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Surface Water Quality: A Case Study of Institut Teknologi Sepuluh Nopember Surabaya, Indonesia

Fadilla Azzahrani Puspa, Ira Shavina Inora Rahma*

Department of Environmental Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

*Correspondence: irashavina@email.com

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ABSTRACT: This study evaluated the surface water quality at two lakes on the Sepuluh Nopember Institute of Technology (ITS) campus in Surabaya, Indonesia from October to December 2024. Water samples from ITS Lake Eight (SS1) and the ITS Student Dormitory Lake (SS2) were analyzed for eight parameters: Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Total Dissolved Solids TDS, pH, temperature, Electrical Conductivity (EC), and turbidity. The results showed that COD, BOD, DO, and turbidity exceeded national quality standards at both locations, while TDS and pH remained within acceptable limits. SS2 exhibited poorer water quality than SS1 due to its proximity to dormitory drainage and domestic waste pollution. Seasonal variations significantly affected water quality, with BOD and COD increasing during the dry season and DO, TDS, and turbidity rising during the rainy season. The main pollution sources were organic matter decomposition and anthropogenic activities, leading to eutrophication and algal growth.

KEYWORDS: Domestic waste; lake; surface water

1. Introduction

Surface water was an essential component of the global hydrological system, playing a vital role in maintaining ecosystem balance and supporting human survival [1]. As a fundamental natural resource, water sustained life, ecosystems, and human societies, making the availability of high-quality water an absolute prerequisite for anthropogenic activities, including those within higher education environments [2]. On university campuses, surface water functioned as a source of raw water for domestic and academic purposes and also served as an environmental quality indicator, reflecting the implementation of sustainable development principles in educational infrastructure management [3].

The intensification of anthropogenic activities in university areas had exerted significant pressure on surface water quality. Globally, over 80% of waste generated by human activities was discharged into rivers and oceans without treatment, leading to environmental pollution and more than 50 types of disease [4]. Campus-related activities such as the discharge of laboratory effluents, poor management of organic and inorganic waste from commercial facilities, the application of agrochemicals for landscape maintenance, and inadequate drainage systems, had the potential to elevate pollutant concentrations in surface water bodies [5]. This contamination originated not only from point sources but also from non-point sources, as surface runoff transported accumulated contaminants from various activity zones within the campus area.

The degradation of surface water quality in campus environments posed multidimensional implications for ecosystem stability and community health. Ecologically, water contamination could lead to eutrophication, disruption of aquatic biodiversity, and destabilization of trophic structures in aquatic ecosystems [6]. Water pollution also affected human health and contributed to disease variability [7]. In the campus context, it influenced academic productivity, increased the risk of waterborne diseases, and diminished the aesthetic value of the environment thereby affecting both learning quality and the overall well-being of the academic community [8].

In the context of the hydrological cycle, surface water in campus areas was part of a complex system involving evapotranspiration, precipitation, infiltration, and surface runoff processes [9]. The acceleration of this cycle, which negatively impacted terrestrial water availability, was one of the effects of climate change. Precipitation falling on campus surfaces underwent qualitative transformation as it flowed across different land covers, accumulating contaminants before entering surface water bodies. A comprehensive understanding of these hydrogeochemical dynamics was therefore essential for identifying contamination pathways and designing effective mitigation strategies [10].

Given the complexity of these issues and the urgent need for sustainable water resource management, analyzing surface water quality in campus environments was a scientific imperative. Surface water was highly vulnerable to contamination since it was commonly used to meet various water demands. Such analysis served as both a diagnostic tool for assessing current water quality and as a foundation for formulating evidence-based environmental management policies. By characterizing physico-chemical and biological parameters, higher education institutions could identify contamination levels, determine pollution sources, and develop sustainable monitoring systems [11]. This process contributed to advancing scientific knowledge in environmental science and sustainable campus management.

Water quality referred to the characteristics of water that determined its suitability for specific uses, defined by its physical, chemical, and biological compositions. Assessing water pollution levels required determining the amount of dissolved oxygen, which played a key role in the decomposition of organic material [12]. When dissolved oxygen concentrations were low, the water could be classified as polluted. Therefore, it was necessary to measure water quality using key pollutant parameters such as Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Total Dissolved Solids (TDS), pH, temperature, electrical conductivity (EC), and turbidity [13]. These parameters were compared to evaluate surface water quality at two lake sampling points representing the study area. Thus, the aim of this study was to analyze the surface water quality of lakes at the Sepuluh Nopember Institute of Technology (ITS). The results of this analysis were expected to contribute significantly to enhancing the surface water monitoring system within the two study areas.

