Assessment of the Water Quality of Lake Kabongo Before and After the Cessation of Anthropic Activities

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Publication Date: 2025/09/16

Abstract: As part of a sustainable development approach, this study analyses the impact of anthropogenic activities on the water quality of Lake Kabongo (Kolwezi, DRC) before and after their removal. Physicochemical and biological analyses were carried out from November 2024 to March 2025. The results reveal a significant improvement: turbidity fell from over 69 NTU to around 62 NTU, and the microbial load fell from 1230 RLU to 486 RLU. This confirms the effectiveness of sanitation measures such as dredging, awareness- raising and flow redirection, and establishes this model as a benchmark for the restoration of impacted aquatic ecosystems.

Keywords: *Pollution, Anthropogenic, Restoration, Ecological, Management, Sustainable, Load and Microbial.*

How to Cite: Bavon Ndala Mbavu; Patrick Mbweb Katshil; Gaylord Mungwa Kalundu; Tina Kon-A-Kabey; Patrick Kashala Mpanga (2025) Assessment of the Water Quality of Lake Kabongo Before and After the Cessation of Anthropic Activities. *International Journal of Innovative Science and Research Technology*, 10(9), 603-607. https://doi.org/10.38124/ijisrt/25sep003

I. INTRODUCTION

Aquatic ecosystems, especially in urban areas, are being weakened by increasing pressures from human activities [1], [2]. In Kolwezi, in the province of Lualaba, there is a lake called Kabongo, bordered by the Kananga, Manika and Kanina neighbourhoods. It is exposed to inflows of wastewater, domestic waste and informal industrial discharges. In November 2024, measurements taken at the intake point of the wastewater treatment plant under construction revealed highly contaminated water: pH 7.48; turbidity 69.9 NTU; conductivity 457 µS/cm; total suspended solids (TSS) 34 mg/L;iron 1 .043 mg/L; coliforms >1230 RLU.

The objective was clear: to observe the evolution of these parameters following the gradual cessation of human activities and the clean-up carried out by the local health department, enabling the installation of a Culligan Omni-filtration (OFSY) water treatment plant.

II. MATERIALS AND METHODS

➢ *Sampling Sites*

Eight sampling points were selected in the polluted areas polluted areas (the lake inlets) and at the water treatment plant intake point (geometric coordinates 7FCC+65F) and at the lake outlet. Samples were taken at a depth of 30 cm and approximately 3 to 4 m from the banks to avoid stagnant water, which is a source of error. Two campaigns were carried out: November 2024 (before intervention) and December 2024– March 2025 (after intervention) [3]. The samples were then placed in bottles that had been washed, dried and sterilised beforehand, then transported at a temperature of 4°C in a cooler [1].

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/25sep003

Fig 1 Map of Lake Kabongo

- *Methods*

The intervention, supported by the logistical resources of the town hall's sanitation department, consisted of targeted cleaning of the lake's banks, where visible waste such as plastic bottles, used cloths and other rubbish thrown directly into the water was removed without any dredging. An awareness campaign was also conducted among local residents, encouraging them not to deliberately discharge substances from septic tanks. Finally, the drain that carried rainwater to the lake was redirected to limit the inflow of pollutants.

The figures below show the situation before the intervention.

Fig 2 The Lake Surroundings Before Intervention: Catchment – Drain Falling Towards Catchment – Domestic Waste Site

With regard to bacteriological analysis, the sample was taken from the previously opened bottle by immersing it in the lake at a depth of 30 cm. The lid was closed after filling before removing the bottle from the lake water. The bottle was resealed under aseptic conditions until the end of the analysis. For physico-chemical analyses, the temperature, electrical conductivity, TDS and pH were measured at each in situ sampling, while the other parameters were evaluated in the laboratory using the analytical methods recommended by Bartram.[1].

- *Parameters Measured*

The parameters measured were Physicochemical parameters and Biological parameters measured are as follows:

- *Physicochemical:*

Temperature, pH, conductivity (Stylo 5-in-1 pH meter), turbidity (AZOVTES AE86065), dissolved oxygen, TSS, COD (LS310) [4].

- *Biological:*

Microbial load via ATP measurement (FT- ATP), faecal coliforms and E. coli using rapid colorimetric tests with a Vansful kit (48 hours) [1].

ATP measurement provides an estimate of biological biomass by measuring ATP in relative light units (RLU) using the FT-ATP model ATP meter.

