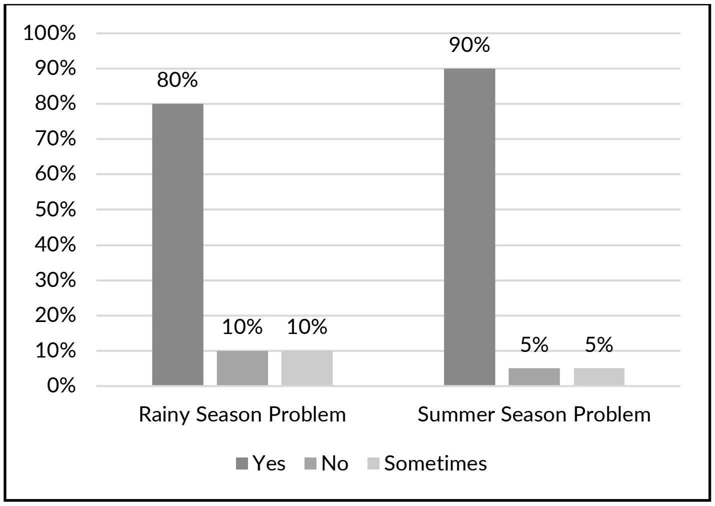

Figure 1: Distribution of public perceptions regarding water quality conditions in Dhanmondi Lake based on responses from 200 residents and visitors.

Table 2: Physicochemical water quality results of Dhanmondi Lake by season.

Parameter	Unit	Pre-Monsoon Mean ± SD	Monsoon Mean ± SD
pH	—	7.33 ± 0.24	7.33 ± 0.25
Conductivity	µS/cm	313 ± 4.5	239 ± 2.5
DO	mg/L	7.25 ± 0.25	5.63 ± 0.01
Iron	mg/L	0.30 ± 0.00	0.30 ± 0.00
Temperature	°C	20.0 ± 0.0	21.33 ± 1.03
Color	Pt-Co	36 ± 1.41	24.33 ± 0.49
Alkalinity	mg/L	260 ± 0.00	148 ± 0.00
CO_2	mg/L	26.67 ± 2.46	25.33 ± 0.49
Salinity	ppt	0.23 ± 0.05	0.23 ± 0.05
Turbidity	JTU	15 ± 0.00	12 ± 0.00
BOD_5	mg/L	23.33 ± 1.03	17.0 ± 1.00

Note. Values are presented as mean ± standard deviation. DO = dissolved oxygen; BOD_5 = five-day biochemical oxygen demand; SD = standard deviation.

severe ecological stress. While basic parameters such as pH, 7.33, and iron, 0.30 mg/L, remain comfortably within the Bangladesh Environment Conservation Rules (ECR 1997) [52] and WHO [51] safety limits, they mask deeper systemic issues. The most alarming finding is the BOD_5. Averaging 23.33 mg/L in the pre-monsoon season and 17 mg/L during the monsoon season, these levels substantially exceed the national drinking water standard of 0.2 mg/L. Even against fisheries standards, which allow up to 6 mg/L, the lake is significantly over-polluted, signaling intense microbial activity from untreated sewage.

Physical aesthetics further highlight this deterioration. Turbidity, 12–15 JTU, and color, 24.33–36 Pt-Co, consistently exceeded the permissible limits set by both Bangladesh and WHO. In addition, CO_2 levels, 25.33–26.67 mg/L, were nearly double the national standard of 15 mg/L, creating a high-stress environment that can impair aquatic respiration.

The lake is highly affected by organic pollution, although monsoonal dilution reduces conductivity and alkalinity. Dissolved oxygen levels approach the minimum required to sustain aquatic life, but the massive organic load suggests an ecosystem under severe ecological stress that requires urgent intervention. The comparison between the measured water quality parameters and the Bangladesh Environment Conservation Rules (ECR 1997) [52], WHO guidelines [51], and fisheries standards [55] is summarized in Table 3.

3.4 Impact Assessment of Water Quality on Fisheries Sustainability

Analysis of the laboratory results for Dhanmondi Lake against national fisheries standards reveals an ecosystem that is unsuitable for sustaining healthy aquatic life under current conditions. While the pH level, 7.33, remains stable and within the ideal range of 6.5–8.5 for fish health, other critical parameters indicate severe ecological degradation. BOD_5 represents the most critical finding. To maintain a healthy environment, BOD_5 levels must be at or below 2 mg/L according to fisheries guidelines. In contrast, Dhanmondi Lake recorded substantially elevated averages of 17 mg/L during the monsoon season and 23.33 mg/L before the monsoon season. These values, which are about 8 to 11 times higher than the allowable limit, indicate a significant organic load and considerable microbial activity that deplete the water's capacity to support aquatic life.