2. Materials and Methods

2.1. Data collection.

The research was conducted from October to December 2024 at the Sepuluh Nopember Institute of Technology (ITS) campus in Surabaya. Geographically, the study area was located between latitude 7.28°S and longitude 112.79°E, covering a total area of 180 hectares (Ha). It was situated in the eastern part of Surabaya, near Kenjeran Beach, and characterized by low-lying terrain. Water sampling was performed three times with repetitions, considering seasonal variations, October represents the dry season and December represents the rainy season. Ex-situ water sample analyses were carried out at the ITS Environmental Engineering Laboratory. Water samples were collected from two surface water locations, as detailed below (Figure 1; Table 1).

Figure 1. Sample Locations in Sepuluh Nopember Institute of Technology.

Table 1. Coordinate points of surface water sampling.

Point	Location	Coordinate Point		Elevation (m)
		BT	LS	
SS_1	ITS Lake Eight	112°47'45"	7°17'11"	1
SS_2	ITS Student Dormitory Lake	112°47'33"	7°17'15"	3

2.2. Sampling methods.

The selection of sampling points was based on a preliminary survey of the study area. The determination of surface water sampling locations considered both the spatial and temporal characteristics of the campus hydrological system. Additionally, ITS Lake Eight and the ITS Student Dormitory Lake were in the downstream area and had relatively large surface areas; therefore, these sites were considered to have direct interaction with the campus hydrological cycle.

The sampling procedure for water quality monitoring followed the Indonesian National Standard (SNI) 6989.57:2008 [14]. Water samples were collected at a depth of ½ to ¾ from the water surface using a horizontal-type water sampler. The sampling depth generally ranged from

20–30 cm below the surface, with the bottle mouth facing opposite to the direction of water flow. Each bottle was filled to approximately ¾ of its volume to allow for expansion. Water samples for physical and chemical analyses were collected using sterilized glass bottles that were rinsed with lake water two to three times prior to sampling. All bottles were ensured to be clean and free from contamination. The labeled containers were then transported to the laboratory for analysis.

2.3. Physicochemical measurement.

Surface water quality at the two sampling sites was assessed based on eight physicochemical parameters: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Total Dissolved Solids (TDS), pH, temperature, Electrical Conductivity (EC), and turbidity. Measurements of physical parameters were performed on-site, while samples for chemical and biological analyses were stored in cooler boxes at low temperatures and analyzed within 24–48 hours after collection. The sampling procedure was conducted in accordance with ISO 5667-6:2014 [15]. The parameters pH, temperature, EC, DO, and turbidity were measured directly in the field using a portable multi-parameter meter immediately after sampling, following the instrument's operating manual. The remaining indicators were preserved, transported, and analyzed at the Water Treatment Laboratory, Environmental Engineering Department, ITS, following the standard methods summarized in Table 2.

Table 2. Methods of field measurement and laboratory analysis.

	Parameters	Unit	Methods of field and laboratory measures
Measure directly in the field	pH	-	pH m, Hand y Lab 100 (Germany)
	Temp	^{O}C	Temperature m, Physics 300 (Germany)
	DO	mg/L	DO m, DO Multi 3620 IDS (USA)
	EC	µS/cm	EC Meter Portable
	Turbidity	NTU	Turbidity m, 2100P-HACH (Germany)
Analysis in the laboratory	TDS	mg/L	SMEWW 2450D:2017
	BOD	mg/L	SMEWW 5210B:2017
	COD	mg/L	SMEWW 5220C:2017

3. Results and Discussion

3.1. Potential lake pollutant sources.

Sources of potential pollutants that might have entered the lakes were identified because they influenced the characteristics and quality of the water. ITS Lake Eight (SS1) and the ITS Student Dormitory Lake (SS2) had relatively static hydrodynamic characteristics and lacked significant outflow systems (Table 3). Therefore, they were not directly connected to wastewater discharge outlets from student or academic activities, minimizing the likelihood of mixing between lake water and wastewater. The primary sources of lake water were direct precipitation and groundwater infiltration, which occurred when rainwater penetrated the pedosphere layer surrounding the lake area.