III. RESULTS AND DISCUSSIONS

- *Physicochemical Parameters*

Before anthropogenic activities were halted, measurements revealed high levels of pollution, with turbidity and suspended solids values exceeding WHO recommendations. Table 1 below shows the physicochemical parameters before and after remediation of the study site.

Table 1 Physicochemical Parameters from November 2024 to March 2025

Parameter	**Nov-2024**	**Dec-2024**	**Jan-2025**	**Feb-2025**	**Marc -2025**	**WHO standard**
Temperature (°C)	19.5	23	21.4	19.5	19.7	≤ 25
pH	7.48	7.39	7.28	7.93	7.65	6.5 - 8.5
Conductivity (µS/cm)	457	434	404	378	387	≤ 1000
Dissolved oxygen (mg/L)	25,985	26,432	23.395	20.152	20,031	≥ 5
Turbidity (NTU)	69.9	83.4	53.82	73.85	62.15	≤ 5
Suspended solids (mg/L)	34	43	40	35	30	≤ 25

After treatment, a significant improvement in parameters was observed, indicating better water quality prior to final treatment.

Table 2 Variation in Parameters Measured Between November 2024 and March 2025

Parameter	**Nov-2024**	**Mar-2025**	**Variation (%)**
Conductivity (µS/cm)	457	387	–15
Turbidity (NTU)	69.9	62.2	–11
TSS (mg/L)	34	30	–12
Dissolved O_2 (mg/L)	25.99	20.03	–23

The decrease in turbidity and TSS reflects the positive impact of actions taken to divert drains that were flowing directly into the lake [5],[6]. Dissolved oxygen levels remain favourable, although slightly high due to local conditions [7].

Table 3 Biological Parameters from November 2024 to March 2025

Parameter	**Nov-2024**	**Dec-2024**	**Jan-2025**	**Feb-2025**	**Mar-2025**	**WHO standard**
Faecal coliforms (CFU/100mL)	Present	Present	Present	Present	Present	0
Presence of Escherichia coli (Colorimetry)	Present	Present	Present	Present	Present	0
Total bacterial load (ATP measurement) RLU	1230	651	486	582	639	≤ 500

The measurements in Table 2 below show the reduction in key physical and chemical parameters:

- *Biological Parameters*

Table 3 and Figure 3 below show the values of the lake's microbiological parameters from November 2024 to March 2025.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/25sep003