Pronounced seasonal variation in DO levels indicates increasing ecological instability. The pre-monsoon DO level of 7.25 mg/L appears healthy, but during the monsoon season, it decreased to 5.63 mg/L, approaching the lower bound of the 4.0–6.0 mg/L fisheries requirement. This declining trend, combined with the overwhelming organic demand, creates a high-risk environment for oxygen stress. The reported temperatures, 20°C to 21.33°C, are slightly below the commonly reported optimal temperature ranges for tropical fish species in this area, posing an additional constraint. Dhanmondi Lake is more appropriately characterized as a heavily polluted urban water body than a productive fishery, and its severe organic pollution directly threatens the survival and reproduction of aquatic species.

The results clearly demonstrate that Dhanmondi Lake is subject to chronic organic pollution, driven primarily by continuous sewage inflow and unmanaged urban waste. The exceptionally high BOD_5 concentrations recorded during both seasons confirm intense microbial respiration and oxygen demand, characteristic of severely organically polluted urban lakes. These findings are consistent with reported patterns in urban lakes experiencing continuous sewage inflow, where elevated biochemical oxygen demand and reduced dissolved oxygen are commonly observed due to sustained organic loading and intensified microbial respiration [7,8].

Although monsoonal rainfall provided partial dilution, the persistence of elevated BOD_5 values indicates that pollution sources are continuous rather than episodic. The seasonal decline in dissolved oxygen during the monsoon highlights a critical ecological vulnerability. While pre-monsoon DO levels appeared sufficient to temporarily sustain aerobic conditions, increased organic decomposition, reduced light penetration, and altered mixing conditions during the monsoon likely intensified oxygen consumption. An apparent inverse trend between BOD_5 and dissolved oxygen was observed in this study, which is consistent with established patterns of organic pollution-driven oxygen consumption reported in other degraded urban lakes across South and Southeast Asia.

Table 3: Comparison of measured water quality with national drinking water, WHO, and fisheries standards.

No.	Water Quality Parameters	Unit	Bangladesh Standards for Drinking Water (ECR 97) [52]	WHO Guideline Values, 1993 [51]	Bangladesh Standards for Fisheries (EQS,1997) [55]	Dhanmondi Lake	
						Pre-Monsoon (Dry Season, April 2025)	Monsoon (Wet Season, July 2025)
1	pH	-	6.5-8.5	6.5-8.5	6.5-8.5	7.33 ± 0.24	7.33 ± 0.25
2	Conductivity	µS/cm	-	-	-	313 ± 4.5	239 ± 2.5
3	DO	mg/L	6.0	5.0	4.0-6.0	7.25 ± 0.25	5.63 ± 0.01
4	Iron	mg/L	0.3-1.0	0.3	-	0.30 ± 0.00	0.30 ± 0.00
5	Temperature	∘C	20-30	-	25	20.0 ± 0.0	21.33 ± 1.03
6	Color	Pt-Co	15	15	-	36 ± 1.41	24.33 ± 0.49
7	Alkalinity	mg/L	200	200	-	260 ± 0.00	148 ± 0.00
8	CO_2	mg/L	15	15	-	26.67 ± 2.46	25.33 ± 0.49
9	Salinity	ppt	0	0	-	0.23 ± 0.05	0.23 ± 0.05
10	Turbidity	JTU	10	5	-	15 ± 0.00	12 ± 0.00
11	BOD_5	mg/L	0.2	-	(-) or below 2	23.33 ± 1.03	17.0 ± 1.00

Physical indicators, such as turbidity and color, further support the presence of excessive organic matter and suspended solids, which limit light penetration and disrupt primary productivity. Elevated carbon dioxide concentrations reinforce the dominance of respiratory over photosynthetic processes, increasing physiological stress on aquatic organisms. Despite acceptable pH and iron levels, these stable parameters mask deeper systemic degradation caused by organic enrichment.

From the standpoint of fisheries, Dhanmondi Lake does not satisfy minimal ecological standards. The system is highly vulnerable to oxygen stress conditions that could harm aquatic organisms due to marginal monsoon DO concentrations and BOD_5 levels that are significantly higher than the tolerable threshold for fish survival. The consistency between laboratory data and socio-environmental survey responses provides qualitative support for the observed environmental conditions; however, no formal statistical correlation analysis was performed. Overall, the findings suggest that hydrological dilution alone is insufficient to restore ecological balance in heavily polluted urban lakes. Effective mitigation will require the elimination of direct sewage inputs, improved solid waste management, and continuous water quality monitoring to prevent further ecological collapse.