The main sources of pollutants in the lakes originated from the decomposition of natural organic matter, such as leaf litter from riparian vegetation, as well as excretions and carcasses of aquatic and terrestrial fauna entering the water bodies. The mineralization of this organic matter produced excess nutrients, particularly nitrogen and phosphorus, which triggered eutrophication processes in the lakes [16]. Although limited, anthropogenic contributions from human activities around the lakes were also present, primarily through surface runoff carrying organic and inorganic detritus particles.

Visual indicators of declining lake water quality were observed through changes in physical appearance, such as green pigmentation and increased turbidity levels, reflecting microalgal blooms and exponential phytoplankton proliferation [17]. These conditions demonstrated how aquatic ecosystems adapted to nutrient enrichment resulting from organic matter degradation. Such processes disrupted the trophic structure and reduced the clarity of the water column [18].

Based on field observations, sampling point SS2 exhibited more turbid and greenish water, indicating excessive algal growth due to elevated nutrient levels. This condition caused the water to appear green and emit an unpleasant odor [19]. Additionally, solid waste from student activities was observed at SS2, suggesting that the lake was also affected by domestic pollution.

Table 3. Surface water quality measurements in coordinate point.

No	Parameters	Unit	SS_1			SS_2			Quality Standard		Average	
			Oct	Nov	Dec	Oct	Nov	Dec	National	International	SS_1	SS_2
1.	COD	mg	18,83	15,21	13,07	20,12	19,54	19,65	10	<1000	15,70	19,77
2.	BOD	mg/L	5,72	4,98	4,52	13,87	11,24	10,98	2	<6000	5,07	12,03
3.	DO		5,42	7,15	6,98	6,34	5,91	5,78	6	5,5 - 9,5	6,51	6,01
4.	TDS		863	792	1120	1067	926	987	1000	500	925	993
5.	pH		6,9	6,9	7	7	7	7	6 - 9	6,5 - 9,5	6,9	7,0
6.	Turbidity	NTU	8,76	7,34	8,61	15,98	16,03	15,34	-	<1	8,23	15,78

3.1.1. COD.

COD was the parameter used to measure the number of organic contaminants in water. A high COD level indicated an increased concentration of oxidized organic matter in the sample, which could lead to a decrease in dissolved oxygen (DO) levels. Based on the analysis of samples from both locations, the COD level in SS2 was higher than in SS1. This difference was attributed to the varying pollutant sources, as SS2 was located near the student dormitory drainage, allowing the inflow of domestic pollutants. The results also showed that COD values at both sampling locations were higher during the dry season than in the rainy season, due to lower water discharge, which reduced dilution capacity [20]. Additionally, both sampling sites recorded COD levels exceeding national quality standards, indicating susceptibility to organic pollution.

3.1.2. BOD.

BOD was the parameter used to determine the amount of dissolved oxygen required by microorganisms to decompose organic matter. It represented the concentration of easily degradable organic material in water bodies. The analysis revealed that the BOD_5 value in SS2 was higher than in SS1. BOD levels were directly influenced by COD concentrations; higher COD levels required more oxygen to oxidize pollutants, resulting in higher BOD levels as more organic matter was decomposed by microorganisms.

3.1.3. DO.

DO indicated the level of oxygen dissolved in water. Based on the Winkler method, the DO concentration in SS2 was lower than in SS1. This parameter was inversely affected by COD and BOD levels—higher COD and BOD values corresponded to lower DO concentrations, as microorganisms consumed more oxygen to decompose organic pollutants. Excessive algal growth caused by elevated nutrient levels (nitrogen and phosphorus) also contributed to a sharp decline in DO, as reflected in the green coloration of the water. Furthermore, higher water temperatures during the dry season compared to the rainy season reduced DO solubility, worsening water quality [21]. Based on national quality standards, both sampling locations exhibited DO levels below the acceptable threshold, indicating pollution stress.