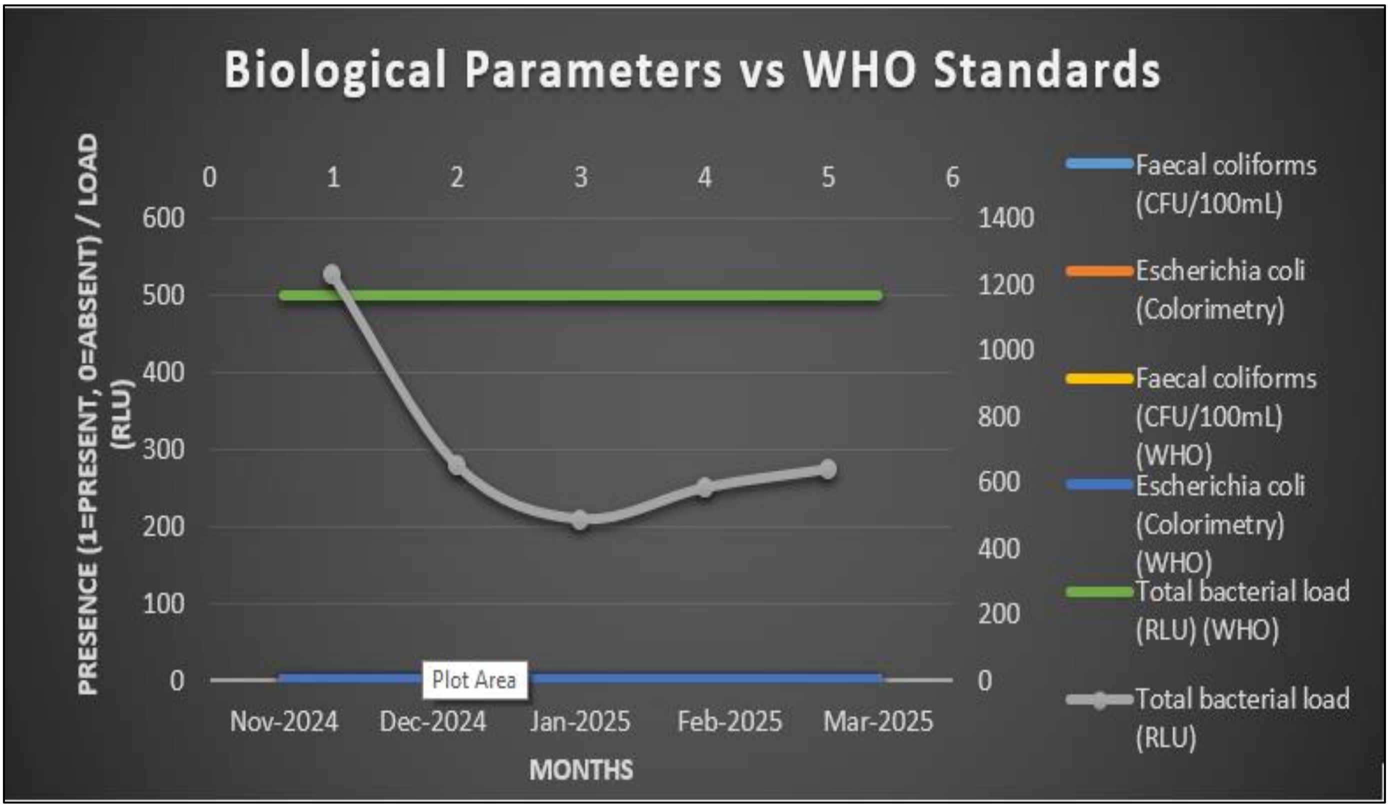

Fig 3 Curve Showing Variation in ATP Bacterial Load over Time

Before the intervention, microbiological analyses indicated high faecal contamination, suggesting significant organic pollution. After remediation, the total microbial load decreased significantly, demonstrating the effectiveness of the measures implemented. The microbial load fell from 1,230 RLU to 486 RLU (-61%) in January, before rising again to 639 RLU (-48% overall) in March, demonstrating the effect of seasonal runoff. The persistent presence of E. coli and coliforms shows that additional sanitation and regular awareness-raising are still necessary [9] [10].

IV. STATISTICAL ANALYSIS

A strong negative correlation (r= –0.85) between the cessation of human activities and the decrease in ATP highlights the relationship between interventions and improved water quality [11]. The cumulative decrease in parameters indicates a positive response to the measures taken.

V. REGIONAL COMPARISONS

It is clear that the results are consistent with those of Sani et al. (2024) in Kinshasa and Lubembe et al. (2024) in Rwanda/DRC, who report similar improvements after urban effluent management [12], [13]. Internationally, studies also show the effect of sanitation strategies on reducing pollutants [14].

VI. LIMITATIONS OF THE STUDY

- Duration Limited to five months, covering only one season [15],[16].
- Not assessment of the complete or precipitation [17].
- Non-specific microbiological analysis via ATP measurement and colorimetry [18].
- Rainfall data not available [19].

VII. CONCLUSION

Ultimately, this study shows that it is possible to significantly improve the water quality of a lake or river in the middle of a city by limiting human activities in the surrounding area. The reductions recorded (turbidity: –11%, TSS: –12%, ATP microbial load: –48%) confirm the positive impact of the rehabilitation measures. However, the residual presence of pathogenic microorganisms calls for vigilance.

The station under construction on the shores of Lake Kabongo will only be fully effective if it is complemented by a comprehensive sanitation plan for the watershed, including education for the population living around the lake, sustainable infrastructure and regular monitoring. This model provides a solid basis for restoring water quality in urban areas.

ACKNOWLEDGEMENTS

First and foremost, I give thanks to Almighty God, Papa Simon Kimbangu Kiangani, for the breath of life He grants me each day. I would like to express my deep gratitude to my wife and my entire family, whose support and encouragement have been essential to the completion of this article. My sincere thanks also go to the Director General of the Higher Institute of Applied Techniques of Kolwezi (ISTA) for his valuable advice and constant commitment to supporting us in our scientific progress. I am also grateful to him for the opportunity he gave us by facilitating our access to the ISTA Kinshasa doctoral school. Finally, I would like to pay fond memory of my late friend Patrick Mbweb Katshil, who sparked my interest in scientific research in the field of water resources. His untimely death in a tragic road accident leaves a huge void, but his memory continues to inspire my journey.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/25sep003

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