Despite increased rainfall and surface water inflow during the monsoon, biochemical oxygen demand remained at critically high levels, indicating that organic pollution sources are continuous rather than seasonal. The modest reduction in BOD_5 during the monsoon reflects hydrological dilution but not source control, as untreated sewage discharges and diffuse urban runoff continue to supply readily biodegradable organic matter. This sustained organic input offsets dilution effects and maintains elevated microbial respiration throughout the wet season.

The observed seasonal decline in dissolved oxygen suggests that oxygen consumption associated with microbial degradation of organic matter may exceed atmospheric reaeration capacity during the monsoon. Increased turbidity and reduced light penetration may further limit photosynthetic oxygen production, while higher temperatures and organic decomposition accelerate oxygen demand. As a result, the lake remains vulnerable to oxygen stress conditions even under increased hydrological inflow during the monsoon.

The concurrent occurrence of high carbon dioxide concentrations, elevated BOD_5, and declining dissolved oxygen reflects a tightly coupled biogeochemical process dominated by heterotrophic metabolism. Such patterns indicate a transition toward a respiration-dominated system commonly observed in highly urbanized aquatic environments. Excessive organic inputs stimulate microbial respiration, increasing CO_2 production while simultaneously depleting dissolved oxygen. This coupled dynamic demonstrates that, under conditions of substantial organic loading and persistent human pressure, the lake operates as a respiration-dominated system.

This study is subject to several limitations that should be considered when interpreting the results. First, the analysis focuses on physicochemical parameters and does not include microbiological indicators or nutrient species, such as total nitrogen and total phosphorus, which could refine eutrophication characterization. Second, sampling was conducted during two major seasonal periods rather than through continuous monthly monitoring, limiting the resolution of short-term variability and extreme pollution events. Third, water samples were collected from surface layers only; vertical profiling was not conducted due to logistical constraints, which may underestimate stratification effects on dissolved oxygen dynamics. Fourth, the socio-environmental survey relied on self-reported perceptions, which, while valuable for contextual interpretation, may be influenced by respondent subjectivity. No formal statistical correlation analysis was conducted between socio-environmental survey responses and laboratory measurements; therefore, relationships are interpreted qualitatively.

Nutrient species, such as total nitrogen and total phosphorus, were not analyzed in this study; therefore, formal trophic status classification of the lake was beyond the scope of this research.

Finally, this research emphasizes diagnostic assessment rather than predictive modeling. Advanced modeling approaches, remote sensing integration, and long-term ecological simulations were beyond the scope of this study. Despite these limitations, the dataset provides a robust, seasonally resolved empirical baseline that reliably captures the magnitude and persistence of organic pollution in Dhanmondi Lake.

4. Conclusion

The findings confirm that Dhanmondi Lake is experiencing chronic organic contamination and persistent organic loading, resulting in seasonal oxygen depletion risk within the lake ecosystem. Extremely high biochemical oxygen demand across both pre-monsoon and monsoon seasons indicates continuous inflow of untreated sewage and organic waste. Although monsoonal rainfall produced partial hydrological dilution, it did not sufficiently reduce the underlying organic pollution pressure. The combined analysis of laboratory measurements and public perception indicates that Dhanmondi Lake is under sustained anthropogenic pressure, suggesting apparent associations between water quality degradation, ecological stress, and community health concerns. While parameters such as pH and iron remained within acceptable limits, they do not reflect the broader ecological dysfunction driven by excessive organic loading. From a fisheries and ecological sustainability perspective, the lake does not meet minimum environmental requirements.

The findings provide a reliable seasonal baseline for assessing pollution in urban lakes in rapidly growing megacities. Addressing the degradation of Dhanmondi Lake will require source-level pollution control, particularly the elimination of sewage inflows and the improvement of waste management practices. Without such interventions, continued organic enrichment will intensify oxygen depletion, biodiversity loss, and human health risks. This study contributes empirical evidence necessary for informed pollution mitigation and long-term restoration planning in urban aquatic systems.

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Conflict of Interest Statement

The author declares no conflict of interest.

Author Contributions

The author confirms sole responsibility for the following: study conception and design, analysis and interpretation of results, and manuscript preparation. The author has approved the final version of this manuscript.

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