3.1.4. TDS.

TDS was the parameter used to measure the total concentration of organic and inorganic materials dissolved in water. The analysis, conducted using the gravimetric method, showed that the TDS value in SS2 was higher than in SS1, influenced by pollutant sources and sampling time. TDS levels tended to be higher during the rainy season, as surface runoff carried more organic and inorganic materials into the lakes. Although both sampling locations recorded elevated TDS values, they still met national water quality standards.

3.1.5. pH.

pH was the parameter used to indicate the acidity or alkalinity of water. It was influenced by the type of pollutants and environmental conditions affecting the acid-base equilibrium of the water body. Measurements were conducted using a portable pH meter, which showed that the average pH values at SS1 and SS2 were 6.9 and 7.0, respectively. Because the sampling sites were located close to each other, their water characteristics were similar. These values indicated that the pH levels at both locations were within the acceptable quality standard range.

3.1.6. Turbidity.

Turbidity was the parameter that measured the degree of cloudiness or haziness of water, influenced by suspended organic and inorganic materials. Measurements were performed using a turbidimeter by immersing the instrument directly into each sample. The results showed that turbidity in SS2 was higher than in SS1 due to the larger amount of pollutants present. Although the national standard for turbidity was not specified, comparison with international standards indicated that the turbidity levels at both sites exceeded the permissible limits for natural water bodies.

4. Conclusion

Based on the data analysis, the parameters that exceeded the national water quality standards were COD, BOD, DO, and turbidity. In contrast, the TDS and pH values remained within acceptable limits, indicating that these parameters were still safe for water quality. The overall assessment of physical, chemical, and biological parameters showed that the surface water quality at Lake Eight (SS1) was better than that at the ITS Student Dormitory (SS2). This difference was primarily due to the higher rate of organic matter decomposition in SS2, which triggered eutrophication processes. Furthermore, SS2 was more susceptible to domestic pollution as a result of continuous human activities around the dormitory area. A significant difference was also observed between the dry and rainy seasons, indicating that seasonal variations influence surface water quality. During the dry season, BOD and COD levels tended to increase, while other parameters decreased. Conversely, in the rainy season, DO, TDS, and turbidity values were higher due to increased water turbulence, which enhanced the decomposition and dispersion of organic materials carried by runoff.

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Author Contribution

Fadilla Azzahrani Puspa and Ira Shavina Inora Rahma contributed equally. Fadilla handled conceptualization, methodology, and data collection, while Ira supervised, revised critically, and managed the project. Both collaborated on data analysis, visualization, and manuscript writing.

Competing Interest

The authors declare no competing financial or non-financial interests related to this work.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

References

[1] Bashir, I.; Ahmad, S.; Lone, F.A.; Bandh, S.A. (2020). Concerns and threats of contamination on aquatic ecosystems. *Bioremediation and Biotechnology*, *1–26*. https://doi.org/10.1007/978-3-030-35691-0_1.

[2] Mendret, J.; Guigui, C.; Cabassud, C. (2019). Urban wastewater reuse using a coupling between nanofiltration and ozonation: Techno-economic assessment. *Chemical Engineering Research*, *145*, 19–28. https://doi.org/10.1016/j.cej.2018.12.013.

[3] Kramer, I.; Bayer, Y.; Mau, Y. (2022). The sustainability of treated wastewater irrigation: The impact of hysteresis on saturated soil hydraulic conductivity. *Water Resources Research*, *58*(3), e2021WR031307. https://doi.org/10.1029/2021WR031307.

[4] Ho, J.Y.; Tan, R.R.; Foo, D.C.Y.; Hashim, H. (2021). Synthesis of wastewater treatment process (WWTP) and supplier selection via Fuzzy Analytic Hierarchy Process (FAHP). *Journal of Cleaner Production*, *314*, 128104. https://doi.org/10.1016/j.jclepro.2021.128104.

[5] Bavumiragira, J.P.; Yin, H. (2022). Fate and transport of pharmaceuticals in water systems: A processes review. *Science of The Total Environment*, *823*, 153635. https://doi.org/10.1016/j.scitotenv.2022.153635.
[6] Hughes, J.; Collins, R.; Rutherford, K. (2021). Impacts and implications of climate change on wastewater systems: A New Zealand perspective. *Climate Risk Management*, *31*, 100262. https://doi.org/10.1016/j.crm.2020.100262.
[7] Lin, L.; Yang, H.; Xu, X. (2022). Effects of water pollution on human health and disease heterogeneity: A review. *Frontiers in Environmental Science*, *10*, 880246. https://doi.org/10.3389/fenvs.2022.880246.
[8] Akhai, S.; Taneja, T. (2025). The critical role of water quality: Health impacts, contaminants, and sustainable solutions for environmental and human well-being. In *Smart Water Technology for Sustainable Management in Modern Cities* (pp. 101–116). IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-6684-8201-5.ch006.
[9] Famiglietti, J.; Wood, E.F. (1991). Evapotranspiration and runoff from large land areas: Land surface hydrology for atmospheric general circulation models. *Surveys in Geophysics*, *12*(1), 179–204. https://doi.org/10.1007/BF01903418.
[10] Warner, S.D.; Nelson, P.O.; Brown, R. (2023). Climate-influenced hydrobiogeochemistry and groundwater remedy design: A review. *Remediation Journal*, *33*(3), 187–207. https://doi.org/10.1002/rem.21765.
[11] Verma, S.; Singh, R.; Kumar, P. (2025). Comprehensive assessment of physico-chemical and biological parameters in water quality monitoring: A review of contaminants, indicators, and health impacts. *International Journal of Horticulture, Agriculture, Food Science*, *9*(2), 611019. https://doi.org/10.34107/ijhaf.611019.
[12] Lv, Z.; Zhao, Y.; Li, H. (2024). Effectiveness of chemical oxygen demand as an indicator of organic pollution in aquatic environments. *Ocean-Land-Atmosphere Research*, *3*, 0050. https://doi.org/10.1016/j.olar.2024.0050.
[13] Sarminingsih, A.; Prasetyo, A.; Rahayu, T. (2024). Water quality monitoring system for temperature, pH, turbidity, DO, BOD, and COD parameters based on internet of things in the Garang watershed. *Ecological Engineering and Environmental Technology*, *25*, 1–10. https://doi.org/10.12912/27197050/180234.
[14] Novita, E.; Suryani, R.; Hidayat, M. (2020). River water quality assessment in East Java, Indonesia. *Journal of Water and Land Development*, *46*, 112–119. https://doi.org/10.24425/jwld.2020.135032.
[15] Malíková, P.; Chromíková, J. (2023). The water quality of revitalized ponds in the Czech Republic post-mining area. *Engineering Proceedings*, *57*(1), 8. https://doi.org/10.3390/ecws-8-14237.
[16] Tiwari, A.K.; Pal, D.B. (2022). Nutrients contamination and eutrophication in the river ecosystem. In *Ecological Significance of River Ecosystems* (pp. 20 3–216). Elsevier. https://doi.org/10.1016/B978-0-323-85342-9.00013-0.
[17] Enawgaw, Y.; Wagaw, S. (2023). Phytoplankton communities and environmental variables as indicators of ecosystem productivity in a shallow tropical lake. *Journal of Freshwater Ecology*, *38*(1), 2216244. https://doi.org/10.1080/02705060.2023.2216244.
[18] Creed, I.F.; Bergström, A.K.; Trick, C.G. (2018). Global change-driven effects on dissolved organic matter composition: Implications for food webs of northern lakes. *Global Change Biology*, *24*(8), 3692–3714. https://doi.org/10.1111/gcb.14129.
[19] Diwan, V. (2025). The impacts of drought on the available water quality. In *Water Sustainability and Hydrological Extremes* (pp. 255–274). Elsevier. https://doi.org/10.1016/B978-0-443-18208-7.00015-6.

[20] Abdul Maulud, K.N.; Yusoff, W.M.; Karim, O. (2021). A study of spatial and water quality index during dry and rainy seasons at Kelantan River Basin, Peninsular Malaysia. *Arabian Journal of Geosciences*, *14*(2), 85. https://doi.org/10.1007/s12517-020-06419-2.
[21] Xu, G.; Zhang, Y.; Liu, C. (2019). Seasonal changes in water quality and its main influencing factors in the Dan River basin. *Catena*, *173*, 131–140. https://doi.org/10.1016/j.catena.2018.10.